MAY 1924

RADIO BROADCAST

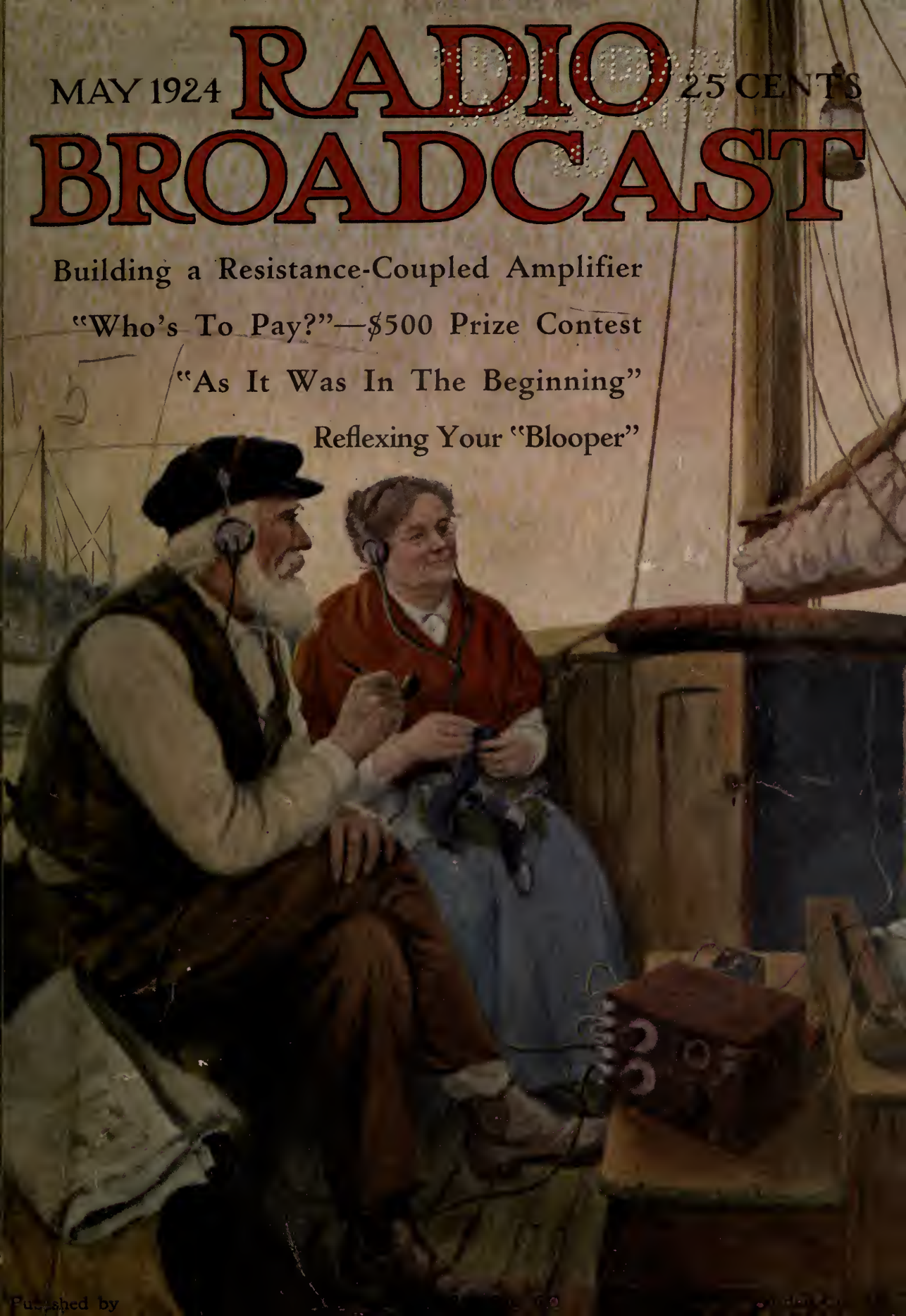
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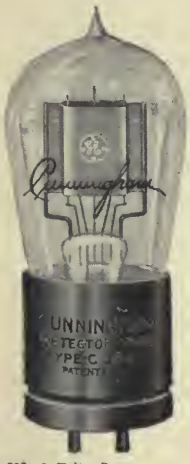
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VOLUME V

MAY, 1924, to OCTOBER, 1924

BETTER RADIO

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1924

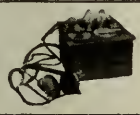
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IN LONDON

Operators from 2LO of the British Broadcasting Company, on the roof of a convenient building, picking up the Westminster Chimes and the musical boom of "Big Ben" atop the Houses of Parliament. The microphone is suspended in sponge rubber and is connected by land wire to the station three quarters of a mile away

RADIO BROADCAST

Vol. 5, No. 1 May, 1924

Home Remedies for Indisposed Receivers

The Simplicity of Good Grounds and Good Antennas. Getting the Bought Set into Action. Where Trouble May Lie and How to Eliminate It

By WILLIAM H. CARY, Jr.

This is the natural sequel to last month's article, "How to Go About Buying a Set." It is written primarily for those who know little or nothing about radio, but who have acquired sets from which they expect good results. Unless you are familiar with the installation and care of broadcast receivers, and unless you know how to diagnose and remedy certain simple ills that beset practically every radio set at one time or another, you are likely to think broadcast receiving a very confused and unsatisfactory hobby, indeed.

We are continually coming in touch with people who are balked by elementary details —who could increase the effectiveness of their receivers 100 per cent. by proper installation and adjustment of them; and perhaps more often still we find people who are prevented, by difficulties existing only in their own imaginations, from getting the best service from their newly acquired sets. This article is not a theoretical discussion: it is based on actual "cases," and on cures which are known to work.—THE EDITOR.

IT WOULD give an impression of pessimism which it is not the writer's intention to create, were he to plunge directly into the subject of treating sick sets, after discussing last month the purchase of brand-new apparatus. Still, new babies need careful treatment if they are to be kept in health; the fact that they are new does not make them immune to a number of elementary indispositions. The missing link in the chain of events from the purchase of a broadcast receiver and accessories, to apply first-aid remedies, is, of course, the assembly of the apparatus and its proper manipulation to get many a distant station and many a quiet evening (yes, it's possible) at home.

You were reminded last month that a thorough study of the instructions issued by the manufacturers of most sets, and the active help of some acquaintance who is familiar with receivers, will help greatly in starting you happily on your way. It is a pity that neither booklets nor acquaintances, however, always disclose the things you most want to know, in terms that resemble plain English.

GOOD AND BAD GROUNDS

A CASE in point is the installation of the antenna and the "ground." Every broadcast listener knows that a wire attached to the ground post on the set "goes" to the water-pipe or radiator (or any conductor which

has connection with the earth). The trouble is, too many wires "go" and too few get there —completely. A space of one thousandth of an inch may separate the conducting part of the wire from the conducting part of the pipe or "ground" to which it is attached. And electrically speaking, one thousandth of an inch may be as unbridgeable as the Grand Canyon.

The other day, a man installed a new set for himself which did not work. He thought the clerk in the store must have given him bad tubes or batteries, and his maledictions fell upon his silent and shiny cabinet. But it was found that he had not scraped clean the surface of the waterpipe nor the wire which he had attached to it; and when one of his friends gently pulled the wire, its several turns unwrapped themselves, and the wire came off in his hands! Here is what the man should have done:

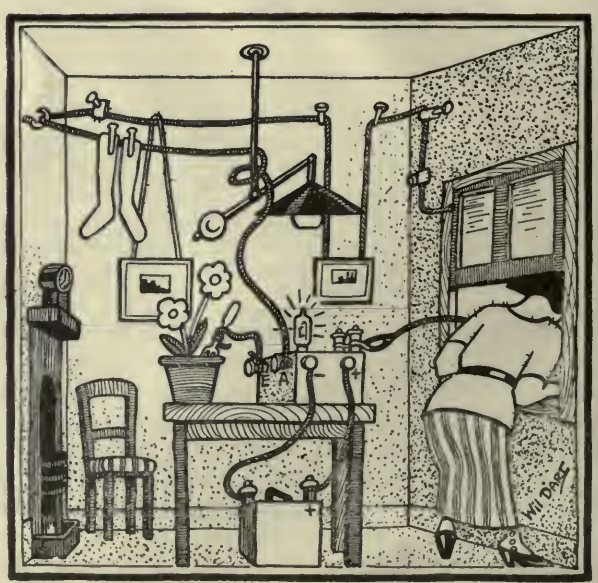
Scraped both wire and pipe, and

1—Soldered the wire to the pipe; or

2—Connected the wire to the pipe firmly with a ground clamp (costing about ten cents at any radio store): or

3—*At least* wrapped four or five turns of cleaned wire round the pipe, drawn it up tight by twisting with a pair of pliers, and bound up the connection with "electrician's tape" or adhesive plaster.

This is all the broadcast listener need know about grounds, except that the conducting path from set to earth should be as short as it can conveniently be made, and it is best not to use wire smaller than No. 14.



TOO MANY GROUND WIRES "GO" AND TOO FEW GET THERE—COMPLETELY

TWO WAYS OF FORGETTING ABOUT YOUR ANTENNA

IT IS also common knowledge that an antenna installation consists of a conducting material (wire) insulated from the ground and leading in to the proper binding post on the set. The following procedure in putting up an antenna is simple and adequate: through one hole in one of your small insulators tie a piece of rope (or cord or wire) and fasten one end of your antenna wire securely through the other hole. Attach the rope end anywhere, so long as it will allow from 50-125 feet of the antenna wire to swing clear (as high as possible above the roof or the earth) when the wire is run through a second insulator—likewise firmly suspended from any convenient object—and down into the room where you have your set. A lightning arrestor, useful principally to save your insurance should your house be struck by lightning (though a radio installation does *not* make this more likely), generally consists of a fuse with two binding posts on it. The antenna lead-in wire goes to one binding post, on its way to the set, and the ground lead goes to the other post, on its way to the set ["'Where does this road go?' inquired the stranger. 'Doesn't go, it stays right here,' said the native." Yes, we stand corrected; but the figure of speech is convenient and clear.] Some types of arrestors require a slight variation from the above hookup. Instructions regarding the installation of lightning arresters are usually included with them.

LET'S THINK ABOUT THESE MATTERS

A PORCELAIN tube insulator inserted in a hole drilled through a corner of the window frame is the most-used method of keeping the antenna insulated at the point where it enters the house.

An antenna need not be erected out-of-doors. If you can run as much as forty feet of wire through several rooms and a hall, for instance, more or less in a straight line, you are likely to get signals, although not so loud as with a higher and longer antenna.

It is by no means necessary to have a

separate lead-in wire attached to the main part of the antenna. In fact, this requires an extra connection—one more place that may cause electrical loss. If you must have a separate piece of lead-in wire—if someone has persuaded you that a length of heavy, insulated copper wire is the "without which not" of successful reception, do not make the mistake of the following "case" (He happened to be, or just naturally was — however you may look at it—the same novice who made the easy-come, easy-go ground connection, referred to above):



AND SO THEY LOOKED AT THE ANTENNA

Everything seemed to be O. K. Signals were audible, in fact; but they faded entirely at times, and at other times were suspiciously faint.

"I suppose your antenna system is all right," said the friend who was still trying to locate the trouble, after having fixed the ground connection.

"Oh, yes—good antenna. It must be the bat——"

"Let's take a look at the antenna."

And so they did.

Up went the window and out went two heads. One head saw nothing particular to write home about, but the other saw this: the upper end of the lead-in wire sliding gently back and forth along the corroded surface of the antenna, in the wind! It is to the friend's credit that he restrained his mirth and broke the news with enviable courtesy to the perpetrator of the installation.

What should the owner of the set have done in the first place? He should have:

1—Used only one piece of wire for both antenna and lead-in; or

2—Soldered the lead-in to the antenna; or

3—*At least*, scraped two inches of the antenna wire and two inches of the end of the lead-in, twisted them tightly together (not merely wrapped the lead-in about the antenna) and bound up the wound with friction tape to prevent infection.

The same care should be used in joining any wires, without solder, in a radio circuit. Many and pathetic are the ways in which beginners—and sometimes others connect wires together. The writer has seen one loop of wire encircling another loosely, taped, and called a joint. The idea seemed to be merely to hold the two wires from pulling apart, not to provide a free path for the flow of electric current. The commonest case of poor splicing is that of one wire twisted round another wire which is left straight Oh, it works—sometimes.

One advantage of installing your ground and antenna in the careful manner described is that when something "goes wrong" with your set, you do not have to run up on the roof to look over the antenna, or get down on your knees by the water—or radiator—pipe to examine the "ground." You can dismiss these factors from your mind. And it is just as well, for there may be other things to think of.

NOW ABOUT THE BATTERIES

ONE of the most useful instruments in any radio first-aid kit is a B battery voltmeter. It ranks next in importance to pliers, jack-knife, and screw-driver. Good voltmeters reading from 0 to 50 volts, may be had for about $2.50 When a 22½-volt B battery falls below about 15 volts, you had better replace it. Sometimes, you will get no "kick" out of a B battery at all, or it will move the voltmeter needle only slightly. It has died in service and there is no use keeping it. Often, when a B battery is low or dead, an indication of its condition is seen in a damp spot on the side, where the electrolyte has leaked through, or by a bulging of the insulating compound on top of the battery Your detector B battery voltage should be at least 16 and generally

cannot be allowed to fall far below 20. If the B battery voltage supplied to the amplifier tubes should fall below 40, it is well to add more "juice" or replace the low units with new ones.

Your A battery—whether it be dry cells or storage battery—is serviceable until you find that even when you turn the lights up as far as the rheostats will allow, the signal is not so loud as you have a right to expect. It is a good rule to burn your tube filaments as low as you can, still getting sufficient volume; it saves your batteries and reduces distortion.



It is advisable to hook up your batteries in this way: (1)—connect the two wires from the A battery to the + and − A posts on the set; (2)—connect either the + or the − wire from the B battery to its proper post on the set; (3)—place the tubes in their sockets, turn up the rheostats (also snap on the battery switch if there is one), and see if the tubes light: (4a) if so, connect the other B battery lead and all will be well: (4b) if not, look over the wiring and see that all connections are correct and good (If the tubes do not seem to make firm contact in their sockets, take the tubes out, bend up the socket prongs with your finger.) This procedure may save you the price of the tubes you are unlucky enough to leave in their sockets when the B battery current runs along the path reserved for the A battery.

AS FOR THE REST OF IT. . .

AS FOR the business of tuning, there is little that can be said which will be of half so much use to the novice as two or three evenings' practice in adjusting his set. He will soon get the "feel" of it, and learn how to cut out as much interference, static, and other noise as is possible, without diminishing the signal strength too much.

If you are using two or more tubes of the same type, try interchanging them and then readjusting the rheostats and other controls. This often results in a considerable increase in signal strength.

When a set goes dead, with antenna and ground connections as they should be, with batteries well up, and tubes hitting on all four, trouble may possibly be located in the jacks, or in the phones, or in a broken connection elsewhere in the set. The jack springs should be inspected: does the tip of the plug make contact with the proper spring? does the side of the plug fit snugly against the side of the jack? do the springs which are displaced by the tip of the plug make (or break) their contacts as they should?

The test for phones is simple: put them on; touch the tip of the plug (or one phone tip) to one terminal of a dry cell, and touch the sleeve of the plug (or the other phone tip) to the other terminal: a click should result. "No clickee, no workee."

If you have done all this, and have looked in vain for a loose or broken connection, it is then time to secure the assistance of someone familiar with the more serious ailments of receiving sets. But the chances are that this will not be necessary. If you had trouble at first, and started reading this article, you will probably have located your trouble and applied the remedy a page or so ago. Instead of reading these words you will have abandoned them for the serious business of bringing in the programs that float so freely through this country's air.

A Plea to Announcers

Many letters have come to Radio Broadcast and many more have been received by broadcasting stations complaining that station announcers announced too indistinctly or too infrequently. This card was recently sent out by the National Association of Broadcasters to all their member stations.—The Editor.

STATION ANNOUNCERS

Numerous complaints have recently come to us of announcers failing to give their call letters at the end of each program event. D.X. fans are especially aggravated.

Local listeners know your station, but hundreds of thousands of long distance listeners on the air each night, do not.

Call letters given immediately after an event and repeated again at the conclusion of announcement are appreciated by these people.

The National Association of Broadcasters
1265 Broadway, New York City

Reflexing Your Single Circuit Receiver

Various Circuits and What They Mean

PART VI

By ZEH BOUCK

There are only a few of our readers to whom RADIO BROADCAST has preached, in vain, the evils of regenerative single circuit tuners. But many owners of single circuit apparatus protest against junking equipment in which they have invested, perhaps, hundreds of dollars. —There is a certain justness in their point of view. However, there is no necessity for relegating the single circuit regenerator to the ash-can. They can be made over, at a very small expense, and with an increase in efficiency into the "Knock-out" reflex circuit that has taken our readers by storm.

Mr. Bouck tells how to do it.—THE EDITOR.

MUCH has been said and written condemning the single circuit regenerative receiver. So vehement has been the reaction against *radiating* (not *re*radiating) receivers, which, like the spark transmitter, has lived its day that was genuinely useful, that there are a very few, even among the manufacturers, who fail to appreciate and proclaim the iniquity of such oscillators. But regardless of the universal appreciation of the several faults of single circuit tuners and the sincere desire to remedy them, the propaganda against them has been mostly destructive, except for advocating a complete change in receiving equipment. The manufacturers have quite profitably backed this advice by placing on the market, at the psychological moment, non-radiating equipment. But there are many of us who, urged by these same manufacturers only a few months back, invested our entire radio budget in the receivers that they now condemn, and who must necessarily hesitate before making the change that means so much to general and individual radio improvement.

While several substitutes have been suggested for the offending circuits—straight radio-frequency amplification, the neutrodyne, the super-regenerative and reflex sets—from the standpoint of economy, simplicity, and the loudness of signals, the three amiable characteristics of the defunct criminal, the one-tube reflex is the only substitute. It is more than a substitute—it is an improvement.

DO NOT THROW AWAY YOUR SINGLE CIRCUIT RECEIVER

TO ACQUIRE the advantages of the reflex receiver, it is neither necessary nor desirable to discard your present single circuit set. By altering a few connections within the receiver and building up a small external panel, all quite within the ability of our more timid experimenters, the most powerful single circuit oscillator can be converted into a reflex set that is a revelation in quality and intensity of signals.

Fig. 1 is a photograph of one of the most prevalent types of single circuit regenerators transformed into the reflex. Figs. 2 and 3 are close-ups of the extra panel equipment that effects the conversion. For want of a better term, and because the same auxiliary arrangement may be applied to any single circuit receiver regardless of superficial circuit variations, the writer has named this little secondary panel the "reflexit."

What You Need to Build the "Reflexit"

IF YOUR set is a single bulb receiver of the type described, the following additional items are necessary to avoid the blot of ostracism:

One crystal detector (preferably fixed)	$1.25
$\frac{1}{8}$th pound No. 22 magnet wire	.35
One length 3 inch cardboard tubing	.15
One .00025 mfd. variable condenser (C_2)	3.00
One audio amplifying transformer (T_3)	4.00
One panel, 5" x 6"	.50
Knob and dial	50
Incidentals	.25
Total	$10.00

IS YOUR SET ONE OF THESE?

WE CHOSE for our original demonstration the single circuit tuner in most common use. The circuit is shown in Fig. 4, and many of the trade names under which this system parades are divulged in "The Truth About Trick Circuits," appearing in the March number of RADIO BROADCAST. In addition to the hundred of thousands of manufactured sets of this type, an incalculable number have been built at home by experimenters.

In the majority of cases, L1 and L2 are respectively primary and secondary of a variocoupler. In the cheaper equipment, L1 is the stator of a variometer, and L2 the rotating ball. The antenna series condenser (C1) is generally a .0005 mfd. (23 plate) variable. The doubtful reader will find the mechanical and electrical characteristics of this receiver more completely described in the March article to which we previously referred. Single tube sets of this type sold—and, alas! still sell—for from eight to twenty-five dollars.

The indicated prices are conservative, and on some items the enthusiast will probably be able to better them. An ordinary cat-whisker crystal stand may, of course, be substituted for the fixed element. The latter, however, is superior in several ways. It insures the most sensitive detection without any adjustment, and, due to the low resistance between its terminals, eliminates the possibility of oscillation and squeals.

Fig. 5 is the complete wiring diagram—the rewired single circuit receiver (left) connected to the "Reflexit" (right). Our observing readers will note that the circuit is identical with that of our "Knock-out" reflex, and it differs only mechanically in the substitution of the variocoupler (T1) for the usual fixed coupler. In re-wiring the single circuit tuner, the



FIG. 1

The "Reflexit" connected to a very common type of single circuit, radiating regenerator

only connection that may remain intact is the lead from the ground to the primary of the vario-coupler and to the filament.

CONSTRUCTION

INDUCTANCE T2 is wound on a $2\frac{1}{2}$ inch length of the 3 inch tubing. The secondary is wound first, and consists of 51 turns. A layer of pasteboard is placed over the winding, and the primary of 31 turns wound on this.

T3 is any good audio frequency amplifying transformer with a ratio of from four to six to one. The Amertran was used by the writer.

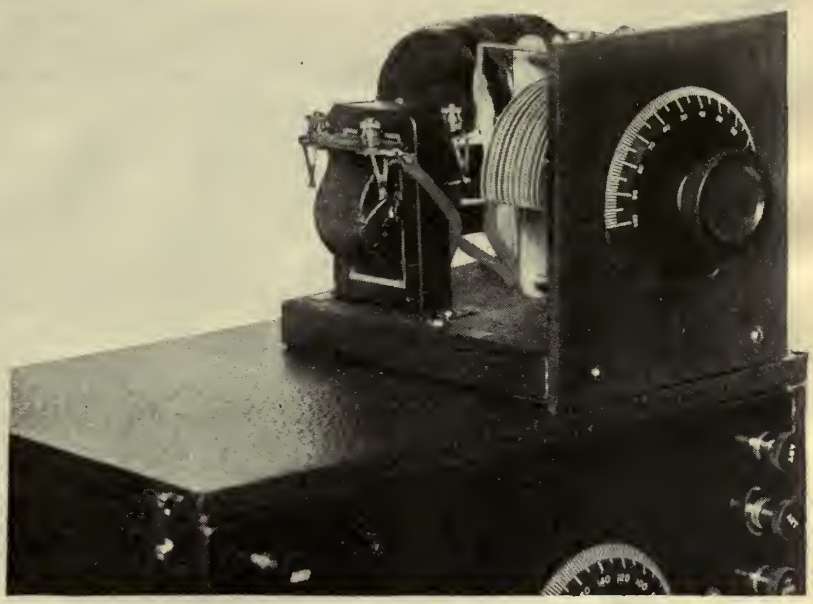


FIG. 2
A close-up of the "Reflexit." The leads to the re-wired single circuit receiver run through the base and cover

The method of mounting and placing of the various parts in the "Reflexit" are clearly shown in the photographs of Figs. 2 and 3. The "Reflexit" may be set and operated in any convenient position near the receiver proper. The writer found it best disposed of by permanently mounting it on the cover of the original cabinet by a wood-screw through the base. Four wires, indicated by the dotted lines in Fig. 5, run through the base and cover, and connect the "Reflexit" to the rewired single circuit tuner. In the combination photographed, the four leads are of flexible lamp cord, sufficiently long to permit the raising of the cabinet cover. They are brought down through *two* holes, the leads from T2 and T3 being purposely separated to obviate the possibility of feedback from plate to grid circuits.

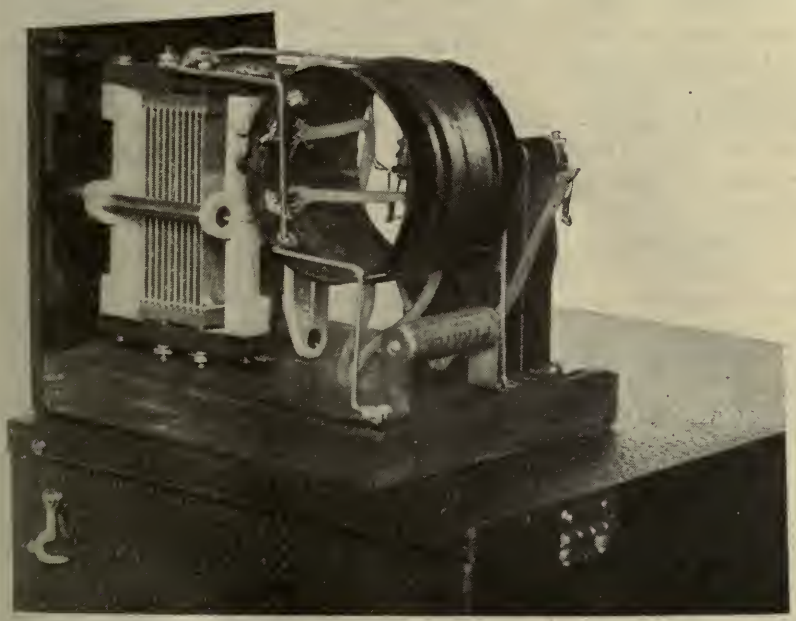


FIG. 3
Another view showing the "works." Note the fixed crystal, a "Pyratek" which works well

Where the original single circuit receiver has been built with a generous distribution of free panel space, the experimenter may find room for the extra control, making it possible to incorporate the "Reflexit" entirely within the old receiver. The Ballantine Varioformer adapts itself very nicely to this more compact arrangement, and a circular space, less than two inches in diameter is sufficient for mounting it.

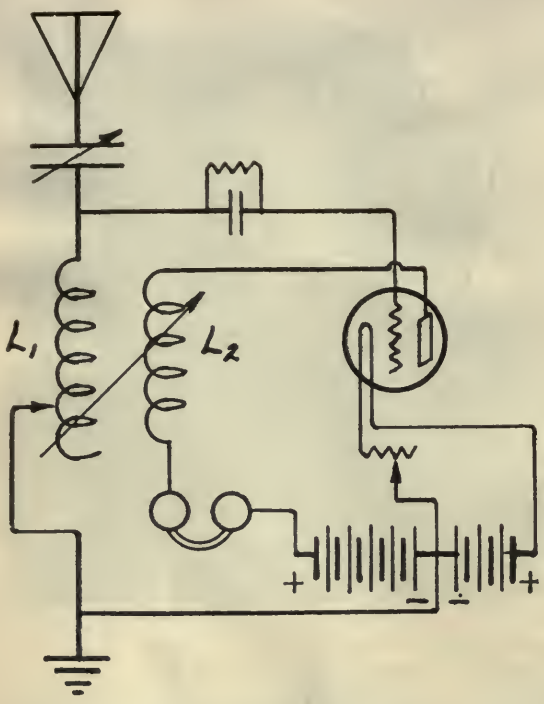


FIG. 4
The most common type of the single circuit receivers

When the Varioformer is used, it is connected in place of T2—the plate connection running to the plate of the tube—and condenser C2 is eliminated. The connections from the secondary of the Varioformer to the crystal and T3, may be effected without regard to lettering or electrical direction. (If a mistake is made, it is compensated for by reversing the cartridge detector in its clip. This experiment should always be made in order to secure the correct directional flow of the rectified current. A difference in signal strength with reversed flow may be noticeable only on weak signals; the test should therefore be made on distant stations.)

The reader is referred to the Laboratory Department of the January Radio Broadcast for additional data on the use of Mr. Ballantine's tuned radio frequency amplifying transformer in the one-tube reflex circuit.

If the reader doesn't care to thread-wind the inductances himself there are several manufactured coils such as the Workrite, Fada, Ansco, and similar transformers designed for use with the neutrodyne receivers which may be employed. When substituting these commercial inductances for T1, it may be necessary to remove a few turns of wire from the primary, reconciling the completed coil to the specifications we have given.

THE SINGLE CIRCUIT TUNER WITH A TWO STEP

IF YOUR present receiver is a single circuit tuner of the type described, plus two stages of audio amplification, it can be reflexed with similar ease, *and with less expense* by using the last audio transformer as T3. A second stage of amplification is seldom necessary with the one-tube reflex, nor, due to complications, is it desirable. The single tube alone will operate a loud speaker satisfactorily on local stations, while one extra audio stage gives "dancing intensity." Using one step of audio

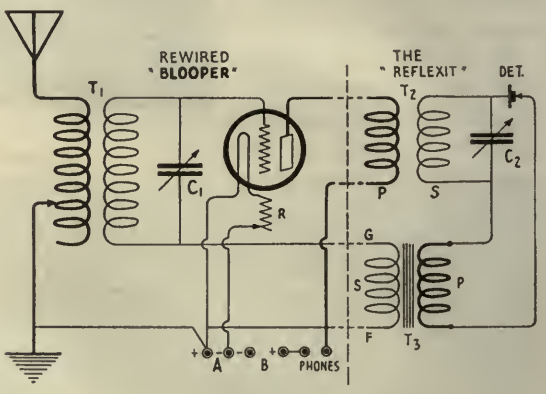


FIG. 5
How to connect the "Reflexit" to the re-wired single circuit receiver. The dotted lines indicate the flexible leads between the two units

amplification, the output or 'phone leads from the reflex are connected to the input—either to jack or primary of the transformer—of the first stage.

OTHER SINGLE CIRCUIT RECEIVERS

ANY single circuit set may be converted into a reflex by the addition of the "Reflexit." In the case of slight electrical or mechanical variations from the circuit described, such as in the "Aeriola Senior," the method of adapting the "Reflexit" will immediately suggest itself to our more experienced readers. However, our less sophisticated enthusiasts, interested in the further possibilities of this device will find them covered "In The R. B. Lab" of coming issues. There will be described, each month until the subject is exhausted, the manner of adapting the "Reflexit" to the less familiar forms of radiating receivers.



REBECCA HAIGHT
'Cellist of the Cleveland Institute of Music String Quartet

The Listeners' Point of View

Conducted by

Jennie Irene Mix

How Shall We Get Great Artists to Broadcast?

WHEN and how this much discussed question of paying the artists who are heard over the radio will be settled to the satisfaction alike of the artists, the public and the broadcast stations, it would be futile to forecast. Thus far the published discussions of the subject have conveyed three outstanding impressions. First, that the public should be given frequent opportunity to hear, through the radio, the most famous singers and instrumentalists. Second, that all concert artists feel that their profession brings them such steady and lucrative returns that the radio can be of no benefit to them other than the compensation received for broadcasting. Third, that this compensation should be the same as that which they receive when appearing on a concert stage.

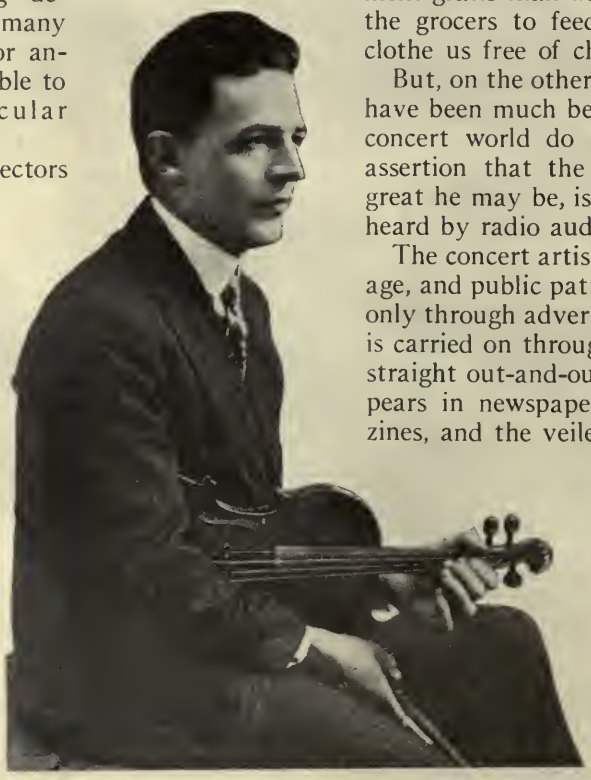
Now for the first point. With the exception of New York, and possibly also Chicago, there is no city or town in the country that has an

average of one concert a week by an artist of international fame.

The accentuation in this country of the fame of an artist, depending chiefly on this for his drawing power, has done much to retard the growth of discriminating musical appreciation by deflecting the interest of the public from music to the musician. It has also been the means of withholding deserved success from many who, for one reason or another, have not been able to achieve this spectacular fame.

The desire of the directors of broadcasting that the whole country be given opportunity, through the radio, to hear the great singers and instrumentalists is deserving of all admiration. Their mistake lies in thinking that concerts of this character should be given once a week and more often if possible. In truth, if these de luxe programs were given once a month it would mean a marked increase in such opportunities as compared with conditions that have prevailed in the past and still prevail.

We come to the second point which is the most vital of the three. Let us begin the answer to this by a question.



ALBERT SPALDING

American Violinist. Mr. Spalding, whose fame has become established far beyond the confines of his own country, is frequently called, "The aristocrat of the violin," for the reason that his playing is always characterized by such classic poise and beauty that place him in a class by himself. When he recently played with the New York Philharmonic orchestra, the concert was broadcast and many from distant stations later sent word that they had heard Mr. Spalding as clearly as if they were in the hall. He is under the management of the Wolfsohn Musical Bureau

Of what benefit is it to a concert artist to be heard by radio?

The benefit is so great and so many-sided that it cannot be measured to the full. Yet, because every man is worthy of his hire, every artist who is asked to contribute to a radio program should be paid for his services. Any other arrangement, when it is a custom, makes for the lowering of the relationship between the artist and those who ask him to give his services for nothing. The concert-giver's art is as much a commercial commodity as are any of the necessities or luxuries which we daily purchase for the support or embellishment of our bodies or our surroundings. With the exception of performances given for charitable purposes, there is no more reason why the musician should be asked to provide entertainment gratis than why any of us should ask the grocers to feed and the clothiers to clothe us free of charge.

But, on the other hand, those of us who have been much behind the scenes of the concert world do not take seriously the assertion that the artist, no matter how great he may be, is not benefited by being heard by radio audiences.

The concert artist lives on public patronage, and public patronage can be obtained only through advertising. This advertising is carried on through two mediums. The straight out-and-out advertising which appears in newspapers and musical magazines, and the veiled medium in the form of stories which the publicity agent concocts and then persuades editors the public will eagerly devour. Both of these mediums cost an incredible amount of money. The reason why so many fine artists have passed into the obscurity of the teaching profession is because they have not had the money to keep up this advertising. Their names must be constantly before the public if they are to succeed. And even after success has come, the advertising must be kept up with equal vigor, or they drop to the rear of the procession, then soon are out entirely.

We grant that every rule has its exceptions. There are at present two artists in the concert field—a man and a woman—who, such is their immense popularity, never have to do any general advertising other than that which gives notice of a coming concert. Who are

they? It should be necessary only to say that one is a violinist, the other an erstwhile prima donna. But, mark you, in past years they spent large sums for all kinds of publicity.

If he is not advertised the artist has no chance to be heard. And many, even if advertised, still have little or no chance. It is not uncommon for thousands of dollars (the artist's dollars) to be spent in attempts to get him before the public, but without success. The workings of the concert world behind the scenes are so intricate, so many factors enter into the success or the failure of every booking even of the long-established artists, that for those less known the profession brings but a hand-to-mouth existence.

To such as these the radio should prove of incalculable value. Through its means they can be heard not only by the general public,

MORIZ ROSENTHAL

—Polish Pianist. For more than forty years Moriz Rosenthal has been a dominating figure in the musical world. He first toured this country when he was little more than a youth. His second tour was in 1896–7. And now, at the age of sixty-two, and after an absence of seventeen years, he is again being heard here. His initial New York recital, given soon after he arrived, was broadcast through the coöperation of the Radio Corporation of America, and reports received from his managers, the Wolfsohn Musical Bureau, tell of gratifying results





ALPHONSE GUYON

A young pianist whose recitals have a number of times been broadcast by the Westinghouse Station, WBZ, at Springfield, Mass. Mr. Guyon's work will bear watching by those who are looking for fresh talent admirably trained. His programs are always of high standard, and his playing, especially of works from the romantic school, intelligent and imaginative

but, what is even more important, by concert managers throughout the country.

The day has gone by when concert managers engage artists on the excerpts of criticisms of the artist's appearance in New York City. This, because such excerpts are only from the laudatory portions of the criticisms, and be-because too many times has it happened that the singer or player has failed to measure up to the exacting standards obtaining in what the effete East so condescendingly refers to as "the provinces." In the past, managers have lost so much money in promoting musical attractions on New York prestige, or what seems to be such from the critical excerpts, that they have grown wary. They must hear to believe. Not being able to hear, they strike the artist's name from their contemplated list of attractions.

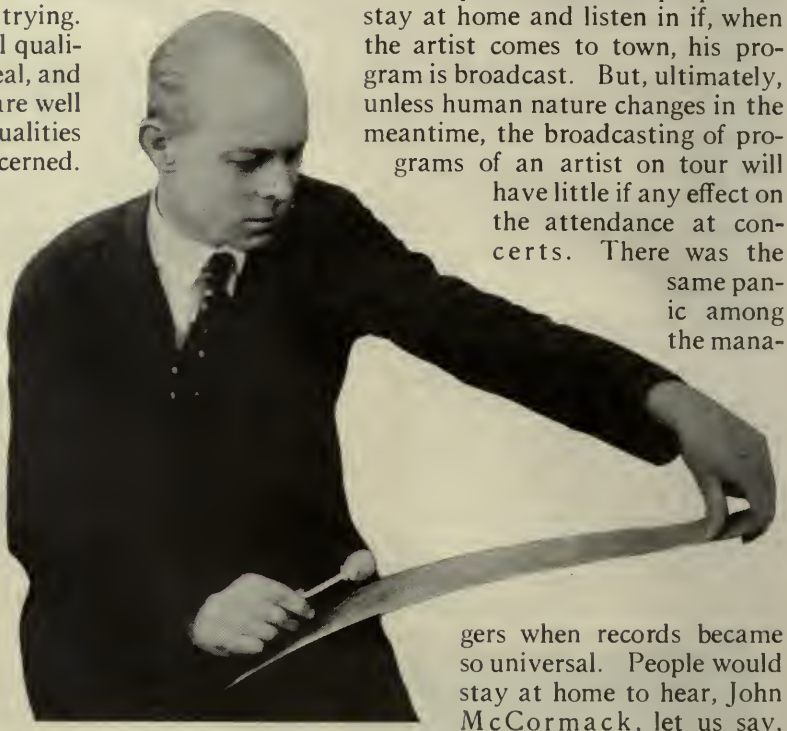
But suppose they could listen in to these

New York concerts, or could hear the artists sing or play a group on a regular radio program. This would go a long way toward solving the problem for the artist and the manager. Music, to be sure, does not always broadcast sufficiently well to give the hearer a just basis from which to judge the performer. But it does so often enough to make this means of communication between the artist and the manager worth the trying. There are certain fundamental qualities that every artist must reveal, and when the numbers broadcast are well known to the listener these qualities can in many instances be discerned. The tempo carries with fidelity; the phrasing can be followed; also the proportion with which the entire number is made a well balanced whole. And, miracle of miracles! the radio brings out with amazing effect the feeling with which a work is interpreted. The performance of a number over the radio that is characterized by consistent *tempi*, intelligent phrasing, the adjustment of each part so that it makes a well proportioned whole, and an understanding of the emotional content, brings assurance that the singer or player has the qualities of an artist.

Why then, if he can get into touch with concert managers through the radio, should such an artist be paid for his performance?

For the simple reason that even while he is benefiting himself he is giving pleasure to untold numbers of listeners and thereby helping to make this particular program a desirable one.

So all-powerful is this matter of publicity in the musical world that it would be well for artists and their managers if every worth-while program given in New York were broadcast. The mechanical devices that have made possible the hearing of artists through their records, are what has made the success of these artists when touring the country. This has been proved beyond all question. The artist who has never made records cannot compete with those who have. This fact destroys the argument that if people hear an artist over the radio they will not trouble to go and hear him in concert. They will not only want to hear him in concert when the opportunity presents itself, but they will go the most readily to the program that contains some of the numbers they have heard by radio.



WILLIAM MENZER

At work with his musical saw. On several occasions the peculiar harmony from this remarkable instrument has been broadcast from WJZ, New York

Perhaps, at first, some people will stay at home and listen in if, when the artist comes to town, his program is broadcast. But, ultimately, unless human nature changes in the meantime, the broadcasting of programs of an artist on tour will have little if any effect on the attendance at concerts. There was the same panic among the managers when records became so universal. People would stay at home to hear, John McCormack, let us say, through his Victrola records, rather than paying to hear the same numbers in the concert hall. But they did nothing of the kind. On the contrary it was because they had his records that they went to hear him. They wanted to be right there on the spot to look at him while he sang.

And now to the third and last point: The amount that should be paid the artist for broadcasting.

The general impression seems to be that the remuneration for a radio performance should be the same as that received on tour. The truth is that one-half of this remuneration should be sufficient to leave the artist as large if not a larger profit than he makes in his regular concert work. Much has been said about the big sums earned by concert artists. But note what has to be paid out by them.

The traveling expenses for the artist, and, unless he is a pianist, the accompanists' fee and also his traveling expenses with the exception of his hotel bills; the manager's commission; advertising and publicity; the practice hours with the accompanist preliminary to the tour; dress proper for every occasion, morning, afternoon, or evening concert, and always up to date and immaculate. The waits between engagements when the hotels make inroads on the fee. And the many small expenses that in the aggregate bring the fee down still more.

All of these expenses are taken into consideration when the artist's fee is fixed. But it is a question whether the same fee should be required for a radio performance which would entail no expense on the artist except his manager's perfectly justifiable commission and, when necessary, his own accompanist. This is a point to which broadcast directors would do well to give consideration.

As for the aspirants for concert careers who are still in the non-professional class, they should not be paid anything for broadcasting. These radio opportunities should be looked upon by them as débuts. If they go to New York to make a début (as hundreds of them do) it costs them, entirely aside from their personal expenses, anywhere from $600 to $1,000 for the one concert. Not a dollar comes in at the box office to help out, because the houses are always papered for these débuts. Why, then, should they expect to be paid if they make a début via radio? To be quite frank, the truth is they should not be heard at all through this medium until their work has been approved by a competent committee of judges.

Music in its relation to the radio is a problem that many directors of broadcasting are earnestly striving to solve. The right solution can come only through a thorough knowledge of the musical conditions existing in the concert field as well as in the field of radio.

"Humoresque" and the "Suwanee River"

ONE of the most popular instrumental numbers with radio listeners is Dvorak's charming, "Humoresque." But perhaps few who hear it know that the theme is taken bodily from "Suwanee River." You can easily prove this by playing the "Humoresque" while at the same time singing the song. In the days when Alma Gluck and Efrem Zimbalist used to tour together one of their most popular encore numbers was the singing by Gluck of "Suwanee River" to the accompaniment of "Humoresque" played by Zimbalist on his violin. The combination was not, as many supposed, a discovery of theirs.



RUTH WILLIAN
Second violin of the Cleveland Institute of Music String Quartet

It has long been known to musicians. Dvorak, from 1892 to 1895, was director of the National Conservatory of Music in New York, and during that time became much interested in the melodic character of plantation music. He made use of these melodies in his "Symphony from the New World" although in mood the symphony bears the flavor of his native Bohemia, and is not, as some would have us believe, intended to be representative of America. And although he used "Suwanee River" as the theme of "Humoresque" this composition, too, is Bohemian in spirit.

If Dvorak were living and could get a royalty on every radio performance of "Suwanee-Humoresque" he would be a plutocrat—among composers.

When Singers Broadcast

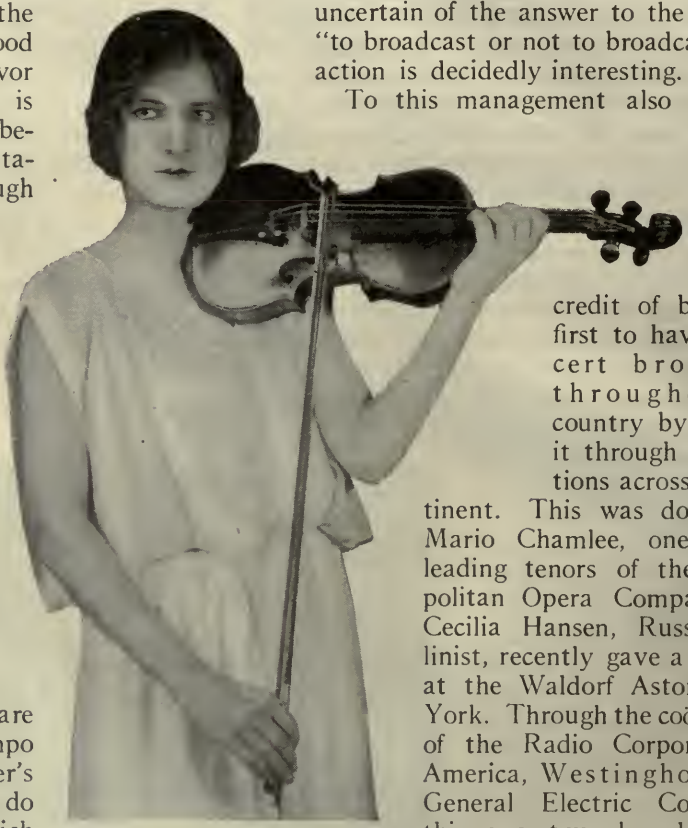
HERE'S a bit of advice for singers who broadcast.

Don't drag the tempo!

Contraltos in particular are apt to slow down the tempo until they get on the listener's nerves. They are inclined to do this on the concert stage, which is bad enough, but when it comes to the radio the habit becomes distressing. Nor are sopranos and tenors wholly exempt from this criticism, but for some reason the baritones nearly always keep the tempo up to normal.

When a singer drags through a phrase, it means a gasp for breath at the end of it. This gasp is even more apparent over the radio than in the concert hall.

The radio microphone is an extraordinarily faithful reproducer of every sound, a fact which artists may slight and it will be well for singers to remember this when broadcasting if they want to make a good impression on their listeners, which, of course, they all do.



CECILIA HANSEN

—Russian violinist. One of the artists under the management of the Wolfsohn Musical Bureau who broadcast from the Waldorf Hotel at the Massachusetts Institute of Technology alumni dinner on March 7, 1924. WJZ, WGY, KDKA, KFKX, KGO, and 2AC (Manchester) broadcast her playing. On the same program was Mario Chamlee, one of the leading tenors of the Metropolitan Opera Company. One estimate has it that an area of one million square miles was covered in this wholesale broadcasting experiment

THE Wolfsohn Musical Bureau goes on record as one of the first organizations among the musical managers to broadcast not only the New York concerts given by their artists but also those presented on tour. At a time when musicians and managers are uncertain of the answer to the question "to broadcast or not to broadcast," this action is decidedly interesting.

To this management also goes the credit of being the first to have a concert broadcast throughout the country by relaying it through four stations across the continent. This was done when Mario Chamlee, one of the leading tenors of the Metropolitan Opera Company, and Cecilia Hansen, Russian violinist, recently gave a program at the Waldorf Astoria, New York. Through the coöperation of the Radio Corporation of America, Westinghouse and General Electric Companies, this concert was broadcast from Station WJZ, New York, picked up to be rebroadcast by WGY, Schenectady; KDKA, Pittsburgh; KFKX, Hastings, Nebraska; and at 10:30 P. M. New York time, station KGO at Oakland, California, and station 2AC of the Metropolitan-Vickers Company at Manchester, England. Various estimates of the amount of territory covered by this quite revolutionary "blanketing" broadcasting have been made, the most striking perhaps being that one million square miles of the earth were reached. Among others under this management whose concerts have been heard by radio are Moriz Rosenthal, Albert Spalding, Manuel Quiroga, Mabel Garrison, and the New York String Quartet.

As If From Heaven

ANY ONE who has not listened over the radio to the choir of St. Paul's Episcopal Church in Detroit should do so at the next opportunity that presents itself. Whoever is the organist there knows, as do few church organists, how to eliminate the usual deadly monotony of church singing. The numbers that should go with spirit go with such unflagging life that the only word by which to describe the effect is the hackneyed, "Inspiring."

Not long ago they sang, evidently as the recessional, "Onward Christian Soldiers," It came through the ether like a thunderous yet bright clarion call to action.

They sang every verse. A group of us listened in silence, the effect being all the greater because the singers could not be seen. At the close, one in the group said, "But it didn't sound at all like church singing." To which a young man, not conspicuous for his interest in church matters, replied, in awed tone:

"No. It sounded like the Heavenly Host."



ANDRE DE REBAUPIERRE
First violin of the Cleveland Institute of Music String Quartet

IT IS becoming quite the thing for radio stations to give occasional programs made up wholly of songs that were the popular songs of the day, thirty, forty, fifty or more years ago. WOAW at Omaha, Nebraska, has presented a number of such programs. A delightful custom and one that should continue. What reminiscences these songs must bring up to those who were young when they were the vogue. It would be a good thing if some of them could be permanently revived. There's romance in them and gayety as well—humor, too. No doubt, when broadcast, they set many a grandfather and grandmother telling of the good times they had when they were young.

ALTHOUGH, in age, this department is only in its second month, a number of inquiries from readers have been received along the line of Won't you please write something about this? or What do you think of that? and so on and so on.

Which leads to the statement that the conductor of this department will always be glad to receive opinions, whether critical or otherwise, of whatever may be said in the department; also suggestions as to what ought to be said for the good of all concerned.

An editor's opinion, although drawn, as it always should be, from long and practical experience along the lines discussed, is yet but an individual opinion. And as we should all, no matter how firm our convictions on any subject, be ready to hear the other side, this department will ever be open to progressive criticisms or constructive ideas.



THE RADIO ANTENNAS ON A DREADNAUGHT

The illustration shows the antennas on the U. S. S. *Colorado*. The long cage antenna is used for the large arc transmitter. The other antennas are used for spark and radio telephone communication

The March of Radio

Is the Problem Solved?

SO MANY times we have asked the question—"Who is going to pay" that any reasonable attempt at the solution of the question of the cost of broadcasting is very welcome and will be watched by millions of listeners with a great deal of interest. In the very first issue of RADIO BROADCAST an attempt to analyze the possible solutions of this problem was made. One of the possibilities suggested then was that of soliciting contributions from the radio audience, a scheme the Church has depended upon heavily for many years. It is not at all evident however that the radio broadcast managers would be as successful in this method of getting funds as are the ministers of the gospel; neither the hope of Heaven nor the fear of Hell will act as brother conspirator with the station manager to pry loose some of the savings of their audience. It seemed possible even two years ago, that the public would respond to an appeal for funds in an unexpected degree, and the possibility is even more imminent to-day after the remarkable demonstrations of the way in which radio broadcasting, properly supported, can instruct and amuse its millions of listeners.

With this idea in mind a committee of New York business men has been formed to try out this scheme of broadcast financing. It seems evident that a station itself could not very well carry out such a scheme because a large

part of the public would imagine that their contributions were going to pay dividends for the stockholders of the company rather than for putting out good programs. One or two rumors to this effect would kill completely any scheme managed and controlled by a business concern such as the Radio Corporation or the American Telephone and Telegraph Company.

To convince the public that a bona fide attempt was being made to give them self-supporting radio, the committee which has undertaken the task of introducing this innovation has been wisely made up of prominent financiers, who could not possibly be suspected of any idea of profit-taking, and who have been intimately connected with many other musical ventures. They are men whose names will at once command the respect and confidence of the prospective contributors. This committee has solicited funds from the radio public, calling for contributions of from a dollar up, from all those who are entertained by WEAF, through which the new broadcasting programs are to be sent. This station has been selected, it is said, because of the "excellent quality of its modulation and transmission." All of the funds received from the radio listeners will be directly applied to the securing of artists of the highest caliber. The committee will serve voluntarily, and the station, WEAF, has agreed to carry out the programs free of charge. This is no small contribution on the part of the American Telephone and Telegraph Company in view of the fact that this station commands a fee of $400 per hour for its use for advertising.

There have been favorable comments made about the scheme, and some adverse and discouraging. The manager of a well known station expresses the opinion that the public will not contribute to any extent for a form of amusement which they have a fair chance of getting without paying for it. For he says the letters he has received from his listeners recently seem to show a spirit of dissatisfaction with what they are getting already, rather than a willingness to part with some of their good money to help the distraught manager in scheduling more interesting events.

The price paid for a good receiving set to-day is high, and any business man who looks inside his $150 or $200 set naturally wonders why he has to pay so much for a few coils, condensers, tube sockets and the like. Feeling that he actually got about $50 worth of apparatus in



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THE MOST IMPORTANT CLOCK IN THE WORLD

Is this chronometer at the Royal Observatory, at Greenwich, England, the starting point of longitude in the world's maps. Signals from this clock are now sent out daily from all nine stations of the British Broadcasting Company

his purchase he expects to realize on the other $100 from the enjoyment of radio programs for which he will not have to pay anything. Hence when these fail to please he unconsciously feels that he has, perhaps, been "done" and hence his letter of discontent to the station manager.

Another objection to this proposed scheme of broadcast financing naturally comes from those stations which will not secure the service of these well paid artists. "It looks all right for WEAF," says one manager, "but how about the other 534 stations in the United States?" This bares a very important point in the broadcasting situation: are all these stations entitled to a share of any fund collected from the radio audience at large? Many of them seem to think so, but there is really no justification at all for their stand. How many of us would contribute money to hear a program from a poorly managed, poorly equipped station, such as many of them are to-day? If these stations put out such a request as has emanated from WEAF it is unlikely that one dollar would be contributed. There are too many stations to-day which feel they have a right to be on the air irrespective of what kind of material they send out. They appear to forget that the ether is the public's and they are on the air not by right but by tacit permission. And the public certainly has a right to send its money in to that station from which it can get the highest return.

Just as every good music lover cannot help but wish success to the Metropolitan Opera, even though this company gets a disproportionately large share of the public's opera money, just so we hope this new scheme will meet with



PRESIDENT COOLIDGE

Calmly before the calm microphone in a recent radio address. The President has three times lately made use of radio to reach great numbers of his fellow countrymen. So can the strength of the Chief Executive be saved. As the most prominent Republican candidate for the Presidential nomination in June, 1924, he may be heard quite frequently by the nation's radio listeners

extraordinary success. Even so, it must not be regarded as a final solution to the problem. We expect that it will serve merely as a trustworthy indication of the public's real desire in broadcasting. And it is the good of the general listener, not that of any station or company, which must be of chief importance in determining the method of solving the problem.

Where Radio Broadcast Stands

PERHAPS no article ever published in any radio magazine has created as much comment as Zeh Bouck's "The Truth About Trick Circuits." The avalanche of letters reaching us expressing various opinions indicates just how badly an expression of honest belief has been needed.

For the most part the letters we have received indicate that we gave expression to thought hiding in many minds. There have been a few objections—from our friends in the industry. And we say "friends" advisedly. Let us explain:

Among the circuits treated in a most caustic manner was the Flewelling adaptation of the super-regenerative receiver. During the radio show and convention held in New York we had the pleasure of meeting Mr. Flewelling.

Amid the din of a few dozen loud speakers, all vying with each other for supremacy, Mr. Flewelling, Dr. G. W. Pickard, inventor, Zeh Bouck, and the editor sat together on a large table where admission tickets were being sold. We went right to bat, laid all our cards on the table and we are glad to chronicle the results here. Doctor Pickard appeared to be very sure that super-regeneration is accomplished by the Flewelling circuit. That may be, but our criticism was of a different nature. Our principal complaint was that the circuit, in the form in which it received so much publicity about a year ago, is a malignant squealer.

Mr. Flewelling paid us a real compliment by saying: "I have been panned many times before; but when RADIO BROADCAST took its crack at me it hit me in a tender spot. You fellows, by inference, intimated that I was party to the the unloading of "gyp" merchandise and the truth of the matter is that I was made some very flattering offers if I would place my approval on all kinds of units which could be used in my circuit. I refused them all."

Such a construction is possible from the article as we published it, but it was entirely unintentional, and Mr. Flewelling could not prevent the exploitation of his own circuit by certain irresponsible agencies. Mr. Bouck aptly says he has been more sinned against than sinning.



SENATOR HIRAM JOHNSON

At home before a receiving set. As another Presidential candidate, his voice may also soon be heard by radio listeners who have a bent toward politics

Another gentleman—a prominent manufacturer of parts and sets, invited us to his office and proceeded with a rather fervent roasting. His most important criticism was that the tone of Mr. Bouck's article was not of the harmonious nature that would create interest in home-built receivers from standard parts. This particular gentleman's days are very crowded and he does not have as much time as he would like for the perusal of magazines. He was unfamiliar with the how-to-make-it articles we publish each month after we have actual working samples of the devices described.

We are firmly convinced that by keeping our faith with our readers we are serving the entire art. It is far from our policy to suggest a reduction in the number of home-built sets. That business, in our opinion, will always thrive. However, we also believe that exaggerated claims for this, that or the other circuit, will, after Mr. Home-Builder has been sadly disappointed a few times, make him doubt the legitimate claims made for even really good circuits and honest products. We hope this will correct any similar impression others among our readers have entertained.

Another manufacturer and strangely enough another maker of parts (in an unsolicited letter), says, in part:

> . . . I was particularly impressed with the article by Mr. Zeh Bouck in the March issue of RADIO BROADCAST which clarifies to the public the



ONE OF THE YOUNGEST RADIO FANS
Is Miss Arline Weber of Chicago. She apparently has no complaint to offer on the incoming program

question of "trick circuits." This has been one of the bad features of the business. It plays on the psychology of public curiosity and I think it may help to sell a lot of merchandise which will certainly put the good merchandise to the fore in time. The cause has turned the American public into a nation of experimenters who are going to register their opinion in time in no uncertain manner.

It is my personal opinion and the opinion of our company that the solution of better reception is not going to be in "trick circuits" or in various frills which will be added to the circuits, but the solution will be in the refinement, both mechanically and electrically, of the material with which we must work. We are, therefore, experimenting constantly until we find both the mechanical and electrical properties of our product to be good. . . .

The writer,who has been twenty-one years in the radio business and during that time watched its progress—both actively and in a purely observing capacity—believes that this will be the ultimate goal for which any legitimate manufacturer must strive. . . .

It is significant to note that not a single criticism from readers not associated with the industry has, as yet, put in its appearance. On the other hand there are many—a great many of the character we are pleased to record below. As most of our older readers will remember, most of the suggestions in this good letter—from a student at Massachusetts Institute of Technology—have already been given attention. In many instances, other periodicals have campaigned against squealing receivers.

Editor, Radio Broadcast.

Dear Sir:

I was very much pleased at Mr. Zeh Bouck's article on "Trick Circuits." You and he invited about twenty libel suits, and I admire your courage. You are the first to come out flatly, give names, and be specific. I know a few "fathead" B. C. L.'s who believe everything they see in print. I hope they accept your article the same way.

You might razz Mr. Kaufman some more. His first circuit was, as you called it, the "goulash." He brought out another, using the reversed feedback—also a transmitting circuit. He called it the Kaufman No. 2. And I think there are thousands ruining the ether. The ultra-audion is another.

Here I am living fifty minutes from a nest of iniquity, at the Riverbank Court Hotel. There are at least 20 aerials on that roof. I tried to stem the tide of radiation. In my first interview I met a *very* well-to-do director. He thought me a fanatic! He had a Grebe "9" and listening in to his tuning was painful. He knew nothing whatever of the subject, nor his receiver, nor radio. He blamed the howls, squeals, etc., on the amateurs. What can you do with such a person? I gave up the task in disgust. *The richer* and more able to afford a non-radiating receiver, the dumber they are. The dumb owners of Colpitts oscillators, alias flivver circuits, are a great menace here in New England.

If you want to do a great service, describe only non-radiating receivers and get fellow editors to do the same.

This other request takes a lot of my nerve. It is a lot to even talk about. A good way to check radiation would be to have an issue in as many maga-

zines as possible devoted entirely to factory made and other receivers, taking each class of "pest" listing all known factory makes of that type, also aliases, and tell how to convert them into good sets. Give good notice to the Sodion tube and how to convert a single circuit into a good receiver, using this tube and without need of much extra parts except a potentiometer. Make it detailed for the "dumb-bells." By mentioning radiating makes of receivers specifically you are in little danger of a libel suit, for radiation can be easily proved, and the truth is a perfect defense for you.

I am an experimenter, and my interest in the music is little, with the exception of some very good music from good stations. Hence I am not a novice. But I would like a clean air to test in. Interference can be avoided by a good set, but the best types of receivers are helpless before radiating receivers.

Yours truly,

C. J. LeBel

Expensive Service

PRESIDENT COOLIDGE'S speech on Washington's birthday was not broadcast from a Chicago station, as it had been announced, because the station's manager thought the service cost too much to make it worth-while. Any broadcasting of this kind is entirely dependent upon the American Telephone and Telegraph Company who control all of the long distance telephone lines of the country. Unless their coöperation is secured, practically no broadcasting can be done from points outside the studio. Thus all of the ambitious broadcasting stations, desiring to put on the air affairs which take place at distant points, are entirely dependent on the country's great communication company.

The Westinghouse engineers, with their short wave transmission from Pittsburg to Nebraska have solved, to a certain extent, the question of remote modulator control but, of course, the Chicago station could not very well set up a short wave transmitter at the White House, to relay the speech to Chicago. The General Electric Company has used a small portable short wave transmitter to actuate WGY from points a few miles away. Such a scheme is possible, but not yet as desirable as a good telephone line connection.

So the question arose—how much should a broadcasting station be charged for the use of a long distance line for a few minutes when the President is speaking? Apparently $1000 was offered but the "asked" price did not get below $2,500, so a sale was not made. In the words of the discomfited radio station manager "the regular long distance charges for the use of wires from Chicago to Washington is only $4.80 for the first three minutes and $1.60 for each additional minute. The original plan was for the President to talk ten minutes; at the regular rates the cost of the wires would then be $14.80. Because of the necessity of having well balanced wires and other possible special care, one Chicago station offered the American Telephone and Telegraph Company $1000 for the service from Washington, but even at that figure the service was refused."

Before condemning the telephone company for its apparently excessive charge for this service it must be considered that the ordinary wire connection will not serve at all for such a purpose. Special lines and repeaters have to be taken out of regular service, have to be put through special tests and adjustments, all extraneous "noises" eliminated and a special



HOW KDKA WAS RE-TRANSMITTED IN ENGLAND

The receiving set had six stages of tuned radio-frequency amplification, detector and two stages of audio-frequency amplification. This special station is installed at Biggin Hill, near Manchester. In the photograph are, *left to right* Mr. Honri, of the British Broadcasting Company, Mr. Webb, of *Popular Wireless*, and Captain West, Assistant Chief Engineer

staff of men, as well as spare lines, be kept in readiness in case the connection should fail.

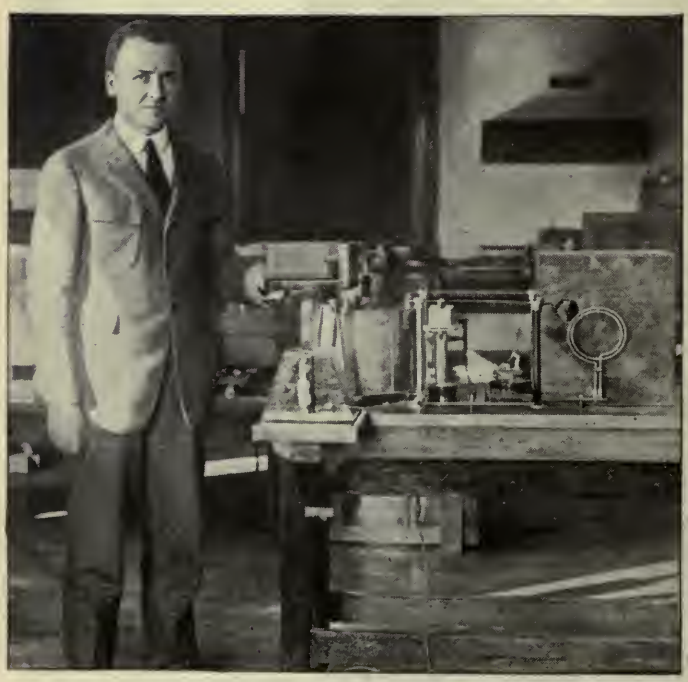
However large we may think the bid of $2,500 for ten minutes' service may be, all of the related factors are not on the surface, and we feel that the Telephone Company is entitled to the benefit of any doubt there may be, when we consider the fine radio broadcast service they have given the public during the past year. Whatever may be the policy of their financial advisors, we do know the company makes a continual effort to improve broadcasting service. This has been of great benefit to the radio public—a public which so far has paid the Telephone Company nothing at all for the service. It is well to remember also that the radio receipts of the American Telephone and Telegraph Company are practically nothing at all whereas an organization like the Radio Corporation has an income from the radio public which must be measured annually in the tens of millions of dollars.

Good Work by the Bureau Physicists

A FEW of the workers in the field of radio development have received rich material rewards for the successful solutions of certain radio problems. We think at once of Armstrong, Pupin, Hazeltine, and others. Other workers spending months and years upon the solution of problems of great importance in the advancement of science, in the saving of lives, prevention of shipwrecks, etc, receive practically no direct financial reward when their work is successfully completed. Among such workers must be reckoned most of the research workers in University laboratories and certainly those on the staffs of such institutions as the Bureau of Standards.

Much valuable work is done by the physicists of the Bureau. This is the kind of work that practically never brings much remuneration to the worker. Tests on the applicability of short waves for radio transmission were carried out at the Bureau quite some time ago. This work is and has been of great value to such companies as the Westinghouse which, of course, gets credit from its radio audience for putting into operation the remarkable short wave channel from Pittsburg to Hastings, Nebraska. This work of the Westinghouse engineers naturally deserves much approbation, and it does get it, whereas the work of the Bureau scientists remains unknown except to a few who happen to consult the bulletins describing the work of the Bureau.

There has recently been published by the Bureau, Scientific Paper No. 480, describing a new type of radio beacon station, and its use in the navigation of aeroplanes. Ordinarily an aeroplane is guided to its port by the use of a directional radio receiver mounted on the plane itself; generally two coils at right angles, the scheme attributed to Bellini-Tosi, is employed. It is by no means easy to carry on accurate directional measurements on a noisy aeroplane, going at its tremendous speed. The Bureau workers set out to find a more easily manipulated scheme for the plane's pilot.



DR. J. H. DELLINGER
Of the Bureau of Standards with the standard wavemeter at the Bureau laboratory in Washington

This pamphlet gives the results of a series of experiments made with the view of not requiring directional measurements on the plane itself. All the operator on the plane had to do was observe the signal intensity. The sending station uses two large coil antennas, mounted about 135 degrees apart. On the plane, a simple non-

directional receiving set suffices. Signals are transmitted alternately from the two coils at the transmitting station. On a line dividing the 135 degree angle the two signals will be received by the pilot with equal strength, but in other directions the signals from the two coils will be of unequal strength. After the radiation from this beacon is once picked up, the pilot maneuvres his plane until the two signals are of equal strength and then holds to the line in which this equality is maintained, and he will be making a straight course for the station.

Tests carried out with the assistance of the Army air pilots seem to indicate that this new type of radio beacon will much facilitate the accurate navigation of air craft, at night or under bad weather conditions, when ordinary observational methods fail. The development of this new radio beacon was carried out by Messrs. Dunmore and Engel, physicists of the Bureau of Standards.

"Fifty Million People Hear General Carty Speak"

SO ONE staid New York newspaper announced recently. Off hand, we thought they had slipped in one too many zeros in the linotype, but these same fabulous figures appeared the next day in even more positive form. This statement is quite in line with other confident assertions of what radio is doing. This newspaper in question should send its radio editor to an elementary class in radio principles, and then to some other necessary one in which gullible souls are taught to distinguish between solid facts and idle dreams.

The occasion which called forth this ridiculous statement was a most remarkable one; no foolish exaggeration was necessary to make possible the wording of an attractive headline. General Carty, vice-president of the American Telephone and Telegraph Company, was giving a speech to a group of business men in Chicago, and as is usual on such an occasion, he spoke on the significance of communication to the prosperity of a people, and especially on the past and future developments in the communication art as it exist in America. After pointing out that radio and wire were not in conflict, but rather supplement one another, this well known telephone engineer gave a most remarkable demonstration of the communication facilities his company had brought into being.

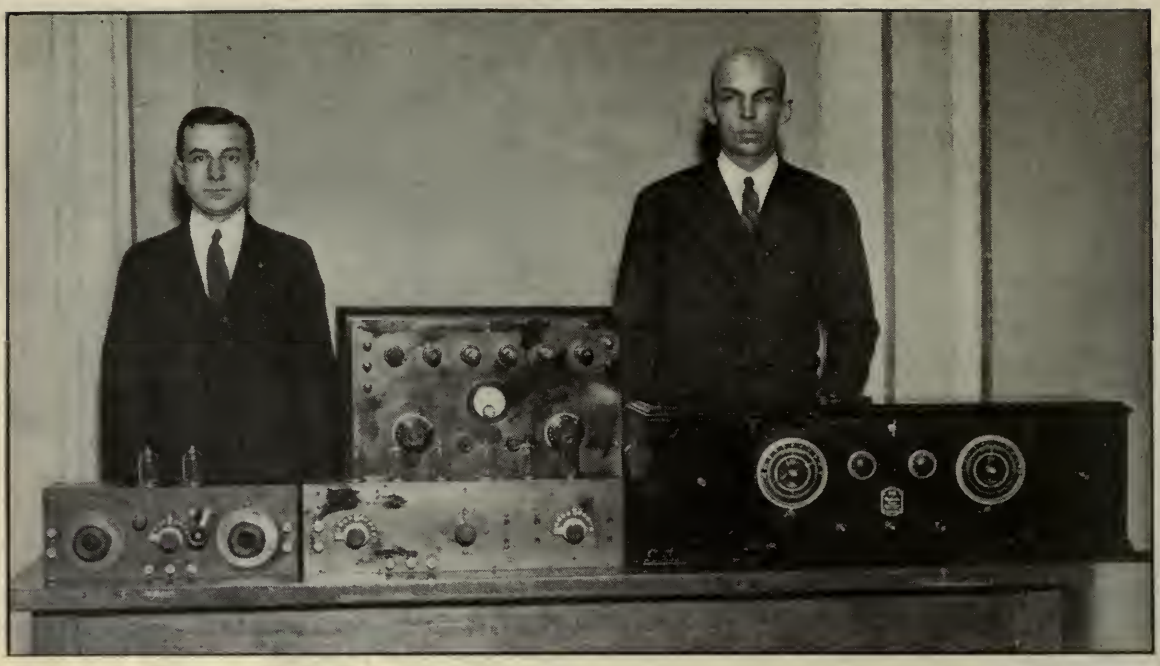


BETTY BALFOUR
A well-known and popular British "cinema" star before the microphone at 2 LO

Speaking into the microphone at the banquet hall in Chicago, General Carty's voice was carried over the company's transcontinental line, from San Francisco to Cuba (the step from Key West to Cuba was by means of specially constructed submarine cable). Operated by the voice currents as they traveled east and west from Chicago over this line, were six radio broadcasting stations: Havana, Washington, New York, Providence, Chicago, and San Francisco. This tremendous spread of ether waves was accurately controlled by the less than one millionth of one watt of sound which was absorbed by the microphone in Chicago. There is a picture for you.

The manager of WEAF has estimated his average radio audience at 500,000 with a possible maximum of three million. This was the most powerful station of the six taking part in the demonstration, and, being situated in the most densely populated part of the United States, a reasonable estimate of the number of people who heard General Carty speak would be five million, at the outside. Every one of these five million must have had his imagination kindled and his admiration of the technical genius of his country enhanced, when, settled in the comfort of his home he heard the speaker say "Hello, Cuba", and the immediate response from Havana, and then a few seconds later "Hello, San Francisco," and immediately back "Hello, General Carty, this is San Francisco talking."

It is a pity that Alexander Graham Bell's death came too soon for him to hear this demonstration of the growth of the art his



SUPER-HETERODYNES

And Major Edwin H. Armstrong, the originator of the super-heterodyne circuit. The cabinet on the left is his original "super," and the cabinet behind it is the working model for the finished commercial product on the right. Mr. H. W. Houck, who aided Major Armstrong in the development of the set is standing on the left

simple experiments started. He would have heard one man speak to millions, scattered over the length and breadth of our land. Even knowing the step by step progress by which this accomplishment has been made possible, it was with difficulty that we kept back the sentiment of that other message so important in the history of communications development: "What hath God wrought." We would also add, What great credit is due to those hundreds and thousands of bright, earnest, young engineers, whose diligent efforts and keen application make possible this almost unbelievable progress!

Radio in Great Britain

TWO recent news items on the radio situation in Great Britain deal with the Government's control of the radio field in that country. As we know, control of the broadcasting has been closely guarded in England. The Postmaster-General is the man whose decisions completely regulate the commercial broadcasters. He it is who tells millions of listeners what kind of receiving apparatus they may use. As related in these columns some time ago, it is illegal in the British Isles to use a receiving set which can radiate an appreciable amount of power, a regulation which, if put into effect in our country, would rule out millions of sets. Incidentally we learn of several new stations being put up in England and Ireland. It must be that most of the listeners use crystal sets as otherwise one or two stations would surely suffice for the whole of such a very small territory.

An encouraging sign of the sensible way in which the Postmaster is seeking to wield his power justly, and in such a manner as not to interfere with the progress of the art, is shown by his acceptance of the recommendations of a committee of broadcasters, that he should appoint a Board to advise him in all the technical points involved in radio supervision. This he has done and the personnel of the Board is a source of encouragement to the radio public, according to a news item in the *Wireless World and Radio Review*. Among those appointed is A. Campbell Swinton, who was President of the Radio Society of Great Britain from 1913 to 1921. He will prove a valuable guardian of the interests of the British radio public.

But another governmental activity has lately served to arouse Guglielmo Marconi himself.

The report in question had to do with the operation of the Imperial Wireless Communications, and suggested the limitation of private enterprise in the radio field to such an extent that Marconi felt that its development would be much hampered. This is of especial importance to Marconi as he feels about ready to go ahead with his directive radio, on a large scale. He feels that suitable radio mirrors can now be constructed, that beams of radiations can be thrown across the Atlantic or even to South Africa, with a resultant diminution in interference between stations and a very considerable saving in the power required.

—J.H.M.

Adventures of a Wireless Free-Lance

My First SOS—A Farce Comedy

By GEORGE F. WORTS

THERE was nothing in the least amusing about it when it was happening. We were soberly and solemnly aware that the most dramatic situation that can arise in the life of a ship confronted us. The *North American* was fast aground and lost in a heavy fog. Five hundred passengers, mostly women and children, were endangered. Responsibility for all these lives had been suddenly dropped upon our shoulders. A heavy swell—the aftermath of a gale—was lifting us and dropping us with great thumps upon a rocky shoal somewhere in the Strait of Mackinac; and the ship was canting dismayingly to starboard.

It was a tremendous moment. I had been "pounding brass" for two years, and here at last was the opportunity for which I had been secretly and shamefully hoping—the opportunity, I suspect, for which every youthful wireless operator secretly and shamefully hopes—of sitting down at the key and rapping out the three most electrifying letters in the alphabet—S O S!

I had retired to my stateroom a little after six o'clock from the midnight-to-six watch, and was asleep when it happened. A sudden jar, a deep banging, startled me awake. We had, I learned later, taken the wrong bearing on a certain light during the night, and were a mile or two off our course.

I sprang from my bunk and put my head out of the porthole. Cold white fog streamed past my face. We had been creeping through fog when I had turned in, and it seemed to me that the fog had become thicker. It was impossible to see farther than twenty portholes in either direction and the white hull above me vanished into creamy nothingness.

From every porthole within range a head protruded, nose down. Some were men's heads and some were women's heads adorned with braids, kid-curlers and lace caps. Every one was gazing at the water, and no one said a word.

The engine had stopped and the ship was as still, as peaceful as though we were at anchor in some snug, quiet harbor. Then a long wave rolled out of the fog and lifted us. We settled down again with a harsh scraping sound and the whole ship seemed to shiver as we listed to starboard.

A woman at a porthole above me said, in an amazed voice, "Why! we're aground!" She did not seem alarmed. In fact, no one seemed alarmed. That, to me, was astonishing. I had heard that in moments such as this every one became panic-stricken. The excitement came later.

We all stared with fascination at the water. It was pale blue and so clear that we could easily see the stones on the bottom. They were of all sizes, some as small as golf-balls, some as large as basket-balls.

My stateroom door opened and Kenneth Little, the junior operator, burst in with a white face and excited eyes. He was grinning nervously.

"Well!" he got out breathlessly. "We're on!"

We exchanged glances with which every wireless operator can sympathize. Our great moment had come! No longer were we the playthings of passengers—luxuries forced upon unappreciative owners. We were, provided the *North American* did not back off the shoal under her own power, the two most important



"FROM EVERY PORTHOLE WITHIN RANGE A HEAD PROTRUDED, NOSE DOWN"

individuals on board the ship! We were about to become heroes!

"Can she get off by herself?" I asked anxiously.

He didn't believe so. She had been running through the fog at half-speed and she had suddenly been brought to a jolting stop. It wasn't conceivable that she could back off that ledge.

Another wave lifted the beautiful white bulk of the *North American* and dropped her with a harsh deep booming still farther up on the shoal. The hull trembled as the engine started full speed in reverse. A glance from the porthole assured me that steam was being wasted. The golf-balls and the basket-balls remained stationary while bubbles from the propeller swept forward.

I had always pictured myself, when this moment came, as a man of coolness, courage, and decision.

"Get back on the job," I said crisply. "Stand by and wait for me. Test out the emergency outfit. Call up the engine-room and tell 'em we'll want plenty of juice."

"Hadn't I better send out an S O S?" he inquired hopefully.

"Not by any means," I said. "Stand by and wait for me."

"Stand by" is a phrase that has always appealed to me, along with other nautical terms such as "Steady as you go," and "Bright light two points off the port bow, sir!"

When I entered the wireless room the telephone from the pilot house commenced to ring. The first mate nervously wanted to know if everything was all right with us. I reported that we were standing by and ready to send an S O S at a moment's notice. He told me rudely to keep my shirt on and not to send an S O S without the Captain's explicit orders.

I asked him if there seemed to be much chance of our backing off the shoal under our own power.

"How do I know?" he said irritably. "Stay where you are and don't go fooling around the decks. We may need you."

It appeared that, in the opinion at least of the first mate, I was not yet the man of the hour. I devoted myself to an inspection of the apparatus.

The wireless room was situated in the starboard after corner of a square hall between-decks known as the "social hall." At one corner of the social hall was the purser's office. Across from that was the steward's office. In another corner was the baggage room; and in the fourth corner was the large glass and mahogany cage housing the radio apparatus and the newsstand. We ran the newsstand—sold magazines, candies and cigars—in addition to operating the wireless.

Our transmitter was a 2 k. w., 240-cycle rotary synchronous set—the first of its kind to be installed on the Great Lakes, and a source of endless trouble. Our receiving set was a heritage from United Wireless days, a loose-coupled tuner and a carborundum crystal detector in which we defiantly used silicon and a cat-whisker of mandolin E-string. The audion had yet to cast its pale glow upon radio scenery.

If the first mate did not appreciate our in-

portance, certainly the passengers did. They swarmed about the newsstand, asking no end of idiotic questions. How long would we be aground? Did the Captain know where we were? Was the fog going to lift? Were ships coming to our relief? How did we know if anybody was calling us when we didn't have those rubber things on over our ears?

I made the interesting discovery that human beings in moments of great crisis crave chewing-gum. Every one wanted to buy chewing-gum. And so I have come to the conclusion that gum chewing is the American way of expressing deep emotion.

We closed the newsstand emphatically. Somehow, selling chewing-gum to anxious passengers did not harmonize with the dignity of our position. We were wireless heroes, not chewing-gum salesmen!



The long waves continued to roll up under the stern from out of the fog, driving the ship farther and farther upon the ledge and tilting us more and more to starboard. The pounding did not excite the passengers, but the listing did. The opinion prevailed that the *North American* was about to turn turtle.

Within half an hour after the first impact, many of the passengers put on life-belts. The social hall was in a hubbub. Every one was asking every one else questions.

The second assistant engineer covered with mud and rust raced through the social hall and demanded the use of our telephone to the pilot house. He had been down in the bilges and wanted to inform the Old Man that no visible damage had been suffered by the garboard strakes.

"She isn't taking any water, but we're stuck tight," he reported excitedly.

The first mate asked for me.

"The Captain wants you to get hold of Mackinac Island and have a tug sent out."

"Yes, sir!" I snapped. "Where are we?"

They didn't, it developed, know exactly where we were.

"On one of the Duck s," he guessed. "Tell the tug to nose around the Ducks. We're probably on Little Duck."

"Yes, sir!" I snapped. A picture came into my mind of the Old Man and I in the act of leaving the ship—sticking to our posts to the very last, while the ship was ground to flinders on one of the Ducks.

This vision possibly was prompted by a sudden and sickening realization that the Mackinac Island operator would not be on the job for at least an hour. It was still very early in the morning.

There was nothing else to do, so I started the motor-generator and called WHQ—the Mackinac Island station. There was no response. At that time of day no one was on the air. Even the static seemed to be reposing.

The telephone rang again, and this time the voice of the first mate was agitated.

"Has that tug started?" he wanted to know. I told him that the Mackinac Island station wasn't open and wouldn't be open for another hour.

"You've got to get word to Mackinac somehow," he said. "We can see land now. We're on Little Duck. This wind is freshening. There isn't any time to lose, Sparks. Get busy!"

I got busy. Futilely I called WHQ. I called and called and called. The operator probably hadn't left his boarding house. It was a tormenting situation. In desperation I called VBB, the Canadian Marconi station at Sault Ste. Marie. Someone was always on duty in VBB. He could put the message on the land line to Mackinac Island. Then I realized with a sensation of sickness that the Western Union office at Mackinac Island did not open until WHQ opened.

VBB did not answer. I called him feverishly for five minutes. Then I rang the pilot house. The Captain answered. I told him that I had tried to raise Mackinac Island and the Soo, but that no one answered.

"See if there isn't some ship near us," he replied.

"That means an S O S," I told him.

"All right—send as S O S!" he snapped. "But get somebody. What are you fellows being paid for?"

And so the great moment came, not precisely as I had wished, perhaps; but here, at all events, it was. After two years of faithful brass pounding I was about to send my first S O S! I was divided between perspiring agitation and a consciousness of the part I played in this epic maritime drama.

Kenneth, the junior operator, looked at me enviously as I slipped into the chair and grasped the handle of the motor-generator starter.

"S O S?" he gasped.

"Yes," I said fatefully. "It's S O S! Keep that door shut! There's somebody else who wants some gum!"

It opened even as I shouted the warning. A perspiring young man with disheleved hair and wild but determined eyes forced his way inside. The eyes of dozens of passengers on the other side of the glass stared at us expectantly. In his hand the young man had clasped a sheaf of papers covered with pencilling. He was a reporter on the *Chicago Examiner*, and this story was, of course, a big one. Nearly all of our passengers were Chicago people. It was a front-page story, worthy of a seven-column streamer.

He shoved the pile of paper at me.

"I want to get this right off," he panted. "It's press. It has right of way over all traffic. It's to be sent collect."

He produced documentary and other evidence to support the statement that he actually was a reporter. Sweat was streaming down his face, and sweat was streaming down mine. I was trying to push him out of the room. He was trying to push me into my chair. We weren't making much progress

"Look here," I said dramatically. "I am in the midst of sending an S O S. How dare you break in here!"

"The devil you are!" he cried. He snatched the paper from my hands and wrote rapidly on the top sheet: "Radio men sending frantic calls for help!" I glanced bewilderedly over his shoulder at other things he had written. The *North American*, I learned, was slowly being pounded to fragments by a savage sea on the gleaming fangs of a rockbound coast. Women and children were running screaming about the decks. The ship's officers were determinedly setting them an example of coolness and courage. The lifeboats were in readiness. A furious gale was blowing up. The lives of five hundred Chicagoans were in acute peril.

"That's bunk," I snorted. "I won't send that stuff. We aren't being pounded to fragments. Nobody's screaming, and a gale is not blowing up. You better let the skipper see that."

"This is press," he shouted. "If you don't send it, I'll have you prosecuted! There's a law that says—that says——."

"If you don't clear out of here," I stopped him, "I'll have you put in irons. You're interfering with the despatch of a distress signal." I appealed desperately to my partner. "Ken, get him out, will you?"

Kenneth grappled with our natural enemy while I sidled into the chair and started the generator. The reporter broke away from Kenneth and shoved his one-act melodrama beside my sending arm. My hand was already at the key.

"Won't you *please* get it off when you're through with that SOS?" he begged, and there were tears in his eyes.

"I'll have to edit it first," I said angrily.

"If you touch a line of that copy," he shrieked, "I'll have you jugged the minute we hit Chicago! I'll break you! I'll beat you up! I'll have your license taken away! I'll——"

Kenneth pushed him out into the crowd in the social hall, and he was shaking with sobs. I could have brained him. He had cheapened my grand dramatic moment and set every nerve to jumping.

My fingers danced on the key.



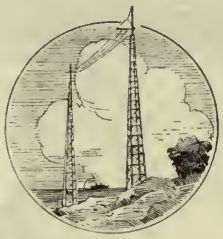
"I AM IN THE MIDST OF SENDING AN S O S. HOW DARE YOU BREAK IN HERE!"

"Z Q P!—S O B!—F O S!" the spark stammered. Then I steadied my hand and ripped off a string of very creditable S O S's.

I threw over the aerial switch to the receiving position. The mournful lazy drawl of a big ore freighter came instantly out of the fog. The name of the ship is forgotten.

"Where are you, O M?" I have always disliked operators who use that solicitous and ingratiating phrase O. M.—"old man." "Are you sinking, O. M? You come in good and loud, O. M. Stick to the ship, O. M."

I coldly informed him that our danger was not yet acute, that we were aground on Little Duck Island and wanted to have some one tow us off.



He replied with a series of irritable "9's". That meant, in those days, "I am being interfered with." I wondered who could be jamming us, and while I wondered the smooth buzz of VBB, the Soo, enlightened me.

"What is your position?" he asked. "Are you in immediate danger?"

I told him to stand by, that he was jamming me, and called the ore boat. VBB came back, insisting on having my position, and a report on the character of our predicament. He additionally wanted to know why I had sent an S O S without first calling him. My nerves were on edge from that tiff with the reporter, and I told him sarcastically that it was a real nice day and I hoped he had enjoyed his smoke. I used profanity freely.

He informed me that the use of profanity was strictly forbidden on aerial circuits and was punishable by a fine and a long term of imprisonment under section 112-A or 233-B or 40-11-X of the International Radio Regulations.

"You should be ashamed of yourself to use such language in a situation as grave as this." Presumably he meant that my chances of getting into Heaven were imperiled. He finished his sermon, and I again addressed my invisible friend on the freighter. Where were they? He reported that they were just rounding McGuipin Point, northbound, which meant that it would take them hours to reach us. That hope was too dim.

I resorted to a few more S O S calls, mingling the distress signals with calls of WHQ, and, when I signed off, WHQ's rasping spark answered. In all of my years of operating, I have never been so relieved to hear a spark.

Complications immediately ensued. The operator at WHQ (there was but one) was then very new to the game. I am glad to say that he later became an expert operator.

His reply to my S O S was bewildering. After wishing me a courteous good morning and making inquiries touching upon the state of my health, he sent me all of the baseball scores for the previous day. He then proceeded to furnish me with long selections from the overnight news. He was not absolutely to blame. For time-saving purposes, we had abbreviated the request for ball scores to the three letters S B S—send ball scores. The similarity between S B S and S O S is noteworthy. Perhaps he was sleepy that morning.

When he was through regaling me with the topics of the day, I slowly and patiently informed him that it was succor and not base ball scores that I had asked for. Here we were, piled up on the rocks, every moment precious, and he was using perfectly good electricity to tell me that Charlie Chaplin had just signed a contract for $1,000 a week. Good God!

For several seconds there was no intelligible response from him—only the stuttering of his spark as his paralyzed hand tried vainly to work the key. In broken Continental he presently told me to stand by a moment while he telephoned the waterfront for a tug. . . .

And so my heroic moment came, was lived, and passed. I telephoned the Captain that a tug was on the way. I read the stirring one-act melodrama with its cast of five hundred screaming women and children supported by the ship's officers who set their cool and courageous example. I tore it up and dropped it into the wastebasket. We were on a popular run; and that story, had it been published in Chicago, would have ruined our passenger business for the rest of the season. The reporter threatened me with sundry revenges, none of which I suffered.

After WHQ had assured me that the tug was on her way, the tension subsided. It was all over. Kenneth and I were once more commercial wireless operators. A wonderful opportunity had been given us to do a land office business.

"Go out and pass the word around," I suggested, "that when news of this reaches Chicago, all their relatives and friends will be



"LOOK! THERE GOES THAT WIRELESS OPERATOR!"

scared green. Drop the hint that it would be a good plan to send radios reassuring them."

It worked very nicely. Kenneth took charge and I went on deck for a breath of fresh air. The fog had evaporated and the warm Michigan sun beat brightly down upon sparkling blue water—and a little island covered with evergreens a few hundred yards ahead. The news had travelled magically over the ship that a tug was on the way from Mackinac Island and that there was nothing now to worry about.

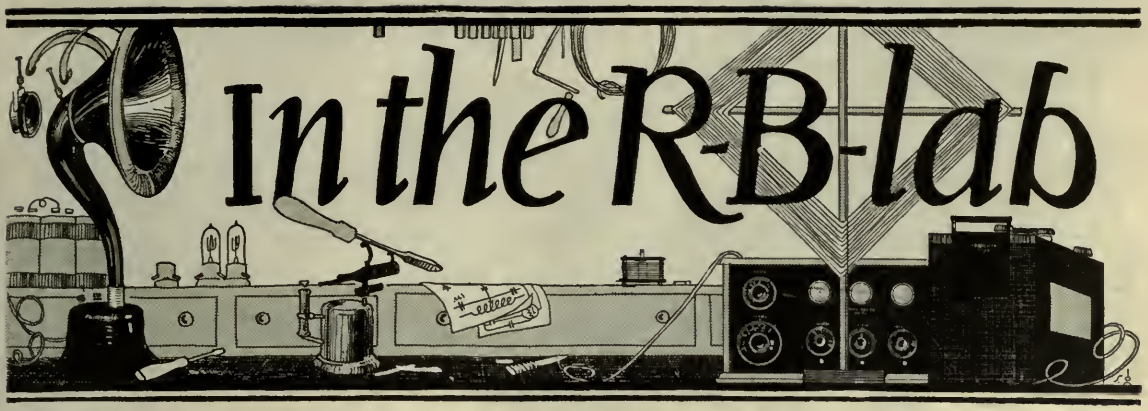
I was proud of myself. Very few wireless operators had gone through this ordeal. I had sent my S O S—a very authentic and dramatic S O S—and was one of that noble company captained by Jack Binns. I glanced up affectionately at the smoke-blackened four-strand antenna and heard a man exclaim:

"Look! There goes that wireless operator!"

And a very pretty girl said, in awed tones, "Gee whiz!"

I pretended not to hear. With head up and shoulders back, I proceeded on my way.

Don't be uncharitable. I was only nineteen.



USING HONEYCOMBS IN THE KNOCK-OUT REFLEX

THE use of different forms of inductances in the RADIO BROADCAST Knock-Out Reflex circuit, such as the straight winding and the spider-web heretofore described in this department, has suggested to many of our readers and to the RADIO BROADCAST laboratory staff, the possibility of using the honeycomb inductance. Our experiments have shown that the experimenter and builder will encounter little difficulty in adopting this form of inductance as the main winding in the reflex circuit.

In reference to the diagram shown on page 327 of the February RADIO BROADCAST, our readers who have been following up the development of this circuit (and they are many) will recall the following specifications for T1 and T2. Using a two and a half inch tube, the secondaries were first wound, sixty turns being used for each transformer. The primaries consisted of fifteen turns for T1 and thirty-five turns for T2, wound over the secondaries, with an insulating layer of paper between.

The simplest way of substituting the honeycomb coils, is using them as the secondaries, winding the primaries over them as usual. Figs. 1 and 2 show a set built up in this manner. Honeycomb or duo-lateral coils, No. 75 were used as the basic inductances. Twenty-five turns of wire were removed from each coil, leaving 50 turns (in the case of the DL, the equivalent). The inductance per turn of the honeycomb coil being greater than that of the layer type inductance, the result is about equal to the usual sixty turns. An eighteen-inch strip of cardboard is wound over each secondary



FIG. 1
Front view of reflex and two step, using honeycomb inductances

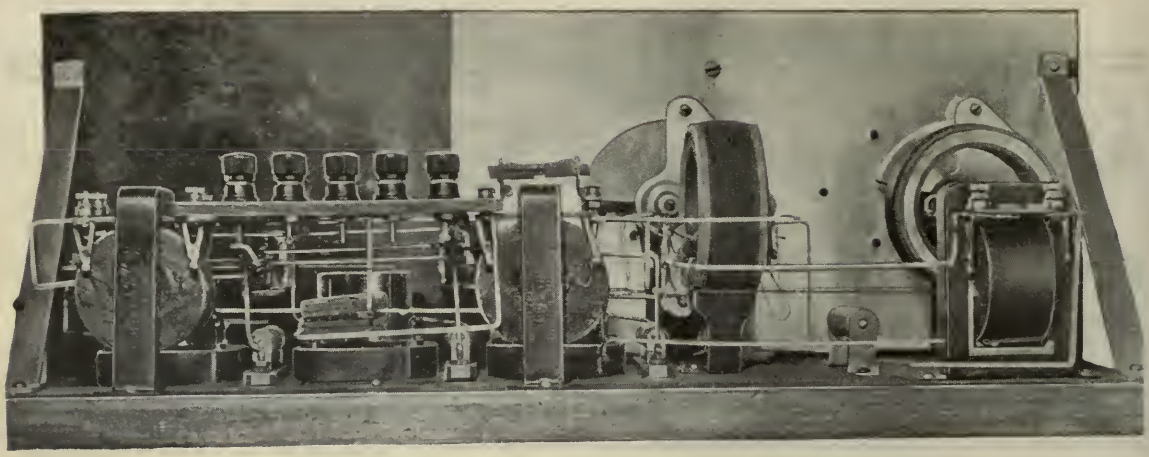


FIG. 2

Rear view of reflex and two step using honeycombs. Amperite resistances have been used in place of rheostats

coil which acts as an insulating layer between the two windings. The cardboard also loosens the coupling, increasing the selectivity of the set.

The 15- and 35-turn primaries are now wound over the secondaries. The 15 turns present no problem whatever. However, due to the narrow winding space, the 35-turn primary must be single bank-wound. Details on bank-winding will be found in the Grid department of the February Radio Broadcast.

The reader may find it easier to make the primary windings, by building up the winding form to the correct size, and slipping it over the secondary when wound.

The completed reflex (Fig. 1) plus two stages audio was constructed in accordance with the instructions outlined in the February Radio Broadcast. The anti-squeal condenser is a .001 mfd. Dubilier Micadon. However, a larger panel, 7″ x 18″ was used. This permits a nicer layout, with less cramping of instruments. The panel working drawing is shown in Fig. 3. The base is $17\frac{1}{4}$″ x $6\frac{3}{4}$″ x $\frac{3}{4}$″. The sockets are spaced three inches between centers, as are the jacks. Thirteen-plate, or .00025 mfd. variable condensers were used, with four-inch dials. Due to the size of the panel, it was thought better to support it by brackets, rather than permit the entire strain to be taken up by the rigid wiring and the screws into the base. The brackets were made from brass strips,

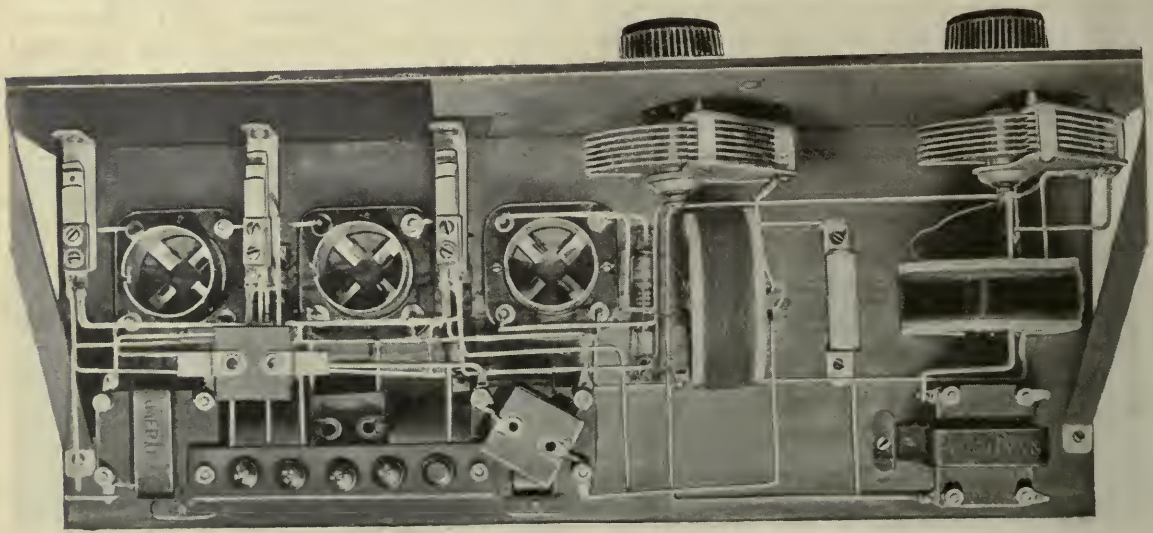


FIG. 2A

eight inches long, one half inch wide and $\frac{3}{32}$ inch thick

A NOVEL BINDING-POST STRIP

WE CALL the attention of the reader-experimenter to the mounting of the binding-post strip which, perhaps, will appeal to him as a novel and efficient method of providing for rear connection in all apparatus having two similar audio transformers. This method eliminates a bit of machine work, conserves space, and raises the binding-posts to a convenient height for soldering connections to the nuts.

BACK-OF-PANEL MOUNTING FOR SPIDER-WEBS

(Data by MR. GEORGE BEANE, JR.)

MANY of our readers have refrained from using spider-web coils, a very efficient form of inductance, due to the fact that mounted in the conventional way on the front of the panel, they are a clumsy and unsightly projection. Mr. Beane, however, has obviated this objection in an ingenious and very efficient manner—efficient because of the possible micrometer adjustment, and the absence of body capacity effect.

The drawing, Fig. 4, explains the idea so clearly that there is little need for a detailed description.

The wood strips to which the coils are fastened, are cut from a cigar box. They are glued to the inductances, and to small blocks at the inside or panel end, to which are screwed small brass hinges obtainable from any hardware store.

The brass rods threaded into the knobs and panel may be any convenient size and thread. The ends against the hinges should be filed round.

If, for the sake of appearance or dials, it is

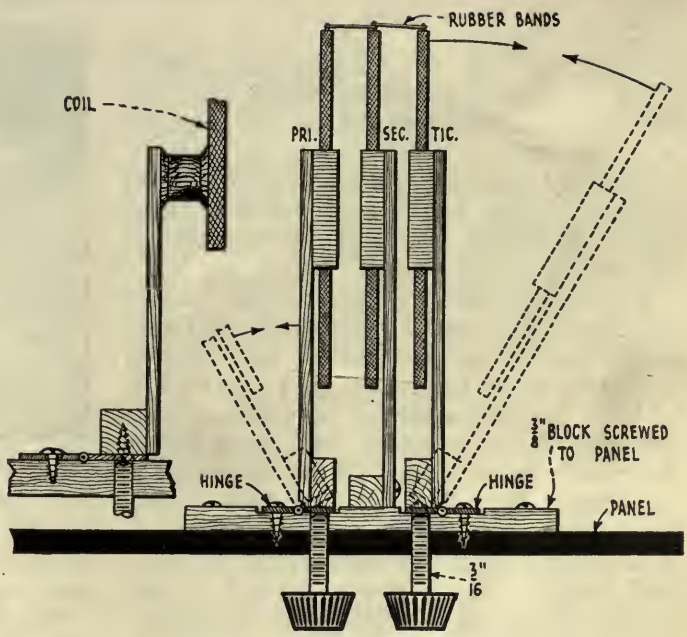


FIG. 4
How to mount your spider-web coils behind the panels

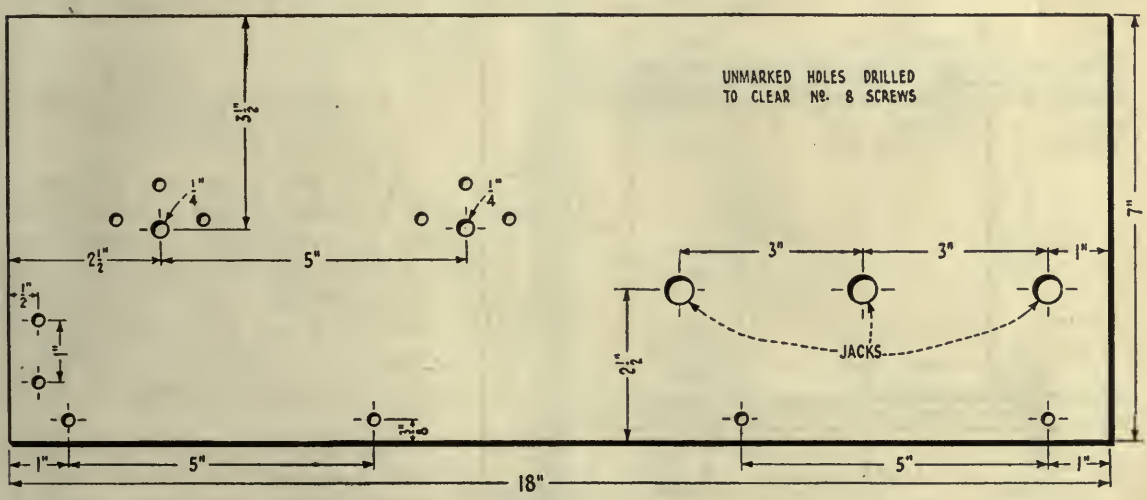


FIG. 3
Panel layout for the reflex and two step

desired to separate the control knobs farther than shown in the main sketch, this is easily done by glueing an empty thread spool between each wooden arm and the coil, as shown in the insert.

Rubber bands supply the tension tending to bring the coils into close inductive relation. By adjusting the bands on different prongs, the tension may be varied.

Honeycomb coils mounted in this manner will appeal to the experimenter using the three-coil tickler regenerative circuit, advocated as a standby set in the March Grid department, and the super-heterodyne, in which a very efficient oscillator-coupler may be made of spider-web inductances. For the latter RADIO BROADCAST suggests a winding form having an odd number of spokes, about nineteen, with a beginning, or minimum diameter of one and a half inches. The pick-up, secondary and tickler coils should be wound with respectively 25, 35, and 50 turns of wire.

AN OPERATING SHELF FOR THE PORTABLE AUTOMOBILE SET

Photo by MR. C. H. BROWN

A CARRYING-CASE arrangement for the ideal portable automobile receiver was described in this department last month. That, however, is only one-half the story. The operation of even the most suitable equipment is marred if it is set up on the running-board,

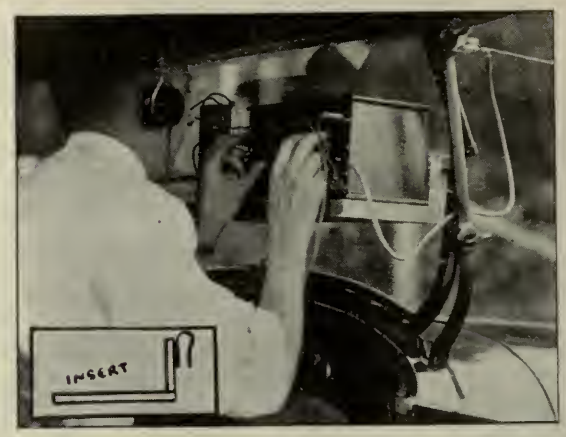


FIG. 5
The windshield shelf for the portable auto-set

the rear seat of the car, or on the ground at the mercy of clumsy and careless picnickers.

Mr. Brown, who designed the carrying-case and equipment, has devised a clever windshield shelf for the operation of his set, from a comfortable seat at the most convenient operating height. The photograph of Fig. 5, with the insert, clearly explains the construction and mounting of the shelf.

The lead-in and beginning of the antenna are also shown in the photograph, and exhibit the neatness and system which adds so materially to the comfort and pleasure of auto radioing. The shelf should be used, of course, only when the car is standing still.

The interested reader will find other details on the portable auto equipment in the April Lab Department.

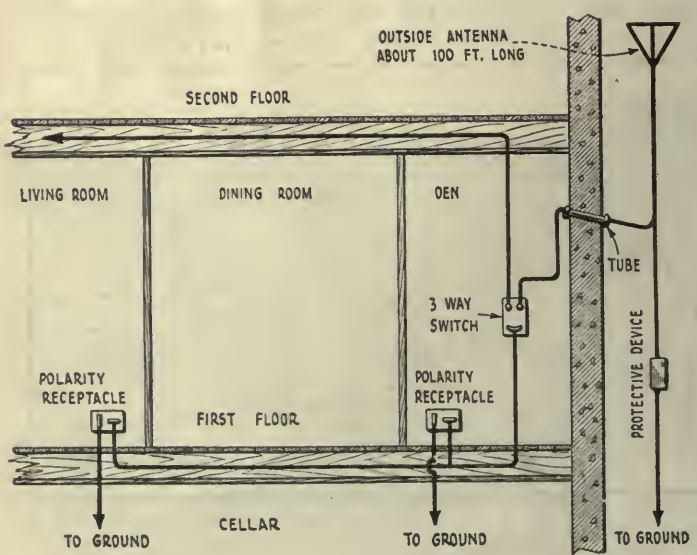


FIG. 6
A tentative plan for wiring your house for radio

WIRE YOUR HOUSE FOR RADIO

ARE you at present building a home, or having plans drawn up for one? If so, instruct your architect when making provisions for electricity, plumbing, heat, etc., not to forget your radio receiver which has become as important a convenience as the less novel facilities.

Fig. 6 indicates the scheme followed out by Mr. George Hofe of South Orange, New Jersey, in which antenna and ground outlets are provided in all rooms where he will

be likely to enjoy reception. In Mr. Hofe's new home, he will plug in his radio set as you, perhaps, now do your electric toaster or vaccum cleaner.

Polarity receptacles and plugs are used. This insures the correct line up of antenna and ground without experimental plugging-in. A three way switch, close to the entrance of the lead-in, makes it possible to cut off all indoor leads if at any time, it should be deemed desirable.

Individual grounds are provided at each polarity receptacle.

The architect, in designing your particular home, might go even farther, and, taking into consideration surroundings, trees, etc., and, perhaps, provide antenna mooring in the way of an artistic mast or tower.

A STANDBY RADIO FREQUENCY SET

MANY of our readers, perhaps not desiring to hazard some of the newer radio frequency developments, have requested a conventional radio frequency circuit, which may be depended upon to work without excessive experimentation. And there are many rather hasty enthusiasts who would benefit from building such a set before venturing on the more precarious Grimes arrangements and the super-heterodyne.

Complete descriptive drawings of such a layout are shown in Figs. 7 and 8. The parts are all standard, and we suggest, as R. F. transformers, such reliable makes as the Acme or Murad. A 7″ x 24″ panel will be about right.

A square solenoid or box loop is suggested, four feet on a side. Nine turns of wire, spaced one half inch, will cover the entire broadcasting range. If it is desired to use an antenna, with greatly increased range and volume, a tuning coil, such as described by Mr. Sheehy in the Laboratory Department for March, may be wound.

This combination has enabled James W. Brennan, of Beverly, Mass. to build up a very creditable DX record.

BUILDING YOUR OWN LAB

FIG. 9 shows how to use dividers, RADIO BROADCAST's suggestion for this month's addition to the growing amateur laboratory. Seven inch dividers is the most common size, and should cost in the neighborhood of seventy-five cents. They are as indispensable to fine panel layout, as is the compass in drawing.

In combination with the ordinary one foot rule, many otherwise difficult panel maneuvers become as easy as drawing a straight line. No templates are required for the mounting of variable condensers, rheostats, etc. The correct distances are measured with the ruler, to one thirty-second of an inch if necessary, and the dividers are spread to span this exactly.

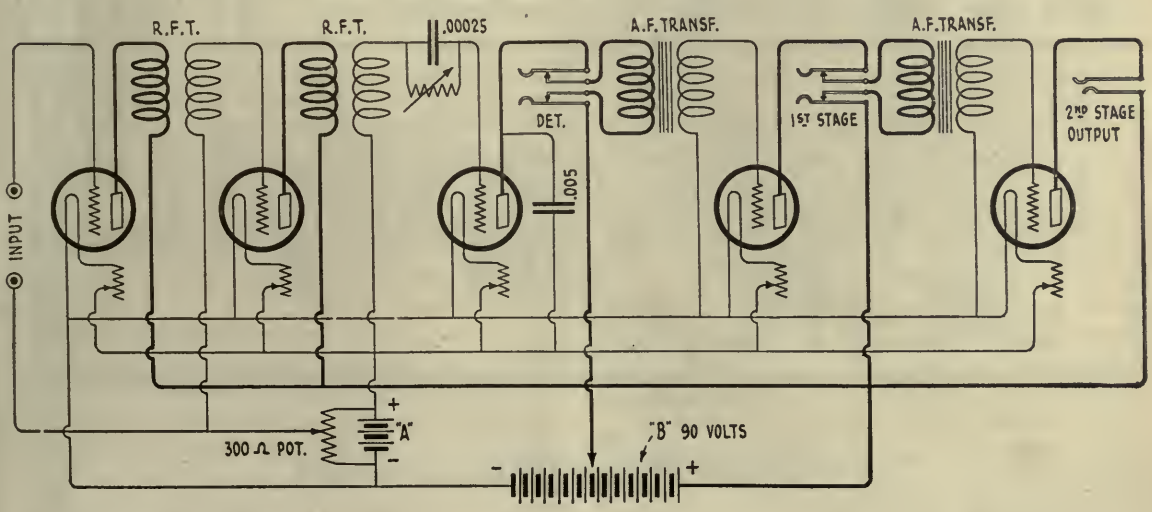


FIG. 7
The circuit for a standard transformer coupled R. F. set



FIG. 9
How to use dividers

The intelligent use of dividers will cut the time of preparing a panel for drilling by half.

A NOVEL USE FOR DIVIDERS

THE R. B. LAB has found the dividers a most handy tool to facilitate the soldering of connections to small condensers of the Dubilier Micadon type. The points of the dividers are placed through the eyelets of the condenser, and the spring released. The condenser is thus held firmly, and may be moved about and adjusted for soldering in places inaccessible to fingers.

One way to eliminate undesirable radiation from your single circuit regenerator is to use Mr. Bouck's "Reflexit" (see page 7). Later numbers of this magazine will contain, in the Lab Department, instructions on how to convert other types of oscillating receivers to unoffending circuits.

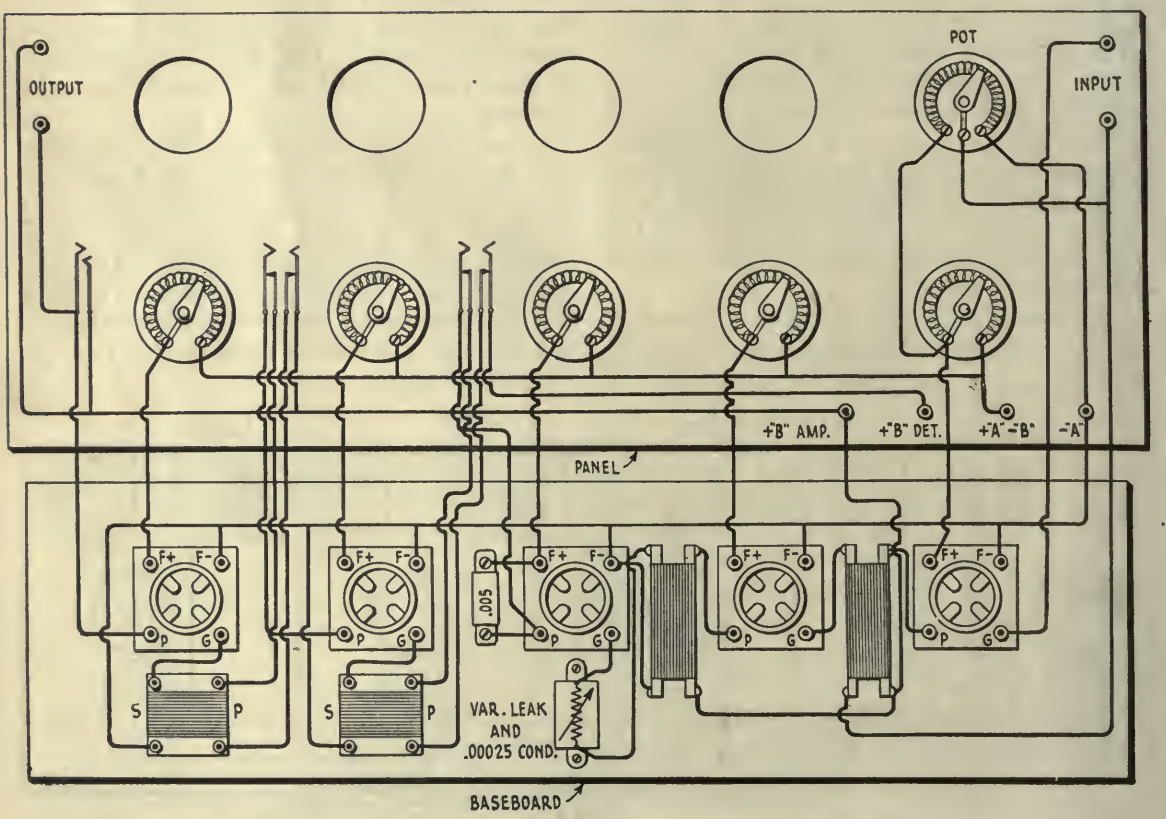


FIG. 8
The panel layout and base, showing the placing of instruments

How to Build a Resistance-Coupled Amplifier

An Inexpensive Three-Stage Amplifier Unit Which Will Give Distortionless Amplification

By G. Y. ALLEN
Westinghouse Electric & Manufacturing Company

THE three-electrode vacuum tube is in itself a very good amplifier of electric voltages. Tubes have been constructed whose plate-to-filament voltages range as much as thirty to forty times the grid-to-filament voltage variations. Furthermore, within certain limits, this voltage amplification is substantially a linear relation.

Where power must be absorbed from the output side of a tube, however, high amplification factors, with their accompanying high plate impedances, require high B battery voltages in order to maintain the linear relationship between the input and output sides. These considerations limit the design of practical tubes to those having an amplification constant of from 6 to 8 and plate impedances ranging around 20,000 ohms. Such tubes work very well as amplifiers using from 45 to 150 volts B battery.

THE PLACE OF THE TRANSFORMER IN AUDIO AMPLIFICATION

NOW it is a well defined law in electrical engineering that the most efficient conditions are met in any device supplying electric power when the impedance drop across the power consuming device is the same as the impedance drop across the device supplying the power. When using two or more tubes in cascade amplification, the grid circuit of any tube is the load consuming device for the plate circuit of the preceding tube. But the grid impedance of a vacuum tube as it is used in an amplifier is very much greater than the plate impedance. Thus, if two or more tubes are connected directly in cascade without intervening apparatus, great amplification will not result. This condition has made very popular the practice of using step up transformers between the plate circuit of one tube and the grid circuit of the next tube, which transformer presents to both the grid and plate circuits impedances permitting the tubes to be worked at their most efficient point. Furthermore the inherent voltage amplification factor of the tube is multiplied by the step up ratio of the transformer resulting in greatly increased amplification per stage.

Were amplification all that were to be considered, transformer-coupled amplification would be ideal. With the advent of good broadcast transmission, however, and with the production of good loud speakers, the broadcast listener's standard of quality has crept steadily upward. A transformer, being essentially an inductance cannot transform all voice frequencies with exactly the same amplification no matter how carefully designed, with the result that *all amplifying transformers suppress the lower and favor the higher frequencies*. True, great improvements have been made in transformer design, but the fact remains that fundamentally the transformer cannot ever give distortionless amplification.

WHEN RESISTANCE-COUPLED AMPLIFIERS ARE DESIRABLE

FOR those who demand quality at all cost, the resistance-coupled amplifier is unquestionably the most desirable. The amplification per stage is not as great as with transformers, but a nearly absolute linear relation holds between input and output.

A curve showing amplification plotted against frequency for a transformer as compared with the linear relation existing in a resistor is shown in Fig. 2. It will be noted that the amplification of a transformer, and the curve is shown for one of the best transformers on the market, falls off very rapidly below 200 cycles. In other words, all notes below middle C on the piano are reproduced much below their normal amplitude with resulting loss in quality. On the other hand (Fig. 3), the amplifier using resistance-coupling shows nearly constant amplification throughout the range of frequencies plotted, although some-

what less in amplitude. To compensate for the reduction in amplitude, it is generally customary to use one more stage than would be used in a transformer-coupled amplifier.

In designing a resistance-coupled amplifier, the theory indicates that the greater the values of the coupling resistance, the greater the amplification per stage. That statement can be proved this way:

Let E_g = AC grid voltage of first tube.
E_p = AC plate voltage of first tube.
R_p = AC plate resistance of first tube.
I_p = AC plate current.
μ = voltage amplification constant of tubes.
R_1 = resistance of coupling resistor.

From fig. 2 it will be evident from Ohm's law that

$$E_p = I_p (R_p + R_1)$$

$$\mu E_g = I_p (R_p + R_1)$$

$$\therefore I_p = \frac{\mu E_g}{R_p + R_1}$$

Also $E^1_g = I_p R_1$

and $E^1_g = \frac{\mu E_g R_1}{R_p + R_1}$ (Assuming negligible impedance in coupling condenser

It is evident, therefore, that the greater the coupling resistance R_1, the greater will be the voltage applied to the grid on the second tube for any potential applied to the grid of the first tube, and therefore the greater will be the amplification.

However, it is plainly evident that the coupling resistor being in series with the plate battery will reduce the part of the plate battery voltage applicable to the plate. There is an upper limit, therefore of coupling resistance, beyond which it is not advisable to go, on account of the large amount of B battery required. Fig. 4 shows the detailed circuit where R are the coupling resistances.

WHAT YOU NEED

THE photograph Fig. 1 shows very clearly the arrangement of the parts on the base board. That is the reason no base layout is

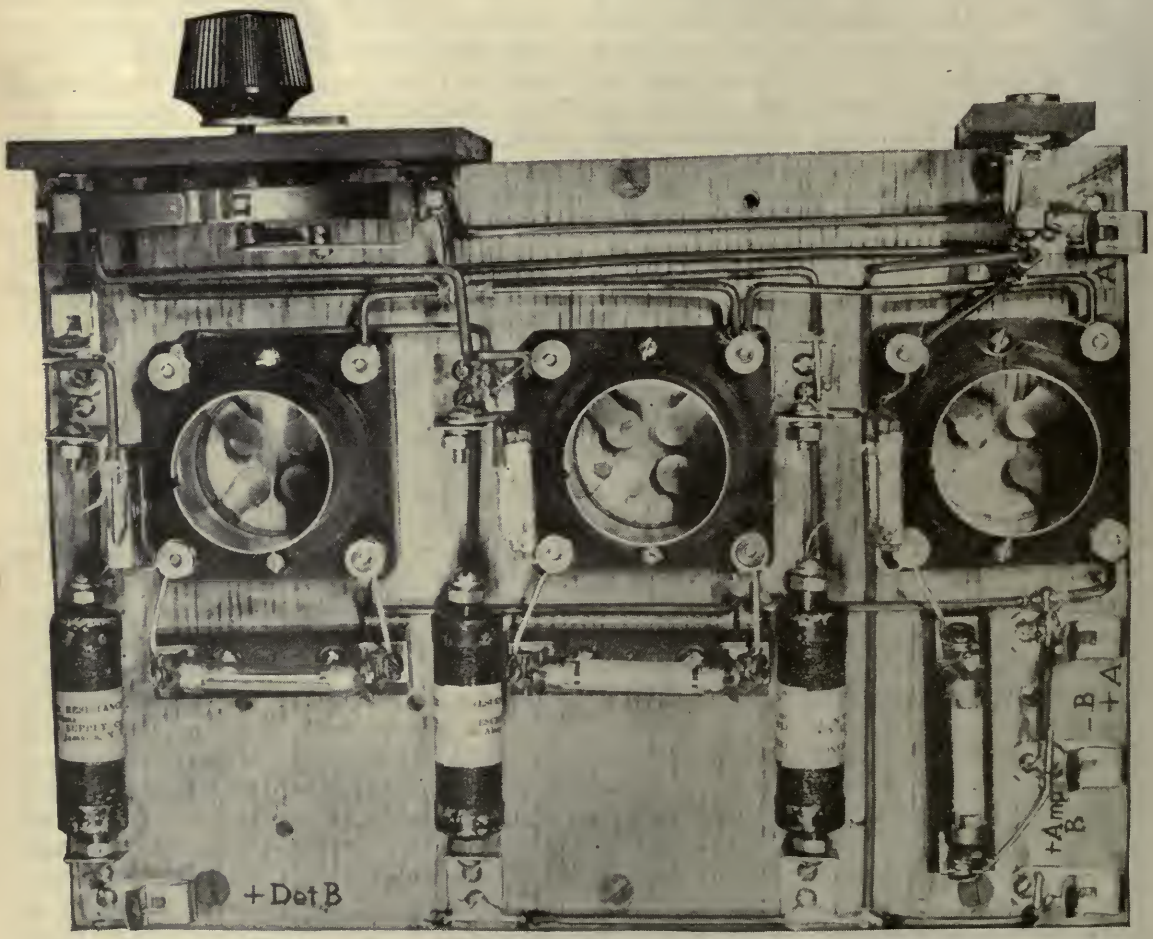


FIG. 1

The complete unit mounted on a base. All wiring is protected by spaghetti tubing. The construction is not at all difficult and the cost of parts quite low. This amplifier gives perfect quality

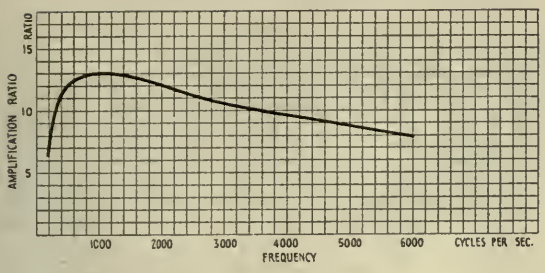


FIG. 2

Shows the relation at various frequencies between the ratio of amplification to the frequency supplied to a transformer

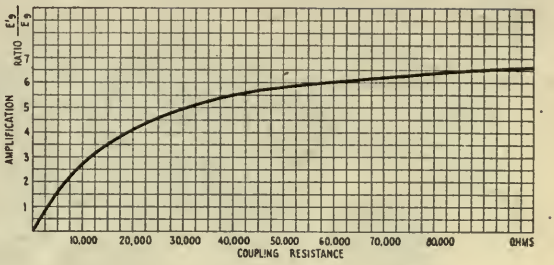


FIG. 3

How the amplification varies in the resistance-coupled amplifier with an increase in value of the coupling resistor. Nothing is gained by using resistors of more than 100,000 ohms

given. The list of the parts required is given below.

		APPROXIMATE PRICE EACH
A^1, A^2, A^3,	Ward Leonard Resistance Tubes, 20,000 ohms resistance	$2.00
	or Lavite Resistors 50,000 or 100,000 ohms manufactured by Crescent Radio Supply Co.	1.50
B^1, B^2, B^3,	Any standard type of socket	.75
C^1, C^2, C^3,	Radio Corporation type UX 543 grid leak mounting	.50
	Grid leaks	.50
D	Carter Rheostat, 6 ohms	1.50
E	Carter pin type jacks	.25
F^1, F^2, F^3,	Dubilier Micadons capacity 0.0025 mfd.	.40
G^1, G^2, G^3,	Fahnestock Connector Posts	.10
	(or similar standard parts can be bought, where the builder prefers one product over another).	——

The rheostat and pin jacks are mounted on hard rubber, bakelite, or micarta panels which are attached to the side of the board. All of the other parts are mounted on the board.

THIS AMPLIFIER IS SIMPLE TO CONSTRUCT

THE amplifier described herein was designed at the suggestion of the editor of RADIO BROADCAST. It can be manufactured from parts that are readily obtainable and it is felt that the constructor will be well repaid for his efforts.

The particular amplifier described was laid out with simplicity as the keynote. Its appearance is more that of a schematic diagram than an assembled set, but the layout is arranged for taking either Ward Leonard or Lavite resistors. These tubes are supported by small brass L pieces as shown in photographs and the two detailed drawings. It was felt that in this way the basic design could be best described and that those desiring to incorporate a resistance-coupled amplifier in a cabinet could easily modify the arrangement of the parts to suit their conditions.

Fig. 3 shows how the amplification varies with the increase of the coupling resistor. It will be noted that nothing is gained by going above 100,000 ohms and that the amplifications will be about 50 per cent. more using 100,000 ohms over and above that obtained using 20,000 ohms.

The complete wiring diagram is shown in Fig. 5. If the parts are assembled as shown in the photograph, no difficulty should be found in following the wiring diagram. It is advisable to use No. 14 tinned copper bus wire covered with spaghetti, both for the sake of neatness and efficiency in operation.

The connections to the Dubilier micadons

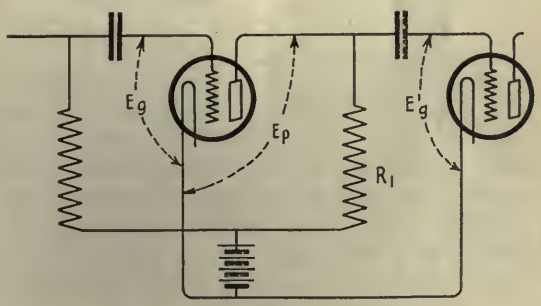


FIG. 4

How the coupling resistor is connected. The drawing shows the circuits involved in the impedance balancing between input and output of tubes in cascade for audio-frequency amplification

are shown soldered in the photograph. A half inch $\frac{6}{32}$ machine screw is inserted with its head supporting the tube and a nut run up for the purpose of clamping the flexible wire terminal of the resistor and grasping the screw tightly. The sketch shown in Fig. 6 will make this construction clear. Fig. 7

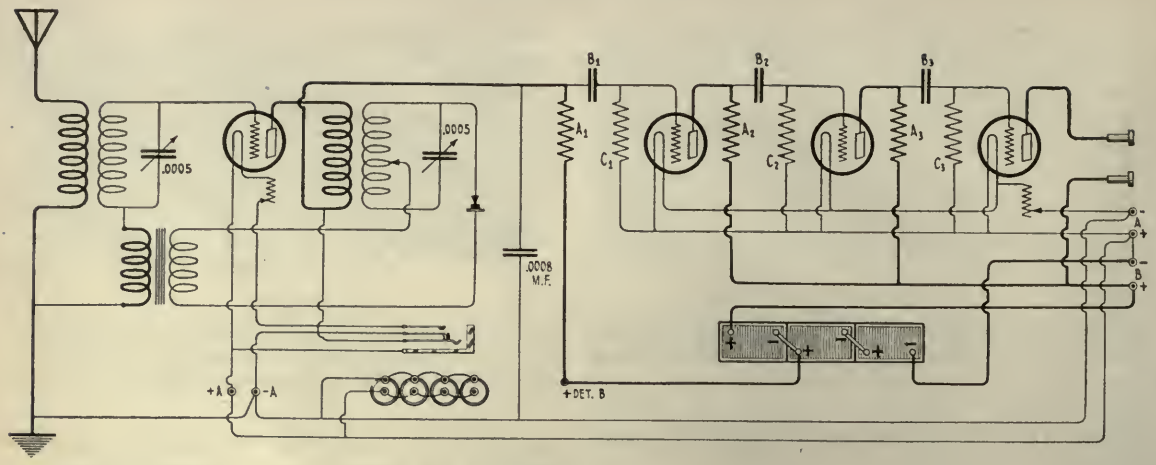


FIG. 5

Complete wiring diagram of the 3-stage resistance coupled audio amplifier connected to the RADIO BROADCAST "Knock-Out One-Tube Reflex" set

shows how to connect the Lavite resistor. Considerable skill is necessary to do this successfully without damaging the condenser and unless the constructor has had considerable experience with the soldering iron, it will be advisable to clamp the wires tightly to the condensers by inserting $\frac{1}{2}$ inch $\frac{6}{32}$ machine screws into the eyelets of the condensers.

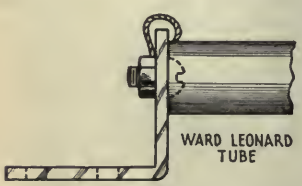


FIG. 6

How the lead from the Ward-Leonard resistance tube is fastened to the connector

B BATTERY VOLTAGE

ON ACCOUNT of the fact that the 100,000 ohm resistors are in series with vacuum tube plates, in the case of the Lavite tubes, approximately 20 per cent. of the available B battery voltage drop will take place across the resistor. Thus, the vacuum tube will get but 80 per cent. of the voltage of the connected B battery. For most efficient results, therefore, at least twice the B battery voltage normally used should be employed with the resistance coupled amplifier. Forty-five to ninety volts should be connected to the detector tube and from ninety to one hundred eighty for the amplifier tubes for loud speaker operation.

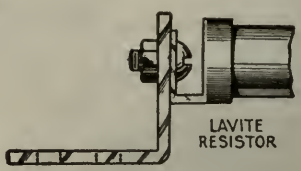


FIG. 7

How the Lavite resistor is connected

If moulded tube sockets are used manufactured from some of the compounds that are not as good insulators as others, it may be found that on weak signals, the grid leaks are apparently unnecessary. On strong signals, however, the tubes will "block" unless the grid leaks are placed in the circuit.

In the June RADIO BROADCAST *will appear a complete how-to-make-it article by Zeh Bouck showing how to incorporate the 3-stage resistance coupled amplifier with the "Knock-out One-Tube Reflex"*

Man-Made Static

Definite Instructions on How to Eliminate Outside Local Interference with Radio Receivers

By A. F. Van DYCK
Engineer, Technical Division, Radio Corporation of America

PART II

IN THE preceding article a general discussion of "man-made static," or inductive interference, was given, including a list of such causes of this interference as are commonly reported. We will now take up these causes individually, to show how each originates and how each can be remedied.

Lightning arrestors used on power lines are not troublesome ordinarily, because they produce interference only when voltage is discharging through them, which is seldom, or when they are being "charged," which requires only a few seconds each day and is usually carried out at times other than broadcasting hours.

Arc lights are frequent and serious offenders. Arc light interference is very difficult, if not impossible, to eliminate. As somebody has said, the best way to eliminate this interference is to move one's home to a neighborhood where none of these lights exist. Arc light interference is particularly troublesome because the light itself has somewhat of the nature of a spark, which sets up interference as explained in the previous article. Consequently, it is often the case that arc light interference can be eliminated only with great difficulty and very special means. Very often, however, the major part of the trouble comes from faulty insulation of the power line, or the lamp itself, because the voltage used in arc light systems is quite high and the insulation must be very good. A number of cases of arc light interference have been cured by replacing defective insulators, etc. Therefore in studying a case of arc light interference, one should make certain that faulty insulation of the line is not responsible, and that the lamp burns steadily without flickering. When this sort of power line is "leaky," the noise produced in radio receivers sounds very much like the "rolling" of a snare drum.

The Dealer and the Radio Owner

Are asked and ask—often, how is my local electrical interference to be eliminated? Here are suggestions which will show the dealer how he can help his customers get greater satisfaction from their sets, and the owner of a receiver to know where the trouble comes from, when there is trouble.

Mr. Van Dyck has a simple remedy for every interference ill the broadcast listener will encounter.—The Editor.

Transformers on power lines are not troublesome very often, because they are inherently simple in design and construction, and are ruggedly and reliably built. A number of cases of loose connections on the terminal blocks of such transformers have been reported, however. That difficulty is simple to remedy.

TELEPHONE LINES AND RINGERS

TELEPHONE and telegraph lines do not often cause trouble because of faulty insulation, because they do not carry much voltage so that even if the insulation of the line becomes faulty no sparking is produced. However, if a telephone line or cable is so located that near-by power circuits induce considerable voltage in it, faulty insulation of the telephone line permits sparking of the voltage it receives from the power line. In one case of this sort, a telephone cable was located underground in a street which passed under an electric railroad. The heavy ground currents from the railroad set up electrolysis on the lead-sheathed telephone cable and finally ate through the lead and into the telephone wires. This action was possible whenever the cable became wet, as it did after every rainfall. For nearly one year, radio receivers in this neighborhood experienced bad inductive interference after every rain. The source was not found until the cable had been so badly damaged as to interrupt the telephone service, after which it was repaired by the telephone company, which of course eliminated the radio interference.

It was said above that telephone and telegraph lines do not often cause trouble because of faulty insulation. They do cause trouble often, however, because of the kind of currents used. It is reported very frequently that telephone ringing machines cause interference. Usually the ringers which inter-

fere are the hand operated type, which is common in small communities. This interference is readily recognized by its intermittent nature, and the use of call signals. When the ringing generator is motor driven and causes interference it is of course continuous, and not intermittent as is the case with hand operated ringing generators. It is particularly severe in the immediate neighborhood of the telephone exchange. Interference from telephone ringers can be eliminated usually, and always greatly reduced, by the use of a proper filter between the ringing keys and the machine. Such a device can be installed by any telephone electrician, and usually is arranged as shown in Fig. 1. This arrangement is effective in preventing interference, although it does not affect the low frequency currents used for ringing, because it prevents the high frequency currents, which also are generated by the ringing machine, from going out on the lines.

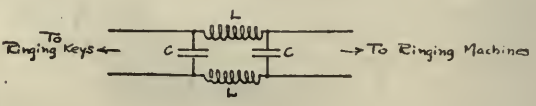


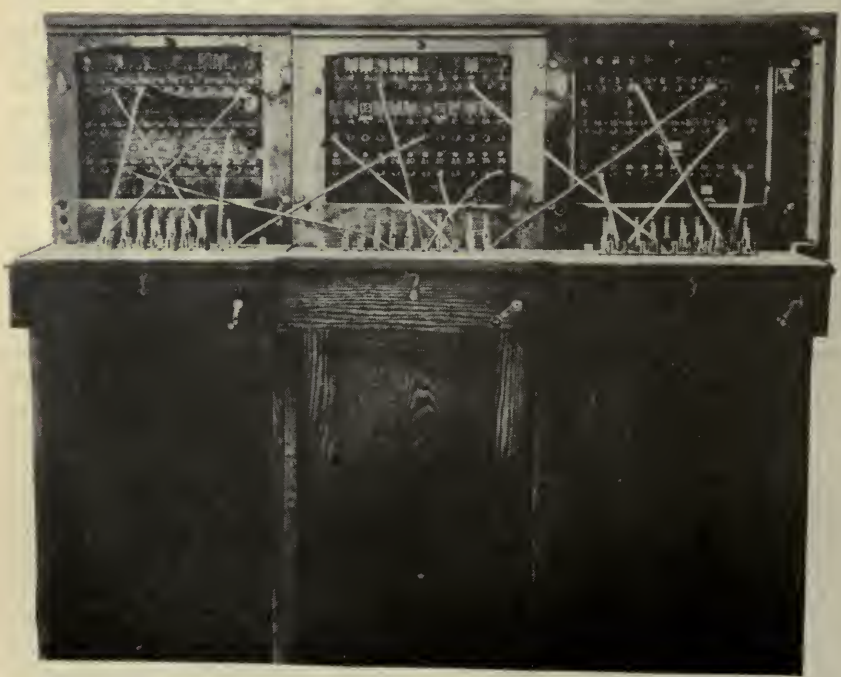
FIG. 1

How to connect a filter to prevent interference from telephone ringing systems. L is a " etard" coil (# 5AA Western Electric, or its equivalent) and C is a condenser of 8 mfd.

POWER COMPANIES COÖPERATE

IT IS interesting, and encouraging, to know that power companies are becoming interested in the interference problem to an increasing extent. Some companies are training men to locate faults causing radio interference. One company in the Middle West, has for several months past had a radio crew which is on duty nightly, and which responds to interference calls from any part of the city. This crew is equipped with a direction finding radio set mounted in an automobile, with which it is usually able to locate sources of interference quickly. A night spent on the job with this crew is an exciting experience, although if the night is one with the thermometer shrinking out of sight, the excitement is not unmixed with tingles of another sort.

Those power companies which are most progressive in keeping their lines free from interference radiation are those which have realized that the wide-spread use of radio has helped their business materially, and as a result, they are doing what they can to help radio, knowing that the better radio reception conditions are in the territory they serve, the greater the electrical energy they are likely to sell. It has been observed that a neighborhood consumes markedly more electrical energy as soon as radio receivers become common in it. This is readily explained by the fact that the members of households equipped with radio sets stay more at home in the evenings, and also stay up later. There is many a home where the "midnight electricity" has burned nearly every night since radio entered in. Likewise the use of power to charge storage batteries has been a considerable item. Since this extra power is used at a time when other demands are light, it is a most desirable sort of load, and power companies which have appreciated this new factor are actively coöperating in reducing interference with radio reception.



A SMALL TELEPHONE EXCHANGE

Showing the hand ringers which may intermittently set up interference to radio listeners

ELECTRIC PRECIPITATORS

MANY cases of interference have been caused by an electric device, the precipitator, although these installations are not very common. The electric precipitator is used to prevent smoke or noxious fumes or material from leaving chimneys. It operates by establishing a highly charged electric field inside the chimney, of such

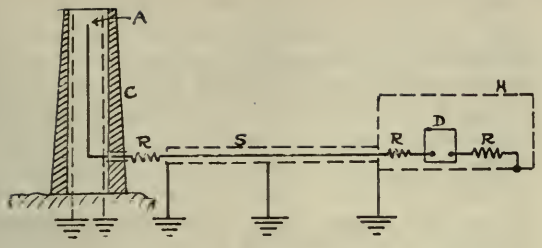


FIG. 2

How to eliminate interference from an electric precipitator. A, grounded wire which must extend above the central high tension wires; C, the chimney; R, resistances of 2,000 to 5,000 ohms; S, screen around high tension wires; D, rectifier; H, screen around rectifier, transformer, etc.

a nature and direction that particles going up the chimney are charged and driven against the walls where they stick. After a sufficient deposit has been created, it is removed in some suitable manner.

Precipitators have been used in concrete manufacturing plants, chemical plants, incinerating plants, as well as in ordinary factories where coal smoke created a nuisance. In many cases, the precipitator does valuable work in preventing actual damage to surrounding vegetable and animal life.

Precipitators cause interference for the reason that the high voltage used in their operation is obtained from an electrical device called a rectifier, which may generate high frequency alternating currents as well as the direct current which the precipitators need. The high frequency currents are not useful to the precipitator and may be eliminated without affecting its operation. If the design of the precipitator is so arranged that the distance between the rectifier and the chimney is only a few feet, there is usually no trouble. But if the rectifier is separated from the chimney, the wire which joins them forms a good antenna which will radiate waves. This wire also runs up the chimney, but here it usually can not radiate, because there are other wires or metal surfaces surrounding it and connected to the ground. Radiation from the precipitator system and consequent interference with radio reception can be eliminated by placing a grounded mesh screen around the rectifier and the wire to the chimney. If screening of the various parts is impracticable, damping resistances can be inserted which will prevent the high frequency currents from getting to parts of the circuit from which they can radiate seriously. A little experimentation may be necessary, but it should always be possible to make interference from a precipitator negligible at distances greater than a few score yards from the installation. The diagram given (Fig. 2) shows proper connections for an installation of the worst sort, that is, one where the rectifier and the chimney are separated by a considerable distance.

Electric signs of the flashing kind are not troublesome often, partly because they are not common in residential neighborhoods. Interference from this source can be minimized by keeping the switching contacts in good condition and by connecting resistances of the proper size across the contacts. It can be eliminated entirely by putting choke coils in *every* wire going into the switch, including the main power lines. The choke coils must be capable of carrying the current which will pass through them.

HOUSEHOLD APPLIANCES

MOST household appliances are used only intermittently and for short periods. Interference is often experienced in the same house where the appliances are used, but rarely extends farther, if the appliances are in good condition. Devices involving small motors may need to have the motor brushes and commutators cleaned and cared for. Bad contacts in plugs, sockets, switches, etc., are much more apt to give trouble, particularly in flatirons and other heating devices. In heating appliances the current used is relatively large and the service conditions are more severe due to the heat, so that bad contacts are quite likely to develop.

Interference from door bells and elevator calls can be prevented by connecting a large condenser (2 mfd. capacitance) across the device, or by connect-



HIGH TENSION WIRES

Like these cause frequent disturbance to the near by broadcast listener. Radio antennas at right angles to power wires such as these will pick up the least interference

ing a "honeycomb" coil in series with each wire to it. In some cases, both condenser and coils may be necessary. In every case, the condenser or coil must be placed as close to the bell as possible.

Violet ray outfits are serious disturbers of the peace, particularly since it seems to be popular practice among owners to use them just before going to their beds, which is about the middle of the evening in the schedule of the radio fan. Neighborly requests to utilize the machines in non-broadcasting hours are usually effective. If not, the interference can be stopped by inserting choke coils in the power lines to the machine, one in each line. These may be made by winding three layers of No. 18 bell wire on a three inch tube with winding about six inches long. Then two condensers each having 1 mfd. capacity should be connected across the terminals of the machine and the mid-point connection grounded. This has been effective in several installations.

It should be understood that the method of inserting choke coils in the lines, which has been mentioned several times, requires the use of parts properly approved by the Board of Fire Underwriters as with all devices connected to the power lines in a house.

HOW TO FIX MISCELLANEOUS INTERFERENCE

AMONG the miscellaneous interference sources listed in last month's article, the X-ray machine is the worst. They are not very common, however. These machines radiate quite powerfully, and the radiations are sent out chiefly from the power lines from which is taken the power to run them. To prevent interference from X-ray machines, the method described for violet ray machines should be used. The size of wire used in the choke coils must be quite large enough to carry the current which the X-ray machine draws. Also additional condensers of the same size and method of connection may be placed across the power lines where they enter the two choke coils. If it is desired to have a radio receiver close to an X-ray outfit, it will also be necessary, probably to enclose the X-ray apparatus in a grounded metal cabinet.

Gas engines with electric ignition often give interference. The farm lighting plant is a common example of this. Part of this interference comes from the high tension leads and sparks at the spark plugs, and part comes from the contactor in the low voltage circuit. The radiation is usually at very short waves and is highly damped in character. Both of these factors make it difficult for the ordinary receiver to tune out the interference. The remedy is to replace *all* the ignition wiring with lead covered cable, the lead coverings being well grounded at frequent intervals and particularly at its ends. Of course if lead covered cable is used for the high tension wires, the insulation between the lead and the wire must be very good to stand the voltage. Sometimes heavy rubber insulated cable, wrapped with tin foil which is grounded, can be used. Occasionally it will be necessary to insert choke coils in the spark plug leads, right at the spark plugs. Such coils may be made with about 200 turns of No. 36 double silk covered wire wound on a two-inch tube. These coils may have to be enclosed in a grounded metal box.

The ignition system of automobiles radiates short waves in the same manner as that of the stationary gas engines described above. These can be heard only a short distance ordinarily, such as when the automobile is almost directly under an outdoor antenna.

Every broadcast listener should assist as much as he can, to locate and eliminate unnecessary inductive interference. Every listener should realize that broadcasting is only one of the many electric applications upon which we have come to depend. It is also the latest, and as such it must do its share in accommodating itself to the others. It is quite unreasonable to expect that every power line, every motor, every electric device, shall operate at all times so as not to produce interference with the weak radio voltage received from some relatively small station hundreds of miles away. The broadcast listener must do his share by working with signals which are strong enough to dominate a reasonable strength of waves from other sources. The romance of reaching out to great distances of reception is apt to cause any one to forget that motors and other things must continue to operate. As broadcasting continues to develop, it will be found that several features will be improved, including better ratios of signal strength to strength of unavoidable interferences. It may be necessary once in a while to have an "Inductive Interference Clean-up Week," but we can reasonably expect that interference troubles will decrease to a satisfactory degree, as radio takes, and is accorded, its proper place among the electrical services of mankind.



Regeneration Without the Squeal

By BOWDEN WASHINGTON
Chief Engineer, Cutting and Washington Radio Corporation

THERE is some reason for each really new radio circuit, though many so-called new circuits seem to be brought out largely because some dealer is over-stocked in variometers, variable grid leaks or some other part, and therefore has his "radio expert" design a marvelous new circuit to help him get rid of them.

WHAT CAUSES RECEIVING DIFFICULTIES

IN RADIO receiving we are subject to four major kinds of interference. First, that from spark transmitters aboard ship. This is only severe along our seaboard and will be rapidly cured by the replacement of the obsolete spark type with modern continuous wave or tonic train (I. C. W.) tube sets.

Second, we have interference from near by broadcasting stations. This probably can be solved with sufficiently selective receivers. The writer has a receiver at his house (this receiver by the way is not a super-heterodyne) which is only three blocks from WLAG, a typical 500-watt Western Electric Station, tuned to 417 meters, and has no difficulty whatever in receiving distant broadcast from 380 meters down and 441 meters up, with absolutely no interference. This same receiver at a distance of fifteen miles from WLAG experiences no difficulty on distant stations at 411 while WLAG is operating on 417, so I think it can be said that this interference is no longer a fundamental difficulty.

Third, we have static, which, of course, can be very bad, but static is intermittent, and troubles us very little in the winter months and probably eventually will be largely eliminated.

Fourth, and worst, we have interference from transmitting or radiating receivers. The reason I say "worst" is that probably there is no solution for this malignant interference but the discontinuance of the use of this type.

As far back as 1922, this magazine raised a protest against the use of "squealing" receivers. And since that time, there have been a number of progressive and broad-minded manufacturers who have done their best to develop efficient, sensitive receivers to take the place of the ether agitators commonly called "bloopers." Dr. Bowden Washington reviews very ably, we think, the entire complicated situation and describes a new receiver his company has designed. This visible cooperation of manufacturers shows much potential good for the industry.

—THE EDITOR.

WHAT HAPPENS—WHEN YOU LISTEN WHILE A RADIATING RECEIVER IS "ON"

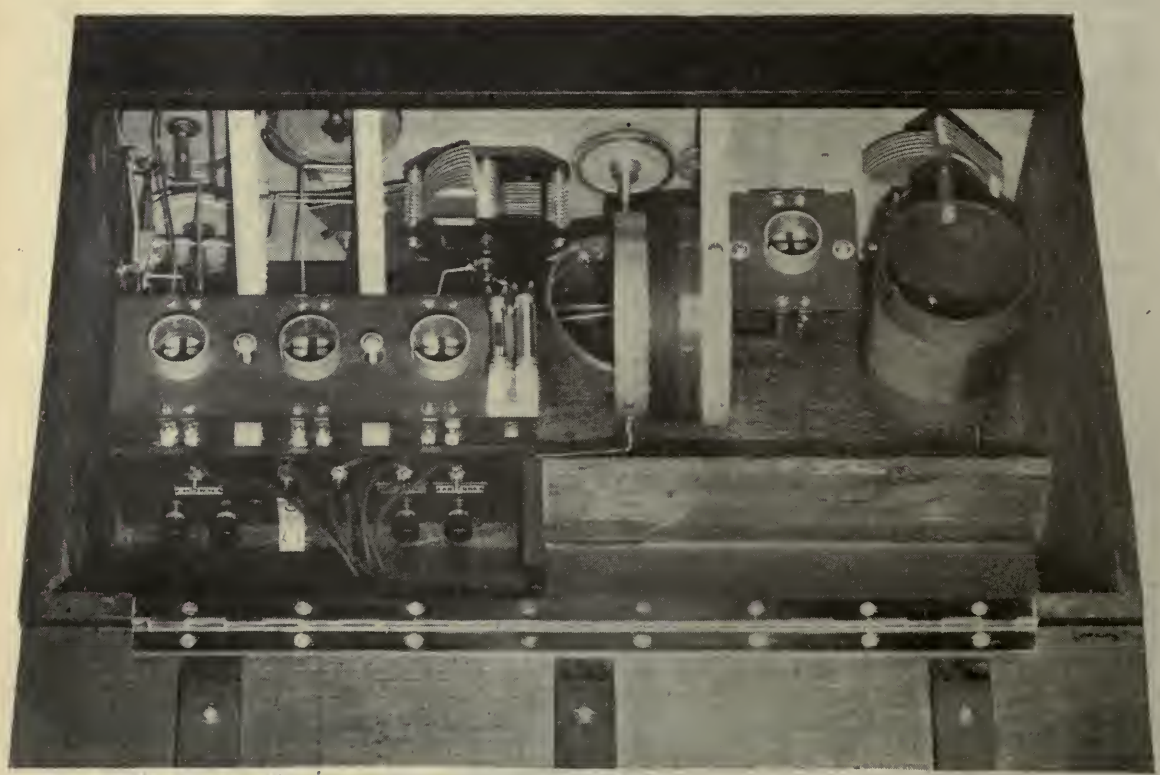
IT IS impossible to evolve a principle which will eliminate noises received from single-circuit regenerative and similar offending receivers, because the noises caused by these receivers are identical electrically to the noises emanating from the broadcasting station which you are trying to listen to when disturbed by them. Everyone is familiar probably with the sound phenomenon known as beats. We know it best perhaps in organ music. If one organ pipe is sending out 300 pulsations a second, and another 340, the two will alternately add and detract from one another forty times a second, and you will hear, apart from the notes of the two pipes, a 40 "cycle" note. A broadcasting station operates on very much the same principle. For instance, we will say that the station is operating on 300 meters. When the transmitter is running and the studio is quiet, a million cycles a second will be sent out in the ether. When then a soprano sings a fairly high note into the microphone, the station continues to send out its million-cycle wave, and in addition to this "carrier wave" two waves called "side bands," one at a million plus a thousand cycles, and the other at a million minus a thousand cycles which when they arrive at your detector produce a thousand impulses a second combined with the carrier wave; and you hear these thousand pulses or the note which the soprano is singing. If a single-circuit oscillating receiver down the block is hunting

for that station, and oscillates at a million plus or minus a thousand cycles, it sends out a wave identical to one of the two side bands produced at the broadcasting station by the soprano. This, combined with the carrier wave of the broadcasting station, produces exactly the same result in your receiving set as the carrier wave plus the station side band. The detector would have to have a brain to be allowed to conclude that no soprano would be allowed to hold this squeal for such a long period, or that the squeal did not belong to the air being sung, and to cut it out. A brain, of course, is something that no mechanical or electrical device can possibly have.

LEGISLATION ISN'T THE ANSWER

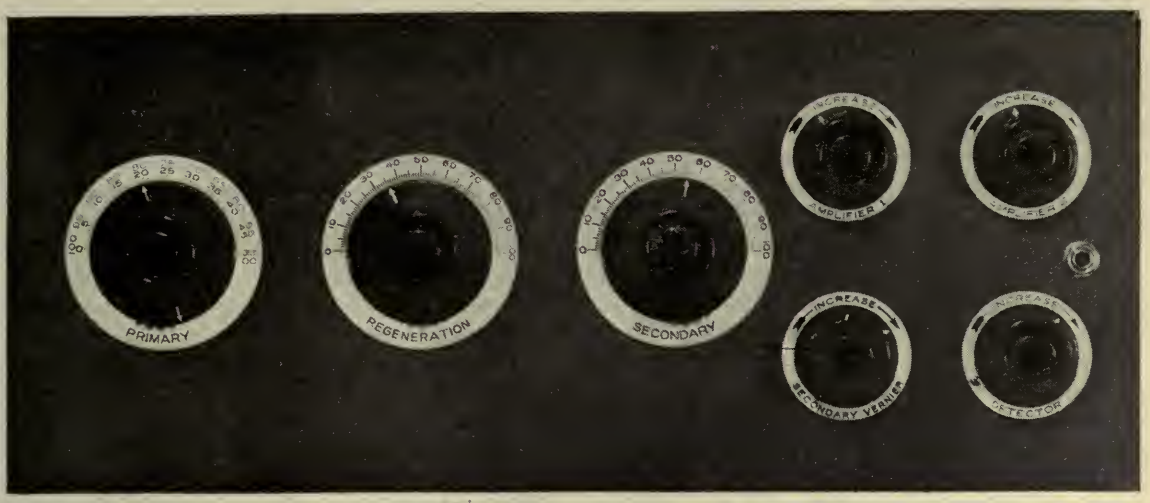
I DO not believe legislation against this receiver or circuit is the answer. We are too prone in this country to feel that all that is necessary to remedy any situation is to pass a law "regulating" it. It would be easy, of course, to prohibit the manufacture of radiating receivers by the reputable companies engaged in the business, but I believe that fully 70 per cent. of the offending receivers in use to-day are of home manufacture. Herein the difficulty lies, for though the single-circuit regenerator is very unselective and usually unable to respond to anything but the loudest signal present, it will certainly give the greatest distance and volume at the minimum expenditure of time and money. Almost everyone knows how to make this apparatus, and it seems to me that it would require a tremendous enforcement personnel to prevent its home manufacture and use.

It would be hard to use the radio compass on the intermittent noises they produce. Owing to the fact that these sets are almost as efficient on a poor antenna as on a good one, a moderate sized indoor antenna can be used with perfect satisfaction, which makes them difficult to find. It is impossible to search private houses without a warrant, and at least moderate grounds for search must be at hand to obtain a warrant. It would be impossible, or at least extremely difficult, to teach through any educational campaign the users



THE "WORKS"

Showing the excellent construction of the sensitive, non-radiating receiver designed by Mr. Washington



THE FRONT PANEL VIEW OF THE SET
But two controls are generally used in tuning

of these receivers how to operate them in such a manner as not to produce interference with their neighbors; because this form of operation would mean a careful and painstaking use of both hands in keeping the regeneration control at all times just below the oscillating point while the wavelength control was operated up and down the scale in searching for distant stations. A much simpler method of finding distant stations, and that in general use, is to cause the receiver to oscillate and move the wavelength control until the operator hears a loud squeal. Incidentally your neighbors and perhaps erstwhile friends hear it, too, worse luck.

AN AGGRESSIVE PUBLIC OPINION IS THE ANSWER

THE only possible solution, to my mind, is so to indoctrinate the public, through magazines, newspapers and broadcasting station publicity, in the harm that this type of receiver does, and in the selfishness, unconscious or otherwise, of its owner, that public opinion and a sense of fair play will rule them out of existence.

Users of these receivers should also be made to realize that on account of the inability of this type to select anything but local broadcasting when near-by stations are running, the owners are missing a great deal of the real enjoyment of radio, i. e., being able to select almost any program at nearly any time.

To the average reader, it may seem that my convictions in this matter are rather extreme. But, I certainly believe that the "transmitting" evil, if allowed to continue, will result in less interest in broadcasting as well as agitation for legislative action.

I think it is generally admitted that the millions of squeals sent out onto the air every night will, in time, lessen the enthusiasm of the listener-in. When the listener-in begins to become disinterested, broadcasting will slacken. Naturally either of two things must result—the squeals must decrease or broadcasting will.

We who are so vitally interested in radio—by "we" I mean the general public—cannot afford to see radio slump, and we will not allow it to slump. Radio is already a necessary and solid institution. The American people never have and never will do without something it likes, merely because of difficulties. Therefore, I do not hesitate to predict that the "transmitting" receiver will perhaps this year become obsolete.

The trouble is not with regeneration as a principle, in fact it is an extremely useful principle, increasing the effectiveness of the vacuum tube enormously. Regeneration applied with extreme care and with very delicate apparatus in the laboratory can make response from all signals weak and strong practically equal. The trouble is that all conventional single-circuit regenerative receivers, and to a considerably lesser degree the two-circuit type, can transmit because the tube which in these circuits is directly connected or coupled to the antenna, may be made to oscillate.

HOW DESIGNERS HAVE AVOIDED REGENERATION

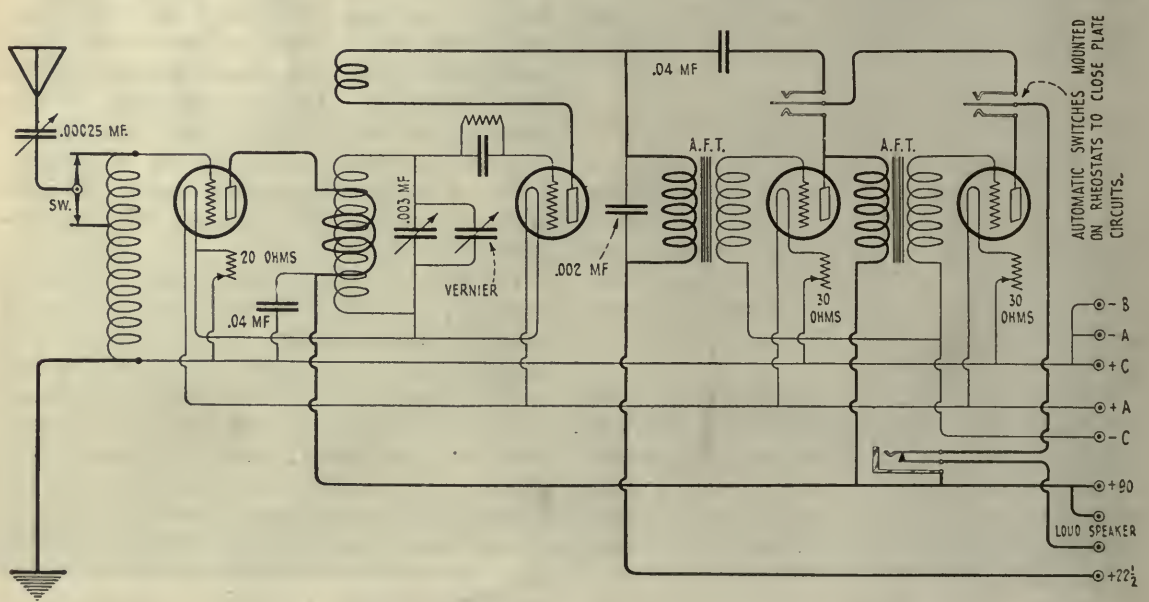
THE neutrodyne was probably the first adequately sensitive receiver which did not to a greater or less degree transmit, but the neutrodyne, as no regeneration is employed, is somewhat wasteful on tubes. By this, I mean that a five-tube neutrodyne does not get anything like the volume from its five tubes that it would, if regeneration could be employed in the three radio-frequency tubes.

Regeneration is also a tremendous aid to selectivity. It can be regarded as an application of negative resistance. As regeneration is increased, the effective resistance of the circuit becomes less and less until it reaches zero. If pushed to, or beyond, this point, oscillation occurs.

You all know that a low resistance circuit is a "sharp" or selective circuit. The neutrodyne owes its selectivity not to the individual selectivity of each circuit, but to what is called the concomitant selectivity of the three circuits involved. For instance, if each circuit reduces interference to 10 per cent. it will be 10 per cent. in the first circuit, 1 per cent. in the second and $\frac{1}{10}$ of 1 per cent. in the third. Approximately the same selectivity can be obtained in fewer circuits by making them of lower effective resistance by using regeneration.

There are several types of receivers which manufacturers have developed to escape regeneration. The Teledyne, which is illustrated in the accompanying photographs is a recent contribution in this line. The Teledyne makes use of full regeneration in the detector, but even if the detector is allowed to oscillate, these oscillations cannot be radiated because of the peculiar type of radio-frequency amplifier ahead of the detector. The Teledyne with four tubes under equal conditions seems to have somewhat more volume than the five tube neutrodyne.

The grid and filament of this radio-frequency amplifier are connected in the usual manner across the antenna tuning inductance. The plate of this tube is coupled to the detector-grid inductance, which is tuned with the usual parallel condenser. The detector is furnished with a conventional regeneration coil commonly called a "tickler." The coupling between these two tubes is such that when the detector-grid circuit is resonant, this circuit has an impedance approximately equal to the output impedance of the amplifier tube, which is the correct load for most efficient output of this tube. In this coupling position, the impedance is not of the correct inductive value to produce oscillations, so that the radio-frequency amplifier cannot itself oscillate. Its grid inductance, which is in the antenna, is at zero coupling position to the detector-grid inductance (primarily to prevent parasitic feed-



COMPLETE CIRCUIT DIAGRAM OF THE TELEDYNE RECEIVER
It uses one stage of radio-, two stages of audio-frequency amplification, and detector

back) and therefore oscillations in the detector can never reach the antenna.

Among the advantages of this circuit may be mentioned ease of handling, as there are only two major controls, one for each hand. The detector regeneration control may be left at a low value and used to increase the intensity after the signal has been found. If searching for an unknown station, the detector may be made to oscillate freely, and the primary and secondary controls manipulated until a so-called "carrier wave whistle" is picked up, much as in the present regenerative receiver, without fear of causing annoyance to your neighbor. It will be found to have high selectivity and extremely high efficiency. It can be used effectively on a small antenna and has, I think, to a greater degree, all the advantages of the conventional regenerative receiver and none of its disadvantages.

"As It Was in the Beginning"

A Personal Narrative of the Early Days of Wireless by One of the Few Men Who were Helping Start the Wheels Almost Before There Were the Necessary Tracks

By ROBERT H. MARRIOTT

Past President, Institute of Radio Engineers, Expert Radio Aide, Puget Sound Navy Yard, Washington

I AM going to try to tell the story of how radio began in the United States. It will not be the story of who invented radio. That question of who invented radio is a subject that people quarrel over. While I am not a Quaker, my ancestors in Maryland may have been Quakers two hundred or more years ago, and I may have a "hang over" from them that makes me desire to avoid quarrels. At any rate I am not going to claim that I or any body else invented anything, but just try to tell how and when regular everyday wireless service started in the United States. I will call it "Wireless" because that is the name it went by in those days. And I am going to tell the story in a personal style because, in many ways, it is a personal story.

I suppose the reader wants to know just why I should write about this. Perhaps I shouldn't, but the reason I am writing about it is that I designed and supervised the construction of the instruments and stations that gave the first regular ordinary everyday radio service in our United States.

The next questions are: How did I happen to do that and what circumstances led up to it? When I entered Ohio State University in 1897, I had decided that I wanted to specialize in physics, especially on "cold light," "X-ray," or "Wireless." The head professor of physics, Dr. Thomas, was just recovering, after several months, from being burned by X-rays, which was discouraging for "X-rays," and he told me he did not think "cold light" was a field that we could do much with, so I decided on "wireless."

Dr. Thomas, was a scientist and he tried to see that I applied myself correctly to the study of what had been written and to the performance of the experiments, which had led up to wireless as it was then. Gradually this worked up to a point where I had quite a collection of wireless apparatus that I experimented with or, one might frankly, say "played with." As no other student was sufficiently impressed by wireless to work with me, I had to control both the transmitters and receivers by myself, therefore the longer distance work about the campus was accomplished by fixing a clock pendulum so

Pioneers Three

Are Mr. Marriott, Mr. G. W. Pickard, and Dr. De Forest in radio. They are some of the few who started in the field who are still active, twenty-four years after. Here is a well-told story of personal experience in the days when the infant radio daily astounded the natives, of whom, most scoffed and few believed. It's a good story.—THE EDITOR

it would touch a pool of mercury closing a circuit and making the transmitter send a dot every second.

THE EARLIEST RADIO COMPANY

IN 1901, articles appeared in newspapers stating that a corporation called the American Wireless Telephone and Telegraph Company was starting into wireless on a commercial scale. That company based its right to exist on a wireless patent issued to Professor Dolbear in 1886. I wrote the company asking for a job. Much to my surprise, the president of the company wrote back and told me I could have a job if I would take it at once. I hadn't quite finished my college course but I took the job, in June, 1901.

We of the American Wireless Telephone and Telegraph Co., built stations at Galilee, Briele and Barnegat, New Jersey, and placed a station on a vessel to report the yacht races of the *Columbia* and *Shamrock* in the fall of 1901.

Three organizations tried to report those yacht races, Marconi representatives from England, De Forest who was starting a wireless company in New Jersey, and our company, the American Wireless Telephone and Telegraph Company. Mr. Greenleaf Whittier Pickard was also with the American Company. I believe that Dr. De Forest, Mr. Pickard, and I are the only Americans who have continued actively in wireless up to the present. The others, who are living, have entered other lines of work or have retired.

Except for the brief service rendered in reporting the yacht races, those stations only served for demonstrating and experimenting as other stations had done before. They were



RADIO PIONEERS TWENTY-FOUR YEARS AGO

The men who built the wireless apparatus during the winter of 1901 and 1902 in the shop of the Carstarphen Electric Co., Denver, Colorado. Mr. W. P. Carstarphen is the tall bald man in the rear. Mr. G. T. Swenson who later became Mr. Marriott's assistant in the California work is the man in the checked shirt in the center. Mr. Marriott is at the left with his hand in his pocket. He says he was trying to raise a beard to look old enough for his job. He was twenty-two



RECEIVING APPARATUS, MODEL 1902

The coherer detector, decoherer, relays, sounder, tuning transformer, and tape recorder are shown on the large board. At the right is shown a contact type detector with telephone receivers. In this contact detector, steel balls floating on mercury were brought into contact with a strip of aluminum or oxidized iron. The contact pressure was varied by screwing a thumb screw in or out of the mercury. The phones used were the adjustable-magnets, watch-case type of Stromberg-Carlson phones, rewound with fine wire (36 or 40 B&S). Note the leveling screws on the coherer receiver board; not only were these necessary but the coherers had to be very carefully made, exhausted by a mercury pump and the circuits screened by a metal case as we screen circuits now. Taken in Denver, March, 1902

not located where there was a demand for the kind of service they could render. One of the main things they demonstrated was that wireless stations should be placed where there was a demand for what they could do, if wireless was to develop as an art. Also those three companies produced the first prominent wireless interference object lesson, when they intentionally and unintentionally interfered with each other in their efforts to each beat the other at reporting the yacht races.

About the time of these races, rumors started in the American Wireless Telephone and Telegraph Company that those who were working for the American Company would get opportunities to become chief engineers of subsidiary companies. According to the story, the promoters of the American Company had formed that company as a parent company and had parcelled out the United States and its possessions to a number of subsidiary organizations. The understanding was that the parent company was to furnish patent protection and instruments for considerations, and trained men for the subsidiary groups to hire as chief engineers.

By the subsidiary arrangement, the Pacific Wireless Telephone and Telegraph Company and the Continental Wireless Telephone and Telegraph Company had the Western States, Pacific States, and Alaska. Practically, they were one company because the two companies had the same men for officers. They seemed to me to have a territory where wireless might be immediately useful. After a few weeks of talks, telegrams, and letters while I was supervising the building of a station at Barnegat, New Jersey, I joined to the Pacific and Continental Wireless Telephone and Telegraph Companies and went to their headquarters in Denver.

The parent company had not lived up to its agreement to supply instruments, and from what I had seen of the officers of the parent company I did not believe they would ever supply the apparatus, so I set out to build two sets of instruments for use between Catalina Island, California, and the mainland of California. Some of the officers of the Pacific and Continental companies wanted to put the stations at Denver and Golden, Colorado, where they would have been, simply, another

case of experimental or demonstration stations and moreover they would have been in competition with both wire telegraph and wire telephone. I believe those officers never did agree to the California plan, however, as the



BIRD'S EYE SKETCH OF CATALINA AND THE ADJACENT MAINLAND OF CALIFORNIA

saying is now "We got away with" the California plan.

Work on the wireless instruments was started in November, 1901, in a little Denver shop belonging to Messrs. Carstarphen and Wallace. By the first of the year 1902, Mr. W. P. Carstarphen had interested capital, moved to a larger place, and changed the name to the Carstarphen Electric Co. I furnished the designs and supervision and the employees of those companies built the apparatus.

WHAT APPARATUS WE HAD

THE induction coil, vibrating interrupters, and the coherer detectors used in wireless sets in those days were not so bad for demonstration purposes, but they were obviously unreliable for giving public telegraph service. The vibrators would stick and stop. The coherers wouldn't work when they should, and would work overtime when they shouldn't, and the tape recorder made the same dots for static that it made for signals. So I designed an interrupter consisting of a motor driven disc with two insulating segments and two brushes pressing against it. That interrupter was effective and more reliable. We built coherer receivers, but in the meantime I built and tried out numerous contact point detectors with telephone receivers for sound reception. In those receivers static did not make the same sound that signals made. I bought watch case receivers like the "Hello girls" wore, rewound them with fine wire and mounted two on one head band like head sets of to-day.

I hired one of Mr. Carstarphen's men, Mr. G. T. Swenson, as an assistant and in April, 1902, we took the completed instruments to California and started construction of a station above Avalon on the Island and another at White's Point on the mainland near San Pedro and about twenty-five miles from Avalon. White's Point was the nearest point and located there was a dance pavilion which we made into a station. At Avalon we had to blast off part of the hill and build a station house.

THE FIRST STATION

A REAL, practical and continuous demand existed for telegraphic communication between Avalon, Santa Catalina Island, and the mainland of California. The demand for a service that would be more suitable than carrier pigeons and two or three daily boats had existed for some time and the needs for such service were growing. Not only was the demand there but the interfering static was more pacific on that coast than on the Atlantic Coast of the United States, and the distance was short enough for day-and-night, all-the-year wireless service. In addition to those

helpful conditions, the wireless apparatus we installed was simple. That apparatus did not contain the erratic coherer or induction coil vibrator and any part or material in it could be bought in the open markets of the United States and repairs could be made by almost any studious electrician. Those are probably the main reasons why wireless became a successful everyday public service between Catalina and the mainland.

Wireless operators did not exist in those days. There were plenty who could receive the signals made by a wire telegraph sounder or read the tape marks as produced with the coherer type of wireless receiver, but they had not learned to recognize the same dots and dashes in the form of short and long buzzes in telephone receivers. The first few messages were sent and received by Mr. Swenson and me although neither of us were operators. To send, we picked the letters out of a printed American Morse code, and to receive we made a mark with a pencil when we heard a short buzz and other marks or left spaces in proportion to the length of buzzes and spaces and when the sending stopped we compared those marks to a copy of the Morse code and wrote the corresponding letters above the combinations of dots and dashes. Many of the subsequent messages were received in almost that painfully slow way until real operators retrained their minds to give the same translation to buzzes that they had been giving to sounder clicks. After a few operators had set the example, others lost the it-can't-be-done feeling, and learned to receive rapidly.

The transmitter dynamo was driven by a gasoline engine having a spark ignition system and those sparks interfered with receiving. Sometimes, the gas engine had to be stopped to receive. Shutting down to receive and starting up the temperamental gas engine to transmit, combined with detector adjusting and undeveloped receiving ability made the early service very slow as compared to a good wire line.



AN HISTORIC RADIO GROUP

R. H. Marriott driving the first nail in the first wireless station at Avalon, Santa Catalina Island, May 12th, 1902. This was the first regular everyday wireless service station in the United States

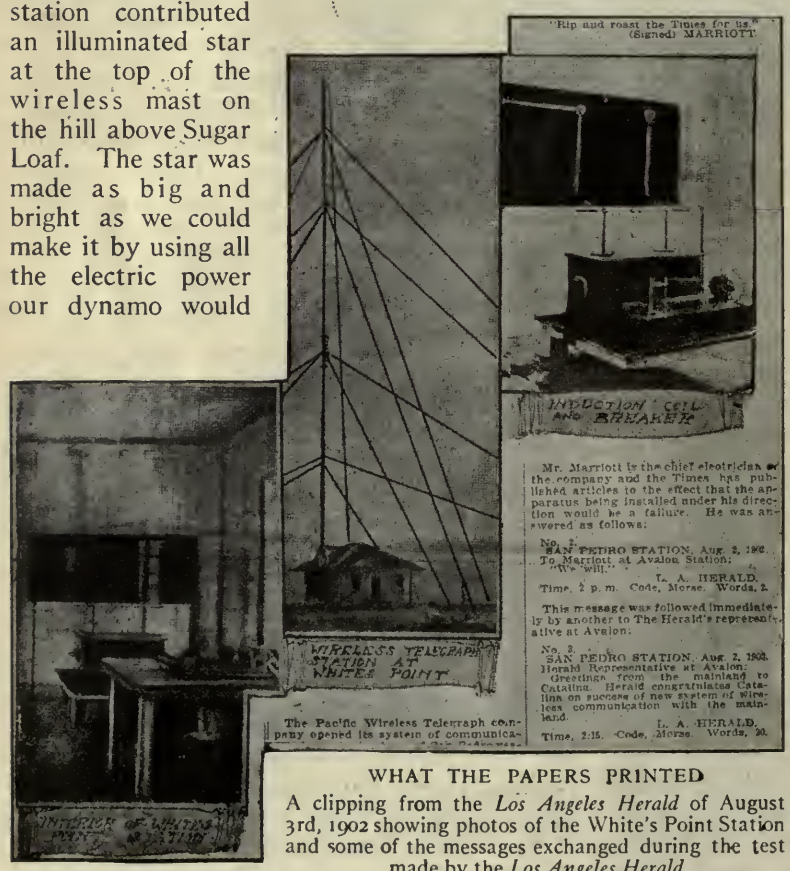
WHEN THE TROUBLE STARTED

THE majority of the public that paid any attention to our efforts during the building and testing of the stations, seemed to be divided in its opinions of wireless experts. They seemed to think the wireless experts were supernatural, crazy, or crooked. These three classes of opinions manifested themselves in ways which were sometimes amusing and sometimes painful to the expert. Where the opinion overrated us, it sometimes caused some embarrassment. For example, while we were developing the sound receiving method, a number of sensitive microphones had been made and the Avalon station had been provided with concrete piers anchored in rock, and a sound proof booth, for delicate microphonic work. Before the station was completed, a visitor asked some question about a carbon-steel microphone that was resting on a piece of paper on a pier and while the microphone was being explained and demonstrated, the visitor wore the telephone receivers attached to it and a fly lit on the paper and walked. The visitor saw and heard the fly light and heard his foot steps in the telephone receiver. The visitor was startled and amazed almost to the point of dragging the microphone off of the pier. And I was equally startled and amazed the next day when I read of myself as a scientific wizard of infinite ability occupied on the hill above Avalon with instruments so sensitive that I could hear flies walk in San Pedro. As the distance was twenty five miles, that was an excellent yarn for those

days although it could be done with radiophones and receivers of to-day.

At Catalina was a resident who had known and admired my grandfather. He had admired my grandfather so much that he did not want to see the family name dragged in the mire by me. From his remarks I gathered that he with others were convinced that wireless was all a fake and he was very much afraid that my notably honest and wise grandfather had failed to leave one or both of those notable characteristics to this grandson. He was sincere even to the extent of intimating he would pay my fare out of the country if I was as weak in my finances as I appeared to be weak in honesty or wisdom.

The 1902 Fourth of July fireworks at Avalon were novel in that they included the burning of a steamship. The old S. S. *Hermosa* which had served Avalon for years, with transportation and communication, was set on fire and towed around and back and forth in the outer harbor while the band played and rockets ascended from the top of Sugar Loaf Rock, and the wireless station contributed an illuminated star at the top of the wireless mast on the hill above Sugar Loaf. The star was made as big and bright as we could make it by using all the electric power our dynamo would deliver. That noticeable brilliancy on our part had an unexpected effect.



WHAT THE PAPERS PRINTED

A clipping from the *Los Angeles Herald* of August 3rd, 1902 showing photos of the White's Point Station and some of the messages exchanged during the test made by the *Los Angeles Herald*

THE FIRST PACIFIC COAST MESSAGE

ON JULY ninth I received the first message at Avalon and all it said was "Do you get me." It was answered in the affirmative, but the answer was not received. Mr. Swenson on the mainland had started sending signals to me on June 28th; however, in trying out the various receivers I had not tried to translate what he said, if he did say anything, until I picked the kind of detector that seemed to be the most serviceable. That detector proved to be a contact between a polished steel tip and an oxidized iron plate. The first plate I made was from a hack saw blade, but I found I could do better by burning the surface off a piece of tin can using a blow torch and a little water and then a little oil on the oxidized surface. To get fine adjustment I needed a well made steady screw with fine threads and a large dial. The spherometers I had used in college to measure the curvature of lenses were the first thing I thought of, so I went to Los Angeles and bought some and Mr. Swenson made them into detectors that were used for several years.

Adjustments at the two stations followed and the exchanging of test messages began. The statement that test messages were being exchanged brought forth a chorus from "Doubting Thomas." A few days later Jeffries and Fitzsimmons fought in San Francisco and as we wanted early returns and wanted to convince doubters, we arranged to wireless the returns across to Avalon.

"EARS THEY HAVE AND HEAR NOT"

THE fight returns were laboriously received by me on the hill above Avalon about midnight and written out and taken down to town and posted. Those who were up read the

bulletin but did not seem to be inclined to pay any bets on the strength of what it said. However, I was happy because I knew the papers would verify my report next day. But I had not studied psychology sufficiently for that situation. The verification by the newspapers resulted in a large collection of stories as to how the news had been received, in every way but by wireless. The knocking was epidemic, for nearly everybody broke out with verbal hammers. Carrier pigeons were credited with the feat, a man was said to have been seen bringing me the message in a small boat, good guessing and advance information were discoursed upon and then somebody bobbed up with the story that the ex-Fourth of July star illumination had been used on the mainland station mast and somebody had seen the flashing light. That yarn about the star was damnable.

The gossip and atmosphere of disbelief in the wireless was enough. However it had not stopped at that but was reflected somewhat in the more durable black and white of the newspapers. Catalina was advertized as a place where one could get scenery, climate, fish, and goats. I enjoyed the scenery, climate, fish, and hospitality of the Banning brothers who owned the Island, but lost my goat to the doubting public and similar newspapers. The *Los Angeles Times* was one of my goat getters.

"AND EYES, BUT SEE NOT"

THE *Los Angeles Herald* had been friendly and was asked to send men to both stations and exchange messages and tell the public what it found. On August second when the *Herald* notified me at Avalon that they were on the job at the mainland stations, I was tired and sore from the effects of oral and newspaper gossip so my message to the *Herald* was "Rip and Roast the *Times* for us." The *Herald* replied "We Will" and patiently sent and received messages over the comparatively slow system and wrote up their work and published it, including my message.

A daughter of a wealthy man was taken sick at Avalon and her mother obtained a specialist from Los Angeles by using the wireless. Those successive demonstrations helped to get more people to believe wireless could give service, but the thing that removed all doubts from everybody's mind was as funny as it was thorough. Two colored men got into the Metropole Hotel Bar on the Island and collected some change, a case of champagne and


BY WIRELESS TELEGRAPHY IS ISSUED

The Wireless

PUBLISHED BY THE LOS ANGELES TIMES. 3 CENTS

AVALON, MARCH 25, 1903.

A BAR OUT FROM THE SEA.

NEWS OF THE MORNING.

police department decide. Squire yacht races with Whitney's aspirations to remove County Hospital others.

Deacon Joseph Mims, colored of Long Beach, convicted of grand larceny.

New County Hospital to be built of home-sold material.

C. L. Parker, carpenter, kills himself with gas.

Pasadena coal slate in Rockefeller.

Rubber murderer believed captured in San Bernardino.

General labor situation grave.

Colton vigilantes drive out hobos.

Long Beach invites Pasadena.

Riverside looking for Salt Lake line.

Lone highwayman in attempt to hold-up Utah stage kills Messenger, Overpowers.

Dimmick confesses; has a confession.

Coroner's jury find the Stokes were murdered.

Midnight ride with mysterious woman cost C. E. Hayes his life.

Sheridan H. Chipman, Expressclerk, killed by Frank J. Candman.

General Funston laughs at Dr. Parkhurst's remarks.

Beast assaults person woman near Arcade.

Mrs. Bartlett's testimony throws no light on murder, but shows remarkable relations existing among all parties to murders.

Indiana coal companies restrained from combining.

New York butter steals powers refused at Salem.

Reported merger of Postal and Western Union Telegraph and Eastern telephone lines.

Miner's strike in Colorado may spread.

Bridge workers out at Pittsburg.

Burlington and Santa Fé in fierce struggle for coal contract.

Morgan discovers international

Washington.

Spanish government to sign protocol with both countries regulating Venezuelan claims.

William M. Collier appointed special assistant for enforcement of anti-trust laws.

Three million dollar issue Philippine certificates. Wabash railroad working for entrance to capital.

Foreign.

Editor Stead denounces the story that King Edward accepted money from Whitaker Wright.

Another revolution in Nicaragua.

Assembly of Department of Panama urges Taft question of Colombian congress.

General Macdonald, commanding British army in Ceylon, accused of immorality.

SECOND EDITION.

FIRST PAGE OF THE WIRELESS.

HOW THE NEWS GOT FROM THEM TO US

First page of *The Wireless* Vol. I No. 1. A little newspaper started by the *Los Angeles Times*, March 23, 1903. It was made up from wireless dispatches received from the California mainland

some miscellaneous drinkables and departed from Avalon with the loot on the five A. M. boat. Such a get-away was old and had been safe for years because there had been no means of communication and the next boat did not go until eleven A. M. But the Bar folks knew the wireless would work and they sent a wireless message to the mainland which caused the colored men to be very surprisingly and very officially received at the pier in San Pedro. It was a spirited wireless comedy for everybody but the Negroes and it caused a laugh which shook almost all remaining stubborn disbelief out of the public.

SO WIRELESS BEGAN FOR US IN 1902

THAT business of putting wireless into common everyday service in the United States occurred in 1902 or ten years after Sir William

Crookes had said "Here, then, is revealed the bewildering possibility of telegraph without wires, posts, cables, or any of our present costly appliances." (*Fortnightly Review*, London: February, 1892.) He said those words while discussing the wireless experiments which Hertz had performed in 1886.

After the stations proved themselves, the newspaper reporters and others said they had not intended to belittle wireless and wireless apparatus or wireless engineers, but that they may have unconsciously done so in attacking the stock jobbers who were exaggerating what wireless could do so they might draw big commissions from the sale of doubtful stock.



Several wireless companies were selling stock and had been selling stock by saying or implying that they were about to span the oceans and continents and take all the business away from the telephone, telegraph, and cable companies. Stock salesmen were not telling the truth when they said the wireless of those days could render everyday service across the Atlantic or Pacific or could compete with wire lines. Antidote statements were a natural result, but they were equally untruthful when they had said that the wireless we had was not capable of giving everyday useful service across that twenty-five miles of ocean where there was no cable to compete with.

After a few months of everyday wireless service, the *Los Angeles Times* started a little paper called "*The Wireless*" at Avalon. The contents of that paper consisted of local news and world news as received via wireless.

HOW THE AVALON CIRCUIT PROGRESSED

SINCE that time, several different organizations have owned and operated and improved that wireless circuit from the mainland to the Island. During those years the island station was shifted about Avalon and the mainland station was shifted about San Pedro, Los Angeles, and Long Beach. The list of owners included the Pacific Wireless Telephone and Telegraph Company, the United Wireless Telegraph Company, the Marconi Wireless Telegraph Company of America, the U. S. Navy, and the Pacific Telephone and Telegraph Company.

The Pacific Telephone and Telegraph Company in late years (1920) made that radio circuit one which could be used for either telephoning or telegraphing and they connected the mainland radio station through repeaters to the whole Bell Telephone System of the United States and they built a local Bell system on the island to serve as an inlet and outlet for the Catalina radio station. Avalon citizens were able to talk by wire to the Catalina radio station and thence by wireless to the mainland and thence by wire to Los Angeles, San Francisco, Chicago or New York. And for the purposes of further demonstration, Deal Beach on the New Jersey shore and the S. S. *Gloucester* on the Atlantic were equipped with radio phones and conversations were carried on via wire and wireless between Avalon and the *Gloucester*.

After the telephone service became a matter of course, many of the Telephone Company's customers talked fluently and freely, not realizing that they were operating a radio telephone circuit between Catalina and the mainland, and a growing number of radio operators, amateurs, and broadcast listeners tuned-in to pick up what was said over that radio telephone circuit. Some of those who used that radio telephone circuit were movie actors and people with no work to do, but with time, money, and energy to spend, therefore it is not difficult to imagine their conversations as possessing sufficiently interesting possibilities to tune-in for. To provide secrecy, the telephone company tried experiments at making the radio waves such that only their receivers were capable of changing the scrambled radio waves into intelligible speech. By this method, the telephone company might have kept the speech unintelligible to all but experts and ingenious amateurs, but there were other interfering factors. When the original radio circuit started in 1902 there were no other radio receivers or transmitters to interfere with it. As time went on, radio service circuits multiplied and produced interference, from transmitters and regenerative receivers.

"THE BOY GREW OLDER"

THE wireless service family had grown in twenty-one years to include service between land stations, ship stations, ships and shore, submarines, airships, aeroplanes and amateur stations and service from compass stations, fog beacon stations and broadcasting stations and besides that, the radio frequencies

and radio apparatus that had been developed for radio service had also been applied for communication over telephone, telegraph, and high and low voltage power lines. From serving dozens it had grown to serve millions.

The telephone company could not entirely avoid all of the interference even though they did carefully choose the sites for their stations and use loops, wave-traps and other selective devices. Such interferences to the wireless telegraph circuits had only been a handicap and irritation for the wireless company's operators, but in the radio telephone it handicapped and irritated the customers. And last of all and probably greatest of all, the wavelengths used by the telephone company were wanted for radio broadcasting.

That first wireless service circuit lived and served the public for twenty-one years. But the wireless circuit family had grown so large there is no longer any room for that first circuit. The Pacific Telephone and Telegraph Company substituted two cables for it when their radio station licenses expired on August 1, 1923, and quit using the wireless. The argument for doing this was that the cables provide more secrecy, no interference, and connect up better with the wire system and business system of the Pacific Telephone and Telegraph Company.

Spoken Literature for Use on the Radio

By FILSON YOUNG,—London

THE literary possibilities of broadcasting seem not to have been realized yet either in England or America. Broadcasting in England began in 1920, and to-day there are something like 500,000 known users of wireless in this country, which with its dense population and large towns dotted over the country at close intervals is particularly suitable for a broadcasting covering the whole country. At present the entertainment provided by the British Broadcasting Company between the hours of 3:30 in the afternoon and 10.30 at night covers an immense variety; short talks on various non-controversial topics; first class symphony concerts, sermons, services, speeches and so forth, as well as hours specially devoted to children's and women's interests. But on the purely literary side the resources suggested by it have as yet hardly been tapped. Once a week indeed there is a "literary talk" of a few minutes, during which certain new books are referred to; a book of my own had the honor of being among the first thus to receive a broadcast review, and the effect was startling.

But just consider the possibilities attaching to the extended and imaginative use of this new and wonderful medium. The written word, although it remains, is always inferior to the spoken word in its actual power and moving influence, Things uttered with the living voice have an appeal and command an attention which in many cases would never have been achieved at all by the written word. At present the newspaper element of broadcasting is represented by brief summaries of news, weather reports and so forth; but why should brief original composition, specially designed for this end, not be added to the utterance of broadcasting? A little five-minute essay, spoken in his own voice by a well known author would have a charm and fascination for people that has evidently not yet been realized. There is no reason, moreover, why leading articles—which are after all only brief essays in the expression of definite opinions—should not form part of the wireless répertoire; there is no reason why the expression of opinion, as represented by the old fashioned leading article, should not take a new lease of life and exert a renewed influence.

The ordinary person who reads a newspaper seldom occupies more than half an hour over it. It ought to be possible to compile a kind of miniature compendium for the purpose of broadcasting, which would represent the picked selection which the ordinary reader makes from a newspaper. Yet, instead of being read from small type printed on indifferent paper, it would be, so to speak, performed like an opera; the individual quality of each writer would be reflected in the tones of his voice.

Of course it is not every good writer who has a good voice; on the contrary, I think it is supposed to be the rule that distinguished writers are bad public speakers. That does not mean so much that they cannot read aloud well, as that their thoughts are marshaled and molded in the form of literature rather than of speech; the redundancies and repetitions and dilutions which make oratory effective are entirely foreign to the spirit of literature, which is compact, concise, and condensed. That is all the more reason why what we may call spoken literature is so suitable for broadcasting, where time is of importance and concentration is of the essence of the program. To produce an effect and a result in a brief utterance is infinitely more within the power of literature than it is of oratory. In America particularly, I should expect this gift to be developed and if American broadcasting is as it is in England I shall expect to hear of a development of my idea before long across the Atlantic.

(Reprinted by Courtesy of *New York Times Book Review*.)



THE GERMAN RADIO CLUB
Meeting in Berlin in the General Post Office with Dr. Bredow, chief of the telegraph, telephone, and broadcasting services in the chair

What German Listeners-In are Up Against

A Berlin Amateur's Story of What Government Restriction, High Prices, and Poor Apparatus are Doing for Broadcasting

By KURT HILDESHEIMER

WE ARE up against the wall here in Germany. No amount of cussing helps. You can't get this and you can't get that, and when you do get something, it is poor stuff. An insulator is nothing but baked mud, taps come off, parts don't fit, and then you begin to chuck the stuff against the wall and go to bed swearing never to touch any of it again. But the next night you are at it again, fishing around for signals.

You have to pay about two months' total income to buy a decent one-bulb receiver. The three shops which are selling radio apparatus in Berlin are handling dismantled former army sets. They don't know the resistance of the grid leaks they sell, they don't know the ratio of the transformers, and you can't get a variable condenser with a vernier anywhere.

The amateur who wants to buy a set must be a German subject, or, if he is a foreigner, licenses will be granted only to citizens of such nations as reciprocate in the granting of licenses to Germans. He must prove his identity and must be more than 21 years old. The postal authorities have the right to refuse the license if they assume that the amateur will in any way abuse his permission to listen-in.

This license does not make it possible for him to listen-in. It merely gives him official permission to listen-in. For the license, he pays 25 marks (equal to $6). This is to-day 90,000,000 paper marks and the average wage-earner is receiving 10,000,000 to 15,000,000 paper marks a week. The license is good for one year and must be renewed after that time by payment of the same fee. However, the Government does not guarantee any of its programs,

> This article is not of a particularly optimistic or constructive tone; it is simply the outburst of a radio experimenter who chafes under the apparently unjust restrictions that prevail in Germany to-day. It possesses the merit of frankness, however, and although we do not vouch for the accuracy of the statements made, we believe they are sincere and indicate, in general, the true color of radio conditions beyond the Rhine.—THE EDITOR.

nor even that there will be any programs. The license cannot be transferred and is good only with apparatus bearing the same number as the license. Only such sets, parts, tubes, may be used which are stamped with the stamp of the R. T. V. (Reichstelegraphenverwaltung) —the Federal Telegraph Administration. It is prohibited to change anything in the set which might alter the wavelength. The antenna may have a maximum length of fifty meters.

The sets may have ranges from 200 to 700 meters. The sets may under no circumstances oscillate. The wavelength restrictions, of course, eliminate all sets in which tuning is done with honeycomb coils. Only German firms are permitted to sell sets.

It is evident that all these limitations are designed to prevent the amateur from reaching out with these crippled sets and trying to listen to an English, French, or Dutch program.

It is evident that all this checking-up and controlling and license-issuing and stamping of apparatus will cut heavily into any profit which the Government might derive from the high fees.

The stamping fees are in gold marks:

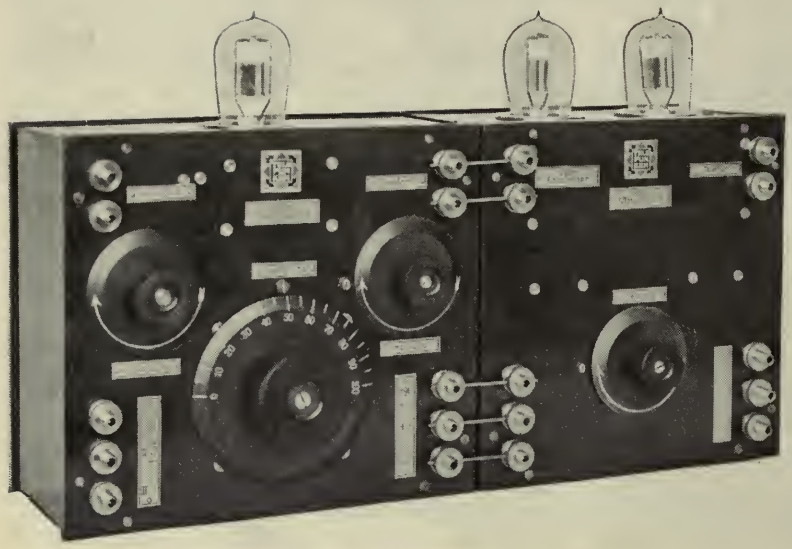
For a crystal detector set. . . .	2.50	[$0.62]
For a tube set without amplification	6.00	[$1.50]
For a tube set with amplication .	7.00	[$1.75]
For a tube	0.50	[$0.12]
For every added stage of amplification	1.00	[$0.25]

(The Post Office, by the way, does not guarantee the quality of the sets or that no patents have been infringed by the manufacturers!)



LISTENING TO TIME SIGNALS

From POZ, at Nauen, Germany, at a German radio exhibition. Broadcasting in Germany has not attained nearly the same popularity as in the United States



A GERMAN "DETECTOR AND TWO AUDIO" OUTFIT
It is built by the Telefunken Company and is quite beyond the financial reach of most German radio enthusiasts

THE DANGER OF CONFISCATION

WHEN you have all your material together and have infringed 121,567 rules and laws in buying your stuff, the obstacles to getting any use out of a set are almost prohibitive. Every time I receive, I climb up my antenna tower and string up my aerial. Then, after I shut down for the night (or at six o'clock the next morning), I go up the tower again and take the aerial down. It is a nice game and the first fifty-six years are the hardest.

And then every night you may sit and listen for broadcasting which isn't there at all. The nearest stations are in Paris, London, and the Hague. But these must have peculiar broadcasting hours, as I haven't been able to catch them yet. London is apparently too far off for one bulb without amplification. So all the fun you have is dit-dah-dit dah-dit. You begin to feel you are lucky at that. Of course, there is no checking up of wavelength and you can never tell where or when you can tune-in on anything. How is the novice ever to try out a circuit or to know what is wrong?

Now that the German radio law is what it is, we can only groan and shed a few tears at it. It does not even give you a chance to fight; it just kills you. I am sure that in spite of all this, I would ultimately have been able to pick up English, French, and perhaps American programs. Now I am really expecting a raid every day. It is nothing short of preposterous the way the Government is killing off activities and is reserving radio for a few profiteers who can afford to pay any price. Besides, it would never appeal to me to have a sealed-up receiver without a chance to go after long-distance stations and to improve my knowledge of radio.

Here a government running the largest (at least, I think it is) station in the world (POZ, at Nauen) and operating directly with many countries on long wavelengths, is suppressing the amateur "because he might disturb the regular traffic." We don't want sending licenses for the present, only the right to experiment with this wonderful art. If the Government cannot code their messages with one of the well-known coding typewriters, or if they cannot use high-speed telegraphy, they will not be able to suppress the man who really intends to exploit the news he hears. He can have his loop and high-powered set in some back room and receive without anyone ever finding it out.

We amateurs would be glad to pay for an experimenting license, if one could be had within reason. We would not think of listening to any telegraph messages. But I know that I am not going to the Post Office to get a license which would allow me to buy a set, because my name would then be on record, and I would have more trouble than fun.

THE FIRST GERMAN RADIO CLUB

THE Deutscher Radioklub was organized in Berlin in the spring of 1923. It developed rapidly and attracted wide attention. Of course, the authorities frowned on the club, and the first series of lectures with demonstrations were followed by official summons to the lecturer, who was a scientist of renowned standing and the holder of an experimenter's license. He was cautioned not to use his sets again outside his laboratory or his license would be cancelled.

The fees for members could not be fixed in marks on account of the upset currency situation in Germany. At present the fees are 10

times the postage on an ordinary letter as entrance fee, and 6 times this postage as monthly fee. This is to-day 10 billion and 6 billion paper marks.

The Radioklub tried to spread information as well as it could through meetings, lectures, demonstrations, and newspaper articles. After some time the Post Office was no longer able to evade the pressure brought to bear on it from all sides.

A BROADCASTING COMPANY STARTED

AT ABOUT this time, the public was astonished to find that the Government has already been "studying the question" since January, 1922. A company called "Die Deutsche Stunde" (the German Hour) had been floated by the Post Office and some of the large firms. Experiments were started in 1923 from the Government station, LP, in Koenigswusterhausen, also from the Telefunken station in Berlin and from the Lorenz station in Eberswalde near Berlin.

Broadcasting was quite irregular and chiefly intended to find out the best conditions under which the service could be finally started. It was during these experiments that the Government claims to have found out that it would be necessary to limit the future broadcasting service considerably, as it might otherwise be disturbed through the enormous traffic between all the surrounding countries. It was stated that the number of waves still available was very limited and this was one of the chief reasons why the amateur activities were going to be carefully watched. However, this statement of the Government can hardly be reconciled with the fact that the commercial traffic is without exception carried on with longer waves than would be required for the amateur broadcasting service.

THE WICKED EXAMPLE OF THE U. S.

A PARTICULARLY striking example of the way in which the public was misled was by newspaper articles about the American Radio Conference under Secretary Hoover. It was stated in these articles that the chaos



GERMAN BROADCAST LISTENERS

Using a receiver which is quite generally sold by one of the broadcasting companies. These receivers are sealed and can only be used over a certain band of wavelengths



FOR TIME SIGNALS ONLY

A neat German receiver, tuned exactly to the wavelength of POZ, Nauen. The listener has no adjusting to do. The diagram on the panel explains how the dots and dashes sent during the five-minute period indicate the correct time

in the U. S. had grown so bad that nobody was able to pick up anything on account of interference but shrieks, growls, and hisses. The public was urged not to follow the "wicked" example of the U. S. and England, where nobody was paying fees for receiving and where the whole broadcasting service would soon break down for lack of funds, but to be a good boy and rely on the ever-so-well-meaning Government and run away and play till everything had been carefully considered.

In October, 1923, the press was invited to attend the first trial demonstration in the Telegraphic Technical Experimental Laboratory in Berlin. A concert and declamations were broadcast from Koenigswusterhausen. At the same time, the exact regulations were printed in a paper published exclusively for the German public broadcasting service, *Der Deutsche Rundfunk* (The German Broadcasting Service). This paper published the laws, the reasons of the Government for limiting the amateur activities, and in the future it will also publish the programs.

The first idea of the Government was that this new sport was a fine field for taxation, so it piled it on thick and heavy. A tax is levied on sets and on licenses for amateurs. The necessity of such taxation was explained by the budget deficit. A large part of the tax should also go toward creating so good a program right from the start, that people would not lose interest after a short time in the radio game, if it did not come up to their expectations. It was the question of who was going to pay for the broadcasting. Here in Germany it is going to be the amateur directly. Of course the Government knows that only a comparatively small number of people will apply for licenses right away so they are cautioning the public not to expect too much for their money in the beginning. The question whether the manufacturers would be willing to bear the expenses of broadcasting has never been raised yet. It is certain, however, that they would be glad to contribute directly to it in order to profit by the consequent sale of sets and not be subject to taxation and bureaucratic control measures.

A certain part of the fees collected from the amateurs goes to the Government and the balance to the Deutsche Stunde or other broadcasting organizations.

MAKING RADIO "POPULAR"

BROADCASTING will take place from the Government station in Koenigswusterhausen and from the Voxhaus in Berlin. This is a private firm making gramophones and records, and while the records are being made in their Berlin studio, the music will be picked up and broadcast. Other broadcasting stations are planned in Munich in Bavaria and in Stuttgart in southern Germany. All will work on different wavelengths to prevent interference. Every station is intended to supply a district of 150 kilometers radius.

At the same time the Deutsche Stunde is going to lease lecture rooms, concert halls, etc., from time to time and install portable receiving sets for the evening and have the lectures and music picked up and reproduced through loud speakers. This absolutely absurd idea is the best way of discrediting radio with the average German who has a highly trained musical ear. It would be like inviting somebody to attend a concert consisting of amplified gramophone records. People coming for the novelty of the thing will leave the place with an utter disgust for radio, when they

can listen to the best soloists, philharmonic orchestra, opera, etc. at slightly higher prices. Of course this is no way to popularize radio in a nation where 90 per cent. of the people know nothing at all of radio.

Another regulation: it is prohibited to receive other than the German programs. Just imagine the poor amateur when he gets tuned in on London dropping his headset in horror and ringing up the Government for instructions what to do, when he cannot tune it out. The owner is further responsible that nobody misuses the set. The government officials are authorized to enter and search any room in which radio sets are stationed just as if you were the vilest criminal.

The amateur (if people with such sets could justly be called amateurs, I think, however, they had better be labeled "wireless gramophonists") is thus crippled on all sides. No buying of parts, building his own, experimenting with different circuits, no amplification for him, he is just switched on to a kind of enlarged gramophone which works only certain hours of the day. No distance work, none of the thrill and fascination of listening to another country and knowing that you are one of the vast and enthusiastic wide-spread audience.

HOW THE PRESENT SYSTEM IS LIKELY TO WORK OUT

THE high costs of administration and the small number of subscribers in the beginning will prevent profitable utilization of the returns and listeners-in abroad cannot be taxed either. There will not be enough amateurs willing to pay the fees, knowing that they will be kept on record and subject to frequent examination and raids on their apparatus. The quality of the service in the beginning will necessarily be poor, just when it is most essential to startle everybody with the high quality and frequency of the performances. It can be safely assumed that the enterprise of the manufacturers, who are eager to create an adequate outlet for their production and willing to coöperate in the broadcasting itself, can not be set aside for any length of time.

Of course there will always be quite a number of people who do not care about the technical part of radio. All they want is to hear the music and not be bothered with assembling the set or with technical knowledge. For these, the regulations may be all right if they can afford to pay the high fees and the high prices for the receiving sets. But preventing all persons who are not 21 years old and all those who want to experiment from going ahead and doing it, is preposterous. The amateur who wants to experiment would be willing to pay for a license, even more than the fee stipulated at present.

However, as long as these crippling conditions prevail, Germany may as well definitely renounce any increase in the technical education and knowledge among the people, and the chance of any improvements or inventions from the ranks of the amateur.

I am afraid this has not been a particularly optimistic account of the radio situation in Germany. The fact is, I have looked pretty thoroughly without so far finding anything that would justify loud hoorays, or even any very cheerful expectations for the future. No one is waiting more anxiously for a good omen than I am; and when it appears I'll be among the first to join in the hymn of thanksgiving.

HOW can we speed up our trans-oceanic and trans-continental radio messages? Is a new code the answer? Has the limit of speed been reached? Arthur H. Lynch has an exclusive interview with Major-General George Owen Squier in the June RADIO BROADCAST *in which General Squier explains a startling and well-worked-out plan which he says would permit, according to his figures, an increase of more than 150 per cent. in the speed of radio telegraphic, cable and telegraph traffic.*

Looking Into the Vacuum Tube

WHAT MAKES THE WHEELS GO 'ROUND: III

What Happens in the Vacuum Tube and How

By WALTER VAN B. ROBERTS

Each of these articles is a unit in itself; you can start reading now. This is the third article in Mr. Roberts's series. The first appeared in this magazine for March.—THE EDITOR.

THE vacuum tube is the heart of most radio circuits, and because of its calm appearance and almost uncanny action, many are persuaded they cannot understand its fundamentals. Every one can see the three elements in the tube, called (reading, so to speak, from right to left), plate, filament, and grid. These elements are insulated from each other, although placed quite close together.

29. THE PLATE CIRCUIT

REFER to Fig. 9. A wire called the filament is heated (in the best possible or "hardest" vacuum) by means of electric current from the filament heating battery which is usually called the A battery. If heated to a temperature sufficiently high (the necessary temperature depending upon the kind of wire the filament is made of) a large number of electrons are emitted from the filament, like steam from boiling water. They are then sucked over to a sheet of metal called the "plate" which attracts them because it is kept at a potential more positive than that of the filament. This flow of electrons to the plate constitutes the plate current, and the battery that keeps the potential of the plate positive and hence maintains the plate current is called the plate battery or the B battery. Electrons leave the filament, are attracted through the vacuum to the plate, leave the vacuum tube via a wire sealed through the glass, traverse the B battery, reenter the vacuum tube by the filament leads along with the filament heating current, and get boiled off the filament again for another round trip.

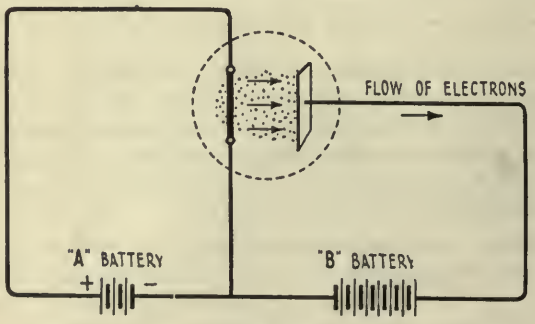


FIG. 9
A simplified diagram showing how the vacuum tube works

30. THE GRID

SO FAR only two electrodes have been mentioned, for the hot filament is considered as only a single electrode although actually two wires are sealed through the glass in order to provide a complete circuit for the heating current. The third electrode is called the "grid" because it is usually in the form of a lot of parallel wires close together and all connected together. When this structure (which is located between the filament and the plate) is given a potential more negative than that of the filament, it repels electrons coming from the filament and thus offsets some of the attractive force due to the plate. It is a very important property of the tube that a small change in the grid potential may be as effective in changing the plate current as a large change in plate potential. The voltage amplification constant, μ, of a tube may be defined as the number of volts that must be added to the plate battery to compensate for making the grid one volt more negative. If the grid is made more positive than the filament, it attracts electrons so that the plate does not get them all. Those electrons going to the grid constitute a grid current and to maintain this current power must be supplied by the source that is keeping the grid positive. Inasmuch as the most important function of the vacuum

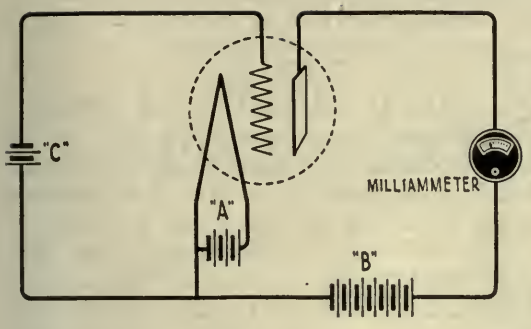


FIG. 10

The essentials of a vacuum tube circuit. The milliammeter measures the plate current

tube is the amplification of power, it is important in almost every case that the grid be kept negative at every instant in order that, as nearly as possible, no power at all be required to maintain or vary the grid potential. (The quantity μ does not have to be greater than unity in order that the tube be capable of amplifying *power*). Wherever we say that the grid or plate potential is so much more positive or more negative than the filament, we always refer to the most negative end of the filament, the latter not being an "equipotential surface" when the heating current is flowing through it.

31. PLATE IMPEDANCE

ANOTHER very important quantity is the ratio of a small change in plate potential (measured as a fraction of a volt) to the resulting change in the plate current (measured as a fraction of an ampere). Of the various names given to this quantity the term "plate impedance" will be used. Except at extraordinarily high frequencies the plate impedance is practically the same as a pure resistance, so that it may be equally well called the plate resistance, and denoted by R_p.

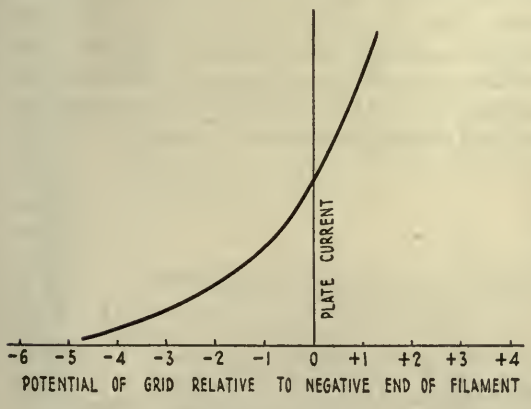


FIG. 11

How the plate current varies in a vacuum tube when the B battery is constant and the polarity of the grid potential is varied

31. MUTUAL CONDUCTANCE

THE ratio $\frac{\mu}{R_p}$ is called the "mutual conductance" (being the change in plate current per volt change in *grid* potential) and this term is coming into use as a convenient figure of merit for a tube.

The quantity, μ is simply a geometrical constant, being greater the larger the wires forming the grid, the closer they are together, and the further they are from the plate. R_p however depends not only upon the actual geometry of the tube but also upon the copiousness of emission of electrons from the filament, and the grid and plate potentials. Hence it is customary to specify the value of R_p for the filament current, grid potential, and plate potential at which the tube is supposed to be used.

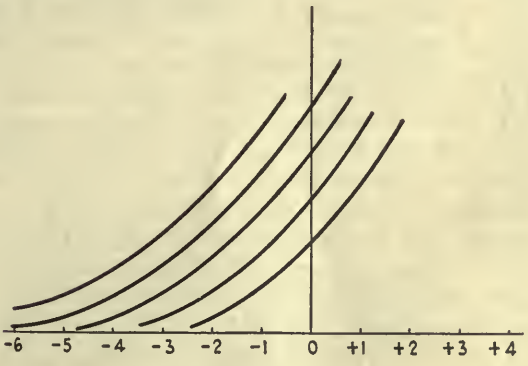


FIG. 12

By varying the B and C battery voltage applied to a vacuum tube this family of plate-current curves results

Most receiving tubes have the value of μ somewhere between 5 and 10 and R_p about 20,000 ohms more or less. Some tubes have μ as high as 40 and R_p as high as 100,000 while others have μ only about 2 and R_p as low as 1,500, but tubes with these extremes are used only for special purposes.

33 GRID POTENTIAL—PLATE CURRENT

FIG. 10 shows a tube with an A battery to heat its filament, a B battery to maintain its plate current, and a C battery to keep its grid negative, and a milliammeter to measure the plate current. If the B battery voltage is

kept constant while the C battery voltage is varied, the plate current will be found to vary as shown by the curve of Fig. 11. This curve is called the "plate current-grid potential characteristic" of the tube. By making such a curve for each of a number of different B battery voltages we obtain a "family" of curves as shown in Fig. 12. From inspection of this family of curves it is easy to find what the current would be for any combination of B and C battery voltages.

34. THE "SQUARE LAW" EQUATION

HOWEVER we do not use this chart much, for it is a very fortunate circumstance that for all purposes in which we will be interested, the simple equation $Ip = K\ (B+\mu C)^2$ gives the plate current with sufficient accuracy especially if there is not much impedance in the plate circuit. (Ip is the plate current, B the number of volts in the plate battery, C the number of volts in the grid battery, and if the grid is negative a minus sign must be used, and k is a constant whose value depends upon the particular tube used, and even with a given tube depends upon the amount of filament current). If we had only the experimental family of curves of Fig. 12 as a guide to the behavior of the tube, we could reason out results quite well in a qualitative way, but by using the equation we can work out quantitative results very much more quickly and simply by straightforward elementary mathematics, and we will not be so likely to overlook unexpected effects. However, for all practical purposes, the curves of Fig. 12 will be found quite satisfactory.

35. SUPERIMPOSITION OF ALTERNATING CURRENT UPON DIRECT

SO FAR, all the currents and potentials mentioned have been direct. As our interest is centered on alternating currents, it should be explained here that if in addition to the C battery an alternating potential be applied to the grid, causing the grid potential to fluctuate about its mean value "C", then as a result the plate current will also fluctuate about its mean value. But as mentioned before, a unidirectional current whose strength varies about a mean value can be considered to be *two* distinct currents flowing simultaneously in the same wire: the first a direct current of constant strength, and the second an alternating current whose strength depends upon the amount of fluctuation. These two currents can be, and often are, fairly completely separated out from each other by the device shown in Fig. 13. Direct current cannot flow through the condenser so it *all* goes through the other branch. On the other hand if the inductive reactance is very large in the other branch compared to the condensive reactance of the condenser (at the frequency used) most of the alternating current will take the easier path, that is, the condenser branch. It is not always necessary to effect this separation. The whole alternating operation of the tube may be summed up by saying that against a background of direct currents and voltages, the tube receives an alternating voltage input to its grid and delivers an alternating current output in its plate circuit.

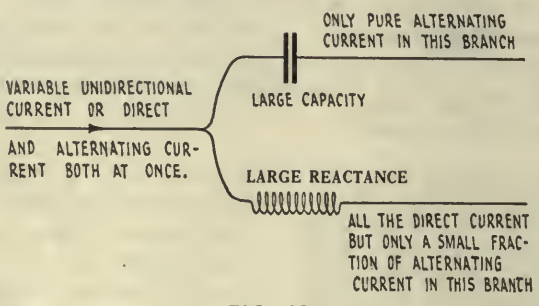


FIG. 13

Experiments using the two-element tube in reflex circuits are described in the Lab Department next month. The host of reflex users will have a whole new field of experiment thus opened to them

WHO IS TO PAY FOR BROADCASTING AND HOW?

A Contest Opened by RADIO BROADCAST in which a prize of $500 is offered

What We Want

A workable plan which shall take into account the problems in present radio broadcasting and propose a practical solution. How, for example, are the restrictions now imposed by the music copyright law to be adjusted to the peculiar conditions of broadcasting? How is the complex radio patent situation to be unsnarled so that broadcasting may develop? Should broadcasting stations be allowed to advertise?

These are some of the questions involved and subjects which must receive careful attention in an intelligent answer to the problem which is the title of this contest.

How It Is To Be Done

The plan must not be more than 1500 words long. It must be double-spaced and typewritten, and must be prefaced with a concise summary. The plan must be in the mails not later than July 20, 1924, and must be addressed, RADIO BROADCAST Who Is to Pay Contest, care American Radio Association, 50 Union Square, New York City.

The contest is open absolutely to every one, except employees of RADIO BROADCAST and officials of the American Radio Association. A contestant may submit more than one plan. If the winning plan is received from two different sources, the judges will award the prize to the contestant whose plan was mailed first.

Judges

Will be shortly announced and will be men well-known in radio and public affairs.

What Information You Need

There are several sources from which the contestant can secure information, in case he does not already know certain of the facts. Among these are the National Association of Broadcasters, 1265 Broadway, New York City; the American Radio Association, 50 Union Square, New York, the Radio Broadcaster's Society of America, care George Schubel, secretary, 154 Nassau Street, New York, the American Society of Composers and Authors, the Westinghouse Electric and Manufacturing Company, the Radio Corporation of America, the General Electric Company, and the various manufacturers, and broadcasting stations.

Prize

The independent committee of judges will award the prize of $500 to the plan which in their judgment is most workable and practical, and which follows the rules given above. No other prizes will be given.

No questions regarding the contest can be answered by RADIO BROADCAST *by mail.*

How to Increase Your Range

Details on How to Apply Radio-Frequency Amplification to Single and Two-Circuit Regenerative Receivers, Preventing Radiation

PART II

By JOHN B. BRENNAN

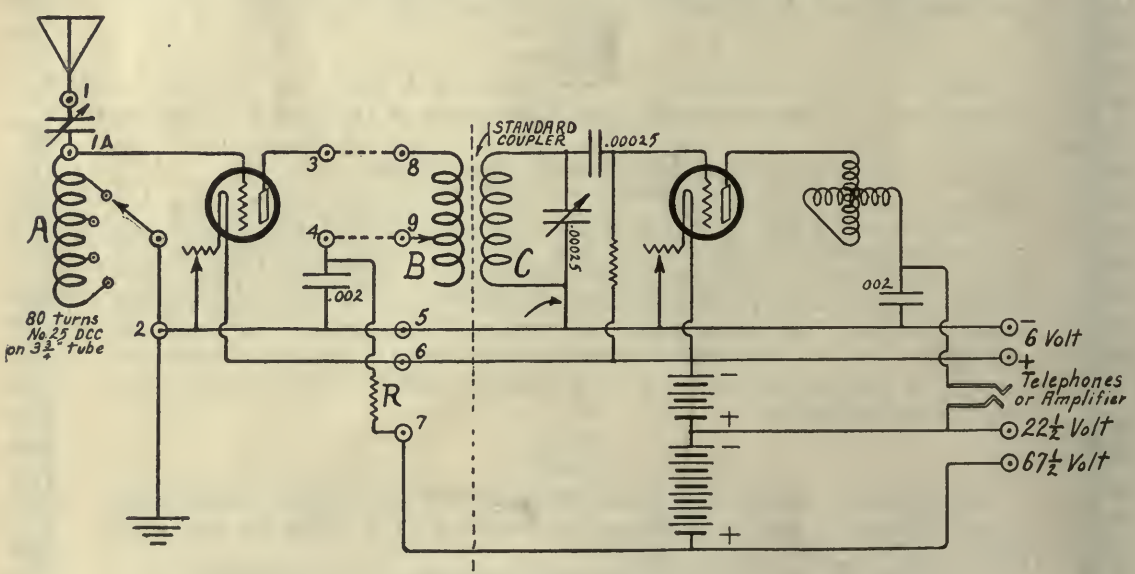
MANY have inquired about details suggested by the article by Mr. Arthur H. Lynch "How to Increase Your Range," in the March RADIO BROADCAST. This article will attempt a further explanation in an effort to simplify the construction of the radio-frequency unit there recommended and described.

The photographs accompanying that article merely illustrated the use of the amplifier unit with the coil B coupled to a single circuit receiver.

Coil A is wound as was described, with 80 turns of No. 25 DCC wire, tapped every 20 turns. It is not bank wound, as shown in the lower right photograph, Fig. 3, page 381, March.

The amplifier unit is shown in Fig. 1. When applying this unit to a standard three-circuit regenerative receiver such as Fig. 5, page 440 in RADIO BROADCAST for March, the following changes are necessary; Disconnect the antenna and ground leads from the primary of the regenerative set and connect them to their respective posts on the amplifier unit as shown in the correct circuit below. Connect the primary or stationary coil of the coupler in the regenerative set to the posts Nos. 8 and 9 (Nos. 1 and 2 as in Fig. 1, next page). This primary coil then becomes coil B (See Fig. 1, page 380, March). The filament circuit must be checked over so as to prevent short-circuiting of the A battery. The set is now ready for use.

By referring to Figs. 1 and 2 the method of connecting to a single circuit receiver will be quite evident. The antenna and ground leads of the single circuit receiver are disconnected from the binding posts and in their place is connected the piece of wire E. This operation shunts the



THE CORRECT CIRCUIT

For changing your single-circuit receiver into a non-blooper by adding a stage of radio-frequency amplification. This is the same circuit which appears on page 380 of this magazine for March. There are several corrections: Coil C, lower lead goes to the — 6 volt lead. If a loop is used in place of an antenna and ground, connect posts 1 to 2 and plug loop in at points 1 and 1A

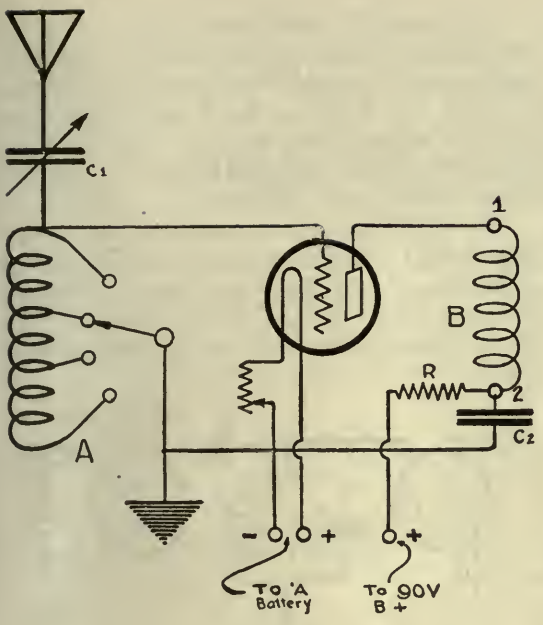


FIG. 1
The radio-frequency unit

variable condenser across the primary coil resulting practically in the equivalent to Fig. 1, page 380, March, with the exception that instead of a plate variometer, we have a rotating coil D coupled to the coil C. The terminals Nos. 1 and 2 of Fig. 1 are connected to the 45-turn coil B and this is loosely coupled to the coil C. The construction of the coils A and B were explained in the March issue; however, a brief resumé follows:

About 150 feet of No. 25 DCC wire will be plenty for the winding of both coils. The tubing for the coils A and B is of formica, bakelite or cardboard, $\frac{1}{8}$ inch thick and $3\frac{3}{4}$ inches in diameter. The tube for A is 3 inches wide and for B, 2 inches wide. A margin of about $\frac{3}{8}$ inch is left on either side of the winding of both coils.

It is to be noticed that the grid leak, which usually shunts the grid condenser, is connected to the positive side of the filament supply as shown in Fig. 2.

One more word about the single circuit receiver. There are many variations and modifications of the single circuit, but in most cases they are of the same principle; that is, the antenna is connected through a variable condenser to a coil, thence through a selector switch arm to the ground lead. The grid and filament connections are usually taken directly off the coil proper. Sometimes this connection is fixed; in other cases it is made variable by additional switch arms.

Unless the owner of a single circuit set is entirely familiar with the wiring circuit of his receiver, it is recommended that he secure the services of a competent radio mechanic to construct the amplifier.

To adapt this circuit to use for radio-frequency amplification, the antenna tuning

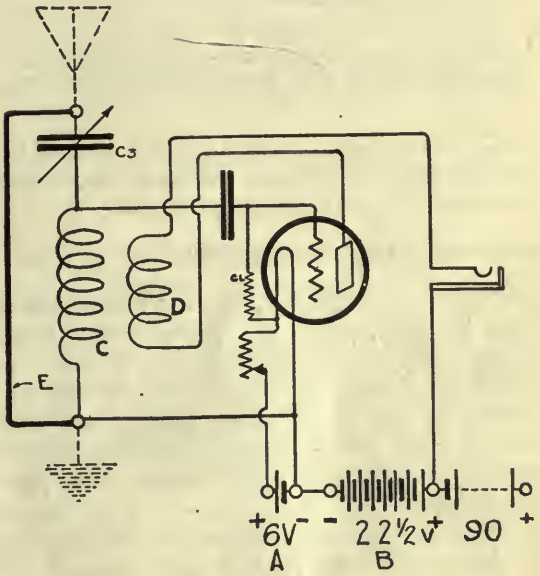


FIG. 2
Connections necessary to change a standard single circuit regenerator to a non-radiator

condenser of the receiving set is shunted across the primary coil. This is usually accomplished by connecting the antenna and ground binding posts with the wire E as shown in Fig. 2.

An error occurred in the wiring diagram in the March issue, page 380. The bottom side of the coil C had been left disconnected. It should be connected to the negative or ground lead.

In Fig. 1, A 80 turns No. 25 D.C.C. wire, tapped every 20 turns; B 45 turns No. 25

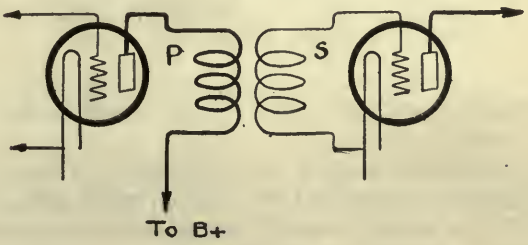


FIG. 3
Circuit of the untuned transformer-coupled amplifier

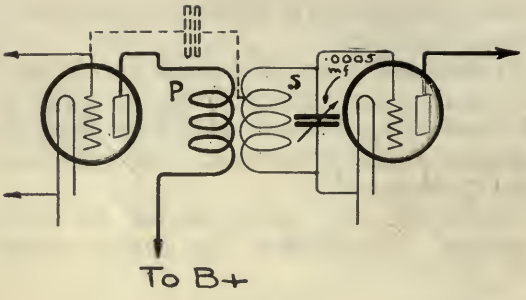


FIG. 4

The tuned transformer-coupled amplifier. Dotted lines show how and where to include neutralizing capacity

D.C.C. wire tapped every 15 turns; C1 and C2 .00025 mfd. condensers; C3 .002 mfd. fixed condenser; R 300-ohm potentiometer.

MULTI-STAGE RADIO-FREQUENCY AMPLIFIERS

CONSIDERABLE interest has been shown in circuit diagrams showing several steps of radio-frequency amplification. It must be remembered that for every additional step, the control of the set becomes more sharp and often critical. This, in a large measure, defeats the very purpose for which the added steps were intended.

There are, however, means for overcoming this drawback in the form of neutralization and

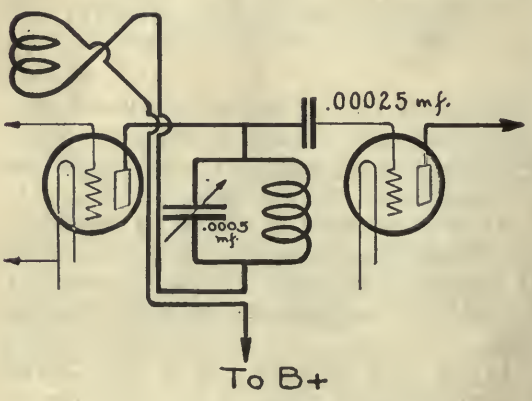


FIG. 6

The circuit for the Superdyne or negative feedback for the impedance-coupled amplifier

negative feedback. Both methods will be discussed.

In general, some of the various forms of radio-frequency amplification are: untuned transformer-coupled, tuned transformer-coupled, tuned impedance-coupled, and resistance-coupled.

The untuned transformer-coupled type is not equally efficient over its entire wavelength range as it is for one certain wavelength within its band. In other words, it has a peak value for most efficient operation. Several steps are needed to equal the performance of various of the other types. See Fig. 3.

The tuned transformer-coupled type was, and perhaps still is, very difficult to tune except where proper steps have been taken to include the neutrodyne feature in the circuit. This renders the set free from the self-oscillation of

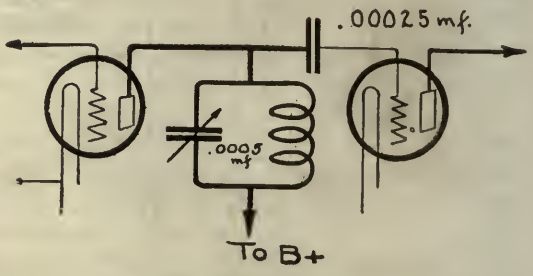


FIG. 5

Circuit for the tuned impedance-coupled amplifier

the tubes, allowing easy yet sharp control. See Fig. 4.

The same oscillation trouble was true of the tuned impedance-coupled amplifiers, but the use of the negative feedback, or Superdyne method, partly eliminated this drawback. See Figs. 5 and 6.

In Figs. 3, 4, 5 and 6, only single stages of the radio-frequency amplifier units have been shown. With the exception of the Superdyne method, for more than one stage of amplification the circuit for the successive units would be the same, that is, the output of one would be connected to the input of the following unit.

Several of these various types of radio-frequency transformers were dealt with in great detail in past issues of RADIO BROADCAST. A reference list follows:

For untuned R. F. transformers, see page 393, March, 1923, issue.

For tuned R. F. transformers see page 393, March, 1923, issue, page 499, April, 1923, issue, and page 214, July, 1923, issue.

For neutrodyne system, see Dec., 1923, Jan., 1924, and Feb., 1924 issues.

For resistance-coupled amplifier, see page 330, Feb., 1923; also this issue page 39.

How to Build the Knock-Out Two-Tube Set Behind a Panel

By WALTER VAN B. ROBERTS

It is worth knowing that this circuit has given excellent satisfaction as to distance, is not hard to build, and is sensitive and *does not radiate*. Mr. Roberts began work on the circuit last December and his original descriptive article appeared in RADIO BROADCAST for April. —THE EDITOR.

IN RESPONSE to the demand for a better looking arrangement of the circuit described by the writer in the April issue of RADIO BROADCAST, the sets shown in the photographs have been built, and work about as well as the original arrangement. For one set the coils were wound on five and ten cent store spider web forms, and a five and ten cent store brass arm was used to operate the tickler coil. The other set makes use of coils built especially for this use by the Turney Laboratories, and can be wired so as to appear somewhat neater. It has adjustable coupling between coils P and S of the circuit diagram of Fig. 1. This feature allows maximum efficiency over the whole wavelength range, but it is recommended that only two or three values of this coupling be used. Variation of this coupling changes the condenser settings. For long waves, say 450 to 600, have P and S about ½ inch apart, for the range 300 to 450 have them, say 30 degrees apart, and for very short waves, have them fully separated. They can of course, be left at some compromise position, as in the other set, and never varied. Both sets work about equally well.

These parts are needed:

If the set is entirely home built.

2 General Radio (or equivalent) .005 mfd. condensers.
.005 mfd. micadon
.0025 mfd. micadon
2 25-ohm Cutler-Hammer resistance strips
Amertran audio-frequency amplifying transformer
6-ohm rheostat
UV-201-A socket
UV-199 socket
Grid condenser with grid leak clips; .00025 mfd. condenser, grid leak, 3 megohms
bus bar (neutralizing capacity "C")
bus bar for connections
spaghetti
binding posts
panel, formica or bakelite
wood sub-base
contact points
switch lever
3 coils (3 ten cent store spider web forms, wire, about No. 26 B & S)

If the set uses purchased coils—

same as above, except parts for the coils are omitted. Turney Laboratories coils and mountings.

Because of the great variation in price of these various parts, no price estimate is given. Any piece of apparatus which will do the same work as a special one mentioned in the article may be substituted for it.

HOW TO BUILD THE SET WITH HOME MADE COILS

FOLLOWING are instructions for building the set using home made coils: Fig. 4 shows how to drill the panel. In case it is necessary to use other makes of parts than those specified, drill only the holes for their shafts according to Fig. 4, and then drill holes for their supporting screws wherever necessary. A baseboard ½ inch thick with cleats ½ inch thick is used. Fig. 3 shows the positions of parts on top of the baseboard, together with the approximate arrangement of some of the wiring. The rest of the wiring is easily done by referring to the circuit diagram of Fig. 1. Coil A, the antenna coil, is mostly hidden in the photograph. Its inner lead goes to the antenna binding post, which is the upper left hand one when the panel is looked at from the front. The ground binding post, which is just beneath, connects to the rotating contact arm. The left contact point (viewed from the front

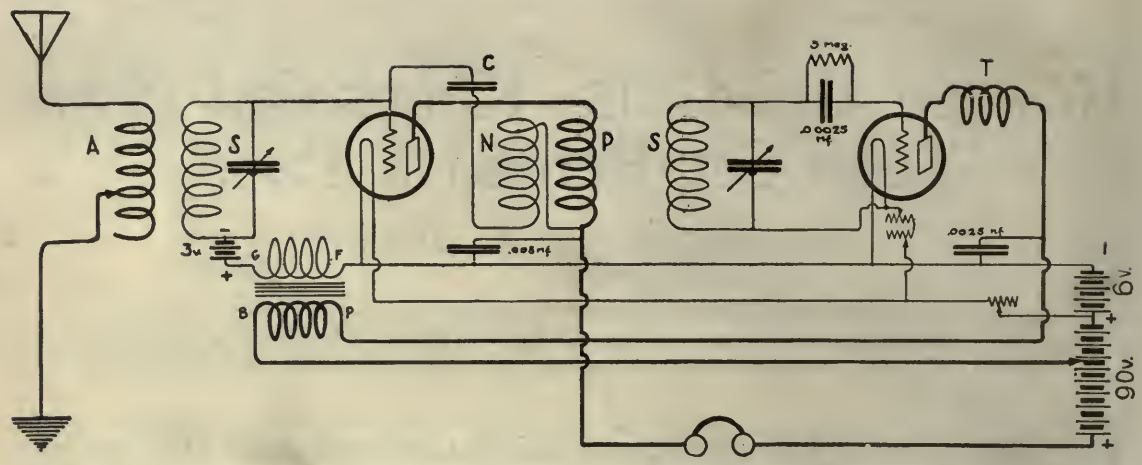


FIG. 1

The Roberts circuit. Revised as originally printed last month. Several changes have been made. A 3- instead of a 4½-volt C battery is used, a .005 mfd. condenser is added in series with winding N, and in the grid return of the UV-199 is made through the — filament

of the panel) is connected to coil A one turn from the inner lead. The next contact point connects to the second turn. Point No. 3 goes to turn No. 5. Point No. 4 to turn No. 10. Point No. 5 to turn No. 20. Point No. 6 to turn No. 30. Point No. 7 to turn No. 40, which is the outer lead from the coil. Coil A is wound of No. 22 d.c.c. wire, winding over two teeth, then under two teeth, etc.

Coils S, one of which hides A in the photograph, are wound in a similar fashion, and with the same kind of wire, but there are 44 turns and no taps. The separation between coils A and S should be ¼ to ½ inch between centers. They are set slightly askew so that they "aim" at the centers of the coils at the other end of the board.

Coil T, the tickler, is the coil mounted on the rotating arm, and has about 18 turns of any kind of magnet wire wound any way. (If oscillations occur before the tickler is turned down somewhere near the other coils, there are too many turns on it. If oscillations do not occur when turned well down toward the other

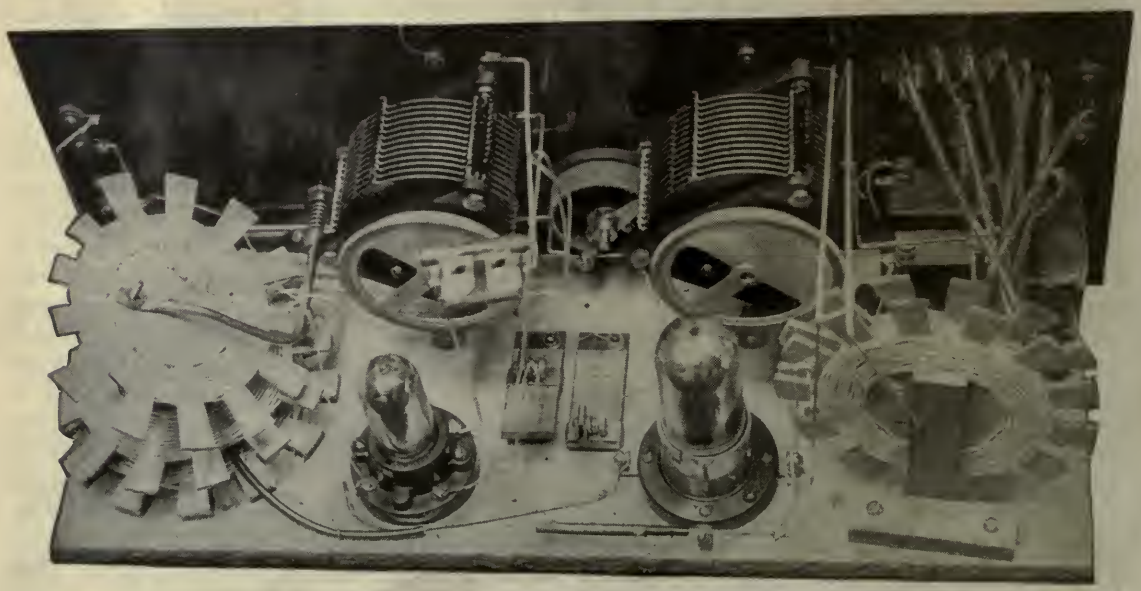


FIG. 2

The home made set behind a panel. As can be seen, the construction is quite simple

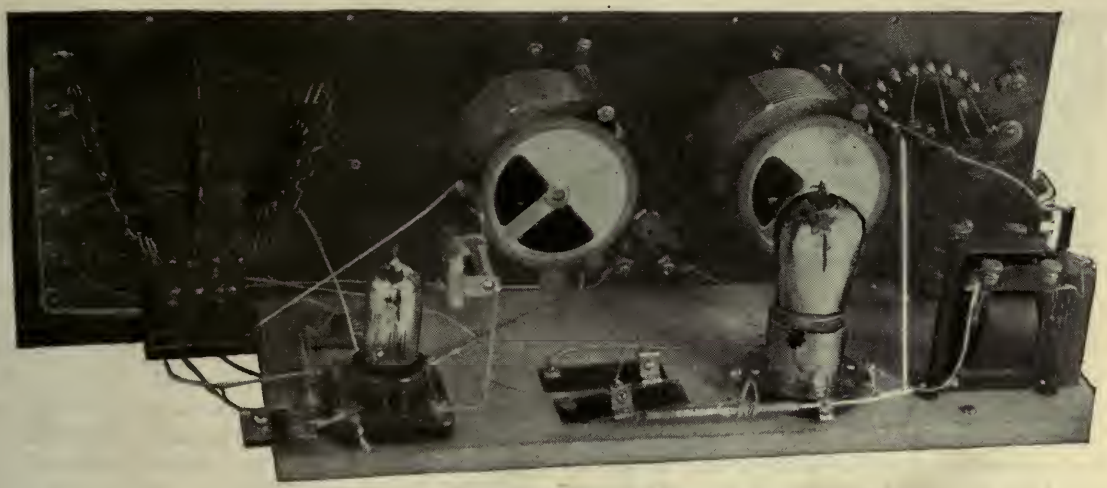


FIG. 3
Behind the scenes of the Roberts circuit using the manufactured coils

coils, the tickler is probably connected backward.)

The coil containing the windings N and P is the one lying flat on the baseboard. Coil S is screwed down on top of it, and separated about ½ inch by a piece of wood with a hole for the screw to go through. N and P are each 20 turns, being wound both at once by simply using a pair of wires instead of a single wire to wind with. Wind over one tooth, then under one, and so on. Use wires no larger than No. 26, preferably of different colors so that no mistake will be made in connecting up.

The sliding contacts on the two Cutler-Hammer 25 ohm resistance strips should be set so that there are about 35 ohms altogether. One slider at the end (about 20 ohms) and the other at the middle, will be about correct. Never remove the 201–A tube from its socket while the filament of the UV-199 is lighted, as this will increase the current through the 199. Connect the outer lead of the coil S which is coupled to coil A, to the grid of the 201–A tube, but the inner lead of the other S coil to the grid of the 199. The stationary plates of the condensers are the ones that are connected to the grids in both cases as is indicated by the diagram. If the rotating arm on which the tickler is mounted happens to be bent the wrong way, saw it off and solder together the other way around. Be sure that the terminal marked P on the primary of the Amertran is connected to the tickler, *not* to the B battery terminal. If some other make of transformer is used, try

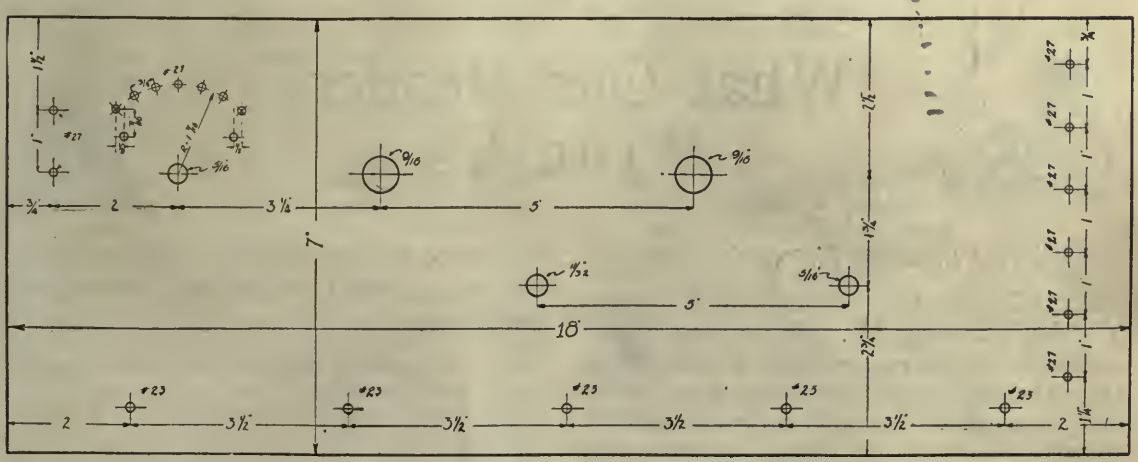


FIG. 4
Panel layout for the home built set. The panel with manufactured coils is three inches longer



FIG. 5

Front view of set using manufactured coils. The experimenter has plenty of leeway in building his own set of this type

connecting its primary both ways to see which works right. In connecting windings N and P, first connect the *outside* lead of one to the inside lead of the other. Be sure not to simply connect the outside lead of one to its own inner lead.

The neutralizing capacity, C, is easily made by leaving two inches of bus bar projecting from the grid terminal of the 201–A tube. This is covered with spaghetti. A brass tube connected to the free end of winding N is then slipped over the spaghetti, fitting snugly. (Bare wire wrapped tightly around the spaghetti will do instead of the tube.)

See the article in the April Radio Broadcast for directions for adjusting the capacity C, and for the theory of the operation of the set.

THE SET WITH PURCHASED COILS

THE set using the Turney coils was built on a 21-inch panel to make it less crowded. The baseboard, however, is only 16 inches long. Coils A and S are mounted 2 inches from the panel and parallel to it. The circuit is the same as in the other case, although the wiring is slightly altered to suit the different arrangement of parts.

In both sets, General Radio .0005 mfd. condensers with slow motion gearing are used. The rheostat is 6 ohms. The 201–A socket is a Paragon, while for the 199 tube, either Paragon, General Radio, or Radio Corporation sockets are recommended. Binding posts, contact points and panel, can be got at the five and ten cent store.

To get an idea of what performance to expect, the following is of interest: WGY is received quite satisfactorily on the loud speaker in Princeton, N. J. at any time of day, and KDKA can be heard faintly. At night KHJ is barely audible on the loud speaker, while KGO is almost loud, and can be separated perfectly from WLW, whose wavelength is only 1 per cent. different. (The respective settings of these two stations on the set using the home made coils are 23 and 22½.)

The original set described in the April Radio Broadcast is now being used by Dr. L. A. Turner of the Dept. of Physics, Princeton University, who has heard KGO on the loud speaker, using an indoor antenna!



What Our Readers Write Us



With the Broadcast Listener in Samoa

ALONG with this extraordinarily interesting letter from Mr. Roberts came several copies of a twenty-page radio bulletin which the enthusiastic listeners of Samoa issue "every once in a while" under the direction of Mr. Roberts who types the thing. We regret we haven't space for it. However, the transatlantic tests which Radio Broadcast sponsored last November were by no means unsuccessful, as the flood of letters we received demonstrated conclusively.

Consulate at Apia, Samoa, January 21, 1924

Editor, Radio Broadcast,
Doubleday, Page and Co.,
Garden City, L. I.

Dear Sir:

I have read in the January issue of Radio Broadcast an account of the transatlantic broadcasting tests. It ap-

pears that interest in the test was general, leading broadcasters, eminent engineers on both sides of the Atlantic, the press services, and prominent men coöperating in the tests.

Using super-heterodyne receivers at Garden City, faint voice and music was heard. The Radio Editor of the *New York Times* writing December 9, 1923, indicates that the tests from the view point of the American listeners were failures. Broadcasting stations, spark stations, and static interfered with the tests.

I have briefly summarized the results of the transatlantic tests as gathered from my latest magazines and papers in order to compare your results with the success of the transpacific tests now being carried on by WBAP the *Star-Telegram,* Fort Worth, Texas.

Incidentally, it may be of interest to learn that RADIO BROADCAST is responsible for the transpacific tests. Mr. G. C. Arnoux, Program Director of WBAP, read "When the Bug Bit in Samoa" in the October number of RADIO BROADCAST and wrote me suggesting a series of tests with Samoa.

The proposal was brought to the attention of the broadcast fans of Western Samoa who established a listening-in schedule drawn up to eliminate interference from Apia and Tutuila spark stations and from the single-circuit regenerative receivers in operation in the vicinity of Apia. Radio fans were to listen in on the following dates:

NPU Tutuila Radio Station, American Samoa. All dates.
VMG Apia Radio Station, Apia, Samoa. All dates.
Father J. B. Dumas, Aleipata, Upolu, Samoa. All dates.
W. R. Ragsdale, Palauli, Savaii, Samoa. All dates.
Quincy F. Roberts, Apia, Samoa. January 6, 1924. 11.30 P. M. to 12:30.
John H. Dixon, Apia, Samoa. January 11, 1924. 11.30 P. M. to 12.30.
VMG was given January 9, 1924. free from interference from the single circuit regenerative receivers.
All stations—January 21, 1924, and January 23, 1924. 11.30 P. M. to 12.30.

The difference in time made WBAP's transmitting hours from 5.00 A. M. to 6.00 A. M. January 7th, 10th, 12th, 22nd, and 24th.

On January 6, 1924, the music from the Coconut Grove Orchestra at the Ambassador Hotel, Los Angeles, transmitted through KFI ended. The next three hours were spent in cleaning connections, adjusting voltages, and changing tubes in an effort to find the right combination for best results. At 11.30 WBAP'S carrier wave came in. Adjustments brought in voice. Bang. Apia Radio opened up with its 8 kilowatt spark set. Tutuila came back with his broad spark. Several ship sparks joined the chorus. Both NPU and VMG had forgotten the Fort Worth tests. The telephone service was over hours earlier. There was no way of informing VMG that his spark was drowning out WBAP'S messages. We could hear voices and strains of music between the dots and dashes.

Static and interference had combined to make the first test a failure, but the strength of the signals was sufficient to convince the radio fans of Western Samoa that under more favorable conditions WBAP would span the Pacific.

Receiving conditions during the second test were slightly better. Static was heavy. Lightning flashed on three sides of Apia. Two or three ship stations were using a frequency which overlapped the Fort Worth wavelength.

WBAP, in the heart of Texas, came on the air at 5.00 o'clock in the early winter morning of January 10, 1924. Radio enthusiasts of Samoa in the last half hour of midsummer January 9, 1924 caught the signals.

Clear and strong the Texan spanned the Pacific with, "This is WBAP, the *Forth Worth Star-Telegram* of Fort Worth, Texas, United States of America calling
NPU—American Samoa,
Savaii Radio Station—Savaii, Samoa,
Apia Radio Station—Apia, Samoa,
Mr. Quincy F. Roberts, American Vice Consul in charge, Apia, Samoa,
Father J. B. Dumas, Aleipata, Samoa,
Mr. John H. Dixon, Apia, Samoa,
Mr. W. R. Ragsdale, Palauli, Samoa,
All stations in New Zealand, Australia, Java, Borneo, Sumatra, Japan, Philippines, and China.
If you receive this send a cablegram or a radiogram to the Radio Department of the *Fort Worth Star-Telegram,* Fort Worth, Texas, and we will refund telegraphic charges to you. This is station WBAP, *Fort Worth Star-Telegram,* Fort Worth, Texas, United States of America. Stand by. We will change to Morse then give you music."

Morse followed. Then the operator shifted to the pipe organ and a longing for home filling the hearts of the listeners brought tears to their eyes as old familiar melodies came through space.

My wife looked up and said. "We've been away too long. We must go home in April."

Then and there we decided to return to the United States in the Spring. Fort Worth's second test is bringing joy to a family in the hills of Tennessee and to another on the Great Lakes. Our relatives are receiving word that we are due in New York next May.

Imagination did not help in the long distance reception. Although static was exceptionally heavy and spark stations interfered, I can safely say that the entire program was received. It was possible for us to recognize the accent of the announcer. We marked errors in the pronunciation of Samoan village names as the speaker struggled through the list of places he called.

Mr. W. R. Ragsdale from Savaii writes, "Speech and music transmitted by Fort Worth came in at my station. The signals were very loud on a single dry cell tube. Conversations were recorded and will be submitted for verification upon the conclusion of the tests. Static and spark stations interfered badly, but it was almost impossible to miss WBAP and his cow bells."

Mr. John H. Dixon, Plant Engineer at Apia Radio reports, "Static was bad during my test with WBAP. I heard the announcer request South Pacific, New Zealand, and Australian, stations to report on the test. Organ music came in. As the names of the pieces played were not announced I can not give the complete program."

There are only two more stations to report. VMG did not listen in. NPU'S short wave receiver failed and was in Honolulu for repairs during the tests. Father J. B. Dumas and Doctor R. L. Christie have not yet had an opportunity to send in their reports to Apia from Aleipata.

The results so far are—three of the five broadcast fans of Western Samoa using a single tube variometer set, a single-circuit regenerative receiver with two stages of audio-frequency amplification, and a five-tube receiver with two stages of radio frequency and two stages of audio-frequency amplification succeeded in receiving WBAP through static and spark signals, a distance of 5,850 statute miles.

The reception of American broadcasting stations by the fans in Western Samoa is no longer considered remarkable.

Seldom are receiving conditions so unfavorable that music transmitted by the high powered Pacific Coast stations can not be tuned-in.

The following American stations are heard regularly in Samoa:

KFI	Los Angeles	4,750 miles
KHJ	Los Angeles	4,750 miles
KPO	San Francisco	4,750 miles
KGO	Oakland	4,750 miles
WJAZ	Chicago	6,555 miles
	Wednesday working WNP	
WDAF	Kansas City.	6,110 miles
	Night Hawk Frolic	

Other stations heard at various times are:

KLX	Oakland	4,750 miles
KGW	Portland	5,080 miles
WBAP	Fort Worth	5,850 miles
	Test only.	
CFAC	Calgary	5,620 miles
	Test only	

An examination of the two lists clearly shows that international broadcasting between the United States and Samoa is carried on during the winter months of the temperate zone. Our small receivers consistently night after night reach out 5,000 miles and bring in American programs. It may be there is a scientific explanation for the long distance records made in Samoa. A study of the territory covered by the larger stations plotting the most distant points reached might be interesting. I know that maps showing the territory covered by KFI, KGO, KPO, WHB, and WJAZ would be interesting to the amateurs of Samoa.

Very respectfully yours,

QUINCY F. ROBERTS,
American Vice Consul in Charge.

What to Do About Radiating Receivers

Editor, RADIO BROADCAST,
Doubleday, Page and Co.,
Garden City, L. I.

DEAR SIR:

In your March issue, Mr. Dreher in his article "Is the Broadcast Listener at Fault" strikes the right chord when he states that the remedy for many of the listener's troubles lies in education of the public. First, the advertiser should be educated to state whether or not the receiver he is selling radiates; second, all radio magazines should be educated to state in connection with every "hook up" printed whether or not it is a radiating circuit, and third, all radio magazines should be educated to run continually instructions as to how to operate radiating receivers without raising the dickens for a dozen or so blocks around them. A new crop of suckers is born every spring and it takes the repeated instruction to keep up with the new crop. There might be added a fourth point, that the magazines should be educated to cease asking for reports on DX reception. Calling for such reports only serves to stimulate the "squealers" to greater activity.

You have started a good educational campaign, but I take it you have "some job" ahead of you yet.

Yours truly,
P. R. VAN FRANK,
Memphis, Tenn.

The Grid

QUESTIONS AND ANSWERS

The Grid is a Question and Answer Department maintained especially for the radio amateurs. Full answers will be given wherever possible. In answering questions, those of a like nature will be grouped together and answered by one article. Every effort will be made to keep the answers simple and direct, yet fully self-explanatory. Questions should be addressed to Editor, "The Grid," RADIO BROADCAST, Garden City, N. Y.

NON-RADIATING RECEIVERS

I read with great interest the article in the March number of Radio Broadcast on "The Truth About Trick Circuits." Allow me to congratulate you on the courageous stand you have taken.

I have been considering for some time, the purchase of a Tuska Superdyne receiver, but am now hesitating for fear it may be one of those referred to in the article. Will you please tell me if it is a re-radiating receiver?

O. A. J., ROCKVILLE CENTER, N. Y.

FIRST allow us to correct our correspondent on the prevalent mis-use of the term "re-radiating." Re-radiating means, of course, radiating again which in very few cases is the phenomenon referred to when the term is applied to oscillating receivers. Re-radiation occurs when resonant or tuned objects, such as wire fences, guy wires, the steel frames of buildings, etc., pick up energy from a near-by and powerful transmitter and, by impulse excitation, retransmit a portion of this energy on their individual wavelengths.

In the case of a banned receiver, the set itself is a small transmitting station, generating its own power which is sent out on the air to make itself evident as squeals and whistles in neighboring receivers. Thus the oscillating receiver is correctly termed a *radiating* set, the prefix *re* being unnecessary and meaningless.

The Tuska Superdyne receiver, when correctly operated, is not a radiating set, and many of our readers have found it a most satisfactory equipment. Oscillation in the first tube which results in radiation, is prevented by what is known as reversed feedback. Most of us who have used tickler feedback receivers have learned that the receiver

will generate and oscillate only when the tickler coil is "connected in the right direction." If the leads to this coil are reversed, the effect is quite the opposite of regeneration—the circuit refuses to oscillate, and signals are weakened as the tickler is more closely coupled to the grid circuit. This is the reversed feedback principle employed in the Tuska Superdyne, which permits the set to take full advantage of tuned plate (resonant) radio-frequency amplification.

For the benefit of our interested readers, and to save them the trouble of communicating with us, we herewith list a few of the more prominent non-radiating receivers.

All forms of radio-frequency amplified sets are non-radiating when properly operated. It is impossible to secure satisfactory reception when they are oscillating. This broad statement completely covers the following:

The Neutrodyne, which is probably the most stable of all R. F. receivers.

The reflex sets De Forest, Grimes, single tube, Erla, Acmedyne, etc.

Receivers having aperiodic primaries, while they radiate to a slight degree, are far less bothersome than other types of regenerative receivers, and, in most cases, they may be used with a clear conscience. This circuit is shown in Fig. 1. The Haynes circuit, which was inadvertently and incorrectly mentioned as a "trick circuit" in the article to which our correspondent refers, is representative of commercial instruments of this type.

The super-heterodyne when used with a loop may be considered as a non-radiating receiver, even though the principle upon which it functions depends on a constantly oscillating circuit. These oscillations, however, are confined to two small coils within the receiver, and for this reason they are not radiated to any great extent. Even this very small radiation has been practically eliminated on broadcasting wavelengths in Armstrong's latest variation of his original receiver which is called "The Second Harmonic Super-heterodyne." This receiver, rather than using direct oscillations in the neighborhood of the received frequency, employs a widely different main frequency, the comparatively weak second harmonic of which replaces the usual heterodyning wave. This system makes practicable the super-heterodyne on the extremely short waves below one hundred and fifty meters, where, using the main oscillating wave, the radiations, which are characterized by a remarkable efficiency, would carry fully as far as the lower frequencies now do on the antenna operated "bloopers."

The Theoretical "Why" of R. F. Amplification

In these advanced days, when radio-frequency amplification is the keynote of wireless reception, I think many of your readers, including myself, would appreciate it if you would clear up a theoretical point that has bothered me for some time.

I do not understand how radio-frequency oscillations are passed on from one tube to the next tube. I have always been taught that the plate current, which of course is responsible for the inter-tube transference of energy, is a direct current. Thus it seems to me that a single tube is all that is required to block effectively a high frequency alternating current such as forms a radio signal. And yet it appears that three or four of such tubes do not block or impede the progress of these currents in any way, but to the contrary intensify them Why?

B. J. S., Niles, Mich.

THE phenomenon which puzzles our reader is, briefly, how can a vacuum tube, through which only a direct current may flow, pass an alternating current on to the next tube? This is explained by pointing out that the tube does not pass on the original current which was applied to its input side—rather each tube "generates" on its output side an entirely new alternating current, which, however, is an amplified duplicate of the original impressed signal.

The majority of our readers are familiar with the action of the three element vacuum tube, the plate current of which is an electron stream, thrown off by the filament, attracted to the plate by the positive B battery charge, which may be varied by an additional charge placed upon the intervening grid. The slightest variation of the original grid potential either impedes (with a minus variation) or increases (with a plus variation) the plate (or space) current. Thus, when an alternating current, or a radio impulse is impressed on the grid of the tube, which means that the original grid charge is momentarily augmented and lessened, the direct plate current becomes stronger and weaker.

The plate current, after the manner of all currents, sets up in its immediate vicinity a magnetic field, which, if the plate current is made to flow through the primary of a radio-frequency amplifying transformer, will "cut" the secondary. The magnetic field varies with the strength of the current which sets it up, and thus the flux will rise and fall, keeping perfect time with the grid variations. When a magnetic field moves in this manner, an alternating current is set up in any adjacent windings such as the secondary of the amplifying transformer.

This alternating current is now impressed on the input side of the succeeding tube where the process is repeated. Thus each radio-frequency amplifying tube relays an alternating current on to the next audion, without actually passing any of the input current.

Phantom Circuits and Phantom Receivers

I read with great interest the article in the March Radio Broadcast *showing how the old standard circuits are dressed up in deceptive garments by unscrupulous and ignorant dealers.*

I have been interested in the possibilities of the Oard Phantom Receiver, manufactured by the Oard Laboratories, Stock-

ton, California. I should appreciate your informing me if this receiver employs the "phantom" circuit described in the article in question. R. O. M., Milwaukee, Wis.

NO. THE circuit employed in the Oard Phantom Receptor is a different one. Moreover, the manufacturers of this receiver do not claim their circuit to be a new one, but distinctly mention in their advertising matter that it is licensed under the Armstrong regenerative patents.

This undesirable association of the Oard Receptor with the "phantom circuit" described in the March RADIO BROADCAST is additionally illustrative of the "gyp" phase of our young industry. Following the national advertising campaign of the Oard people, an unscrupulous concern advertised "the famous Phantom circuit" which, through natural association, cashed in on the Oard advertising.

This commercial plagiarism is found in all varieties of endeavor, but it is particularly malignant in budding industries, such as radio now is. The "Micadyne" condenser is another example of "gyp" enterprise. The "Micadyne" is an obvious and unjust take off on the Dubilier "Micadon," and a permanent injunction has been issued enjoining the counterfeiters from manufacturing the "Micadyne."

The radio enthusiast will find many other misleading trade similarities. He should discover, if he can, the original product or prototype, and beware of the imitation. An honest product will stand on its own legs—and an honest manufacturer does not stoop to camouflage or deception.

"Accept nothing but the genuine", has been applied to everything from pills to suspenders, but in no industry should this warning be taken more seriously than in radio.

WHEN IS MY SET OSCILLATING?

I have a three-circuit regenerative receiver which I understand should not interfere with my neighbors as much as would a single-circuit set. However, another fan, living next door to me, claims that he hears me when my set is oscillating. I have no desire to interfere with his pleasure, and am always unaware of the fact when my set is radiating. Is there any way that you can tell definitely when a set is oscillating?
A. T. R., Roswell, N. M.

IT IS often difficult for the untrained radio ear to determine when a circuit is oscillating. However, you may be certain that you are causing trouble when, as you tune across the wave of the broadcasting station, a whistle is audible that varies directly with your tuning.

A sure test for oscillations is touching either the grid connection of the tube, or the antenna binding-post. A slight click or scratch will always be audible when this is done, but a much more definite "blop" will be heard if the circuit is oscillating. However, touching the antenna post only affects the first tube, and the grid connection should be touched when testing radio-frequency amplifiers, difficulty with which is often caused by one or more of the tube circuits falling into oscillation.

Oscillations are controlled in most receivers by turning down the filament and by reducing regeneration. In radio-frequency stages, they are generally eliminated by potentiometer adjustment, reduction of filament current, and by reducing the plate voltage.

A. C. AND D. C. CHARGERS

Is there any difference in storage battery chargers operating from the house lighting lines, as determined by whether the user is supplied with alternating or direct current?
A. L. J., New York City.

YES, there is all the difference in the world. A charger designed for alternating or direct current will operate only on the current supply for which it was intended. A direct current charger, connected to an alternating current source, will not charge, while an A. C. charger connected to direct current mains will burn out its primary winding, or blow fuses.

Direct current for charging need only be reduced to the proper voltage, while alternating current must be reduced and then rectified to direct current. Direct current voltages are generally reduced by the inclusion in the circuit of a suitable resistance. The Ward-Leonard direct current charger is an excellent example of this type of apparatus.

Alternating current chargers consist of step down transformers for rec[illegible]

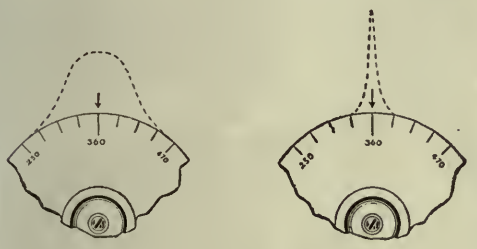
ABOUT YOUR GRID

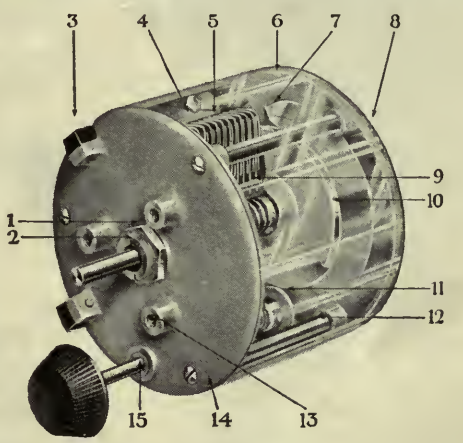
Judging from the rapidly increasing demands made upon this section, it is performing a valuable service—but it is getting to be a very serious problem.

As a general rule replies to letters addressed to the GRID require the drawing of a diagram or two and a considerable amount of research. Similar service, if purchased elsewhere, would cost a very tidy sum. We are pleased to offer this service to our readers without charge but feel that it is up to our readers to coöperate with us to the extent of sending, with their requests for information, a self-addressed, stamped envelope. Unless our request is complied with the GRID will be unable to consider these inquiries.—THE EDITOR.

Improve your set with an ★ ACME "lowest loss" condenser

Because of low losses and sharp tuning practically all the currents on the antenna can now be used





Which one is your tuning circuit— *the hump or peak?*

HERE are the curves of two tuning circuits The hump has a high loss condenser and the peak a low loss condenser Both receive broadcasting, but the peak receives local and distant stations without interference, while the hump receives only the nearby stations with interference The new Acme Condenser will change your tuning circuit from a hump to a peak

The Acme Engineers have been working for two years to bring out a condenser which would give to Radio experimenters sharp tuning and minimum losses. The new Acme Condenser has these fundamental advantages and also has many new improvements in structure and equipment. See the illustration with explanation, and for more information write to us for booklet—"Amplification without Distortion," which contains many diagrams and helpful hints on how to build and get the most out of a set.

ACME APPARATUS COMPANY
Dept 65 Cambridge, Mass

1. Steel brass cone bearings adjustable.
2. Lock nut for bearing.
3. Highest grade hard rubber. Dielectric in that part of the field to prevent losses
4. Brass separator to which both rotary and stationary plates are soldered, making continuous circuit for each.
5. Brass silver plated plates, rotary plates logalogarithmic.
6. Dust proof covering
7. Stops at extreme end of movements
8. Coiled connection between shaft and heads allowing lubrication of bearings.
9. Brass separator to which both rotary and stationary plates are soldered, making continuous circuit for each.
10. Counterweight which balances rotary plates
11. Noiseless friction Vernier control seven to one ratio.
12. Brass separators to prevent twisting and to take strain off Dielectric
13. Panel mounting holds for 120 degrees spacing.
14. Metal heads
15. Steel bushing to prevent wear on Vernier shaft.

All parts are of non-rusting metal, except steel bearing, which is covered with nickel-plated protective surface. End plate capacity is .000016 m f , full capacity is .0005 m.f. Price $6 50

CUT OUT AND SEND THIS COUPON

ACME APPARATUS COMPANY,
Dept 65 Cambridge, Mass , U S A

Gentlemen: I am enclosing 10 cents (U S. stamps or coin) for a copy of your book, "Amplification without Distortion."

Name .....

Street .....

City ..... *State* .....

ACME ~for amplification

★ Tested and approved by RADIO BROADCAST ★



© Harris & Ewing

WALLACE H. WHITE, JR.

The author of the bill which proposes further to regulate radio communication in the United States. Among other things the bill contains stringent provision against monopoly in radio and provides for license fees to be collected by the Department of Commerce, ranging from $300 for transatlantic stations to fifty cents for an amateur license. Owners of receiving sets are not subject to a charge. Mr. White represents the second Congressional District of Maine

RADIO BROADCAST

Vol. 5, No. 2 June, 1924

Can We Save Millions by Altering the Telegraphic Code?

From a Close Study of the Plan Proposed by Major-General George O. Squier It Would Seem Possible. This plan deserves Serious Consideration

By ARTHUR H. LYNCH

SOMEONE has been sleeping. In fact so many of us have been sleeping that we've simply let a problem involving a saving of millions slip right by for more than seventy years* without troubling for a solution. Perhaps our noses have been so close to the picture as to distort our perspective. Major-General George O. Squier who told this story to me at the Metropolitan Club in Washington, D. C., a few weeks ago said: "The neglect on the part of the radio telegraph industry to alter its only product is a problem in psychology of sufficient magnitude to warrant the study of a James."

"Our automobile factories, for instance," continued the General, "are never satisfied with the product they turn out. Even though they spend veritable fortunes for machinery to make a certain type of car, whether it be a truck or a luxurious sedan, they go right on developing new models. And they find it profitable.

"More efficient cars, more efficient production methods, more rapid turnover and a greater volume of business usually result in a lower price and better service to the consumer and the demand continues to grow each year.

*The present radio alphabet was adopted by the Vienna Convention for European languages in Oct. 1851.

"Can you imagine any automobile corporation attempting to sell wheelbarrows produced in factories capable of turning out the best-grade pleasure car in the world?" The General's eyes sparkled and the color rose in his cheeks as he continued: "That's exactly what we're trying to do in radio telegraphy—and they're flat-wheeled barrows at that.

"WE ARE ASLEEP IN RADIO"

"WHY, just imagine how ridiculous it would be for a factory representative of any large company attempting to secure orders for his product from samples made in 1851 or thereabouts! It's preposterous.

"Now, let me briefly outline for you what I maintain is one of the greatest pieces of neglect in the entire communications art. Then, having told you of our short-sightedness, let me tell you what I think about solving the problem. Understand me, I do not maintain that my method of solving the problem is the best method, nor that it is impossible to improve upon it. All I want to do is to demonstrate the need for a revision of our radio, telegraph and cable traffic which will cause a great financial saving annually. Then I want to tell you how I believe it can be done. If my system can be

improved upon, so much the better. All I claim for it is that it is a step in the right direction.

"Radio's function, or to be more exact, one of its present functions, is to transmit intelligence from point to point. In the case of ships at sea and aircraft it is the only method. When we send a telegram or a cablegram or a radiogram, we pay to have a small piece of paper, bearing a few characters, delivered to a person or persons some distance from us. The more messages we wish sent, the greater the number of little papers the company delivering them must be able to take care of satisfactorily. In many instances the lines between us and the person on the other end are heavily laden with messages sent by other folks and our messages suffer a delay.

"Something must be done to offset the delay. It is sometimes necessary, because of the great volume of traffic to have a great many similar lines between two points to carry the heavy burden of traffic. Engineers, ever since electric signaling was discovered have studied the action of the machines used in transmitting and receiving this intelligence. They have made astounding improvements and have increased the speed of transmission many, many times. Why it was but last night that both you and I witnessed a transmission of a dot sent from the lecture room of the Cosmos Club to Warsaw and back again to Washington before we could say Jack Robinson.

"If we had suggested any such thing a few years ago people would have shaken their heads and have had grave doubts of our mental stability. But it was done before our very eyes.

"Although my plan is not at all confined to radio but may be employed on the cables and telegraph and even the telephone lines, we will do well, for the purpose of explanation to stick to radio and the necessary changes for all forms of wire application will suggest themselves to most of your readers.

"You know as well as I do that radio transmission, especially over long distances, such as between America and Europe is subject to certain atmospheric disturbances during the summer. Although engineers have made great strides in overcoming this interference there are many periods when it is necessary for the transoceanic traffic to be handled at very low speed and when it is necessary to have each word repeated two or three times.

That means a severe crowding of the ether lane used by any two stations being used for intercommunication and the few available wavelengths preclude the possibility of doubling up the number of stations to offset this difficulty.

"If we consider that for a definite period of unfavorable atmospheric conditions it were possible for us to double the speed of transmission during the favorable hours of each day. we would double the revenue of our system for that period. Further than that—you know that most of the messages sent from this country to Europe are important. Many of them have to do with ships, shipping, foreign exchange and so on. With each day, the importance of our communication with Europe becomes even greater. Offsetting by even a few moments in the delivery of a message sent by one of the large banks, like the Irving National or National City Bank to a bank in Germany or England may result in preventing a loss of thousands of dollars to American investors. Commerce to-day is on what manufacturers are pleased to term a production basis. Speed in communication is everything.

"Manufacturers in most lines spend thousands yearly, attempting to lower costs of production by saving a little time here and a little material there. Efficiency seems to be our war cry and it is just here that radio suffers by comparison with other industries.

PRODUCING CAVE-MAN VEHICLES IN LIMOUSINE FACTORIES

"WE'RE selling a seventy-year old model and turning it out in modern factories. We have million dollar factories on occasion covering many square miles for the sole purpose of sending dots and dashes. We have been in short, perfectly content to take things as we find them and make the best of it."

Then the General took a long pull on his cigar, looked at the ceiling and exhaled the smoke slowly and thoughtfully. He smiled, sensing my unspoken question.

"Oh, no!" he said, "I am not discounting any of the wonderful work the engineers have accomplished, either in the design of transmitters or receivers. I am merely saying that they have overlooked the little pieces of paper that carry the thoughts of one individual to another.

"Their transmitters and receivers are wonderful. But the product of the factories must



MAJOR-GENERAL GEORGE O. SQUIER (RETIRED)

Who, since his retirement on January 1st as Chief Signal Officer of the army after more than forty years of continuous service, has been indulging in long deferred plans to carry out experimental work in electrical communication engineering

TABLE I

RESULTS OF INTERCHANGING THE SIGNALS FOR THE LETTERS "O" AND "M"

For International Morse:		
Present values of these letters:		
O—frequency in 10,000, times length of signal	844 x 14 =	11816
M— " " " " " " "	273 x 10 =	2730
Total		14546
Values if interchanged:		
O—frequency in 10,000, times length of signal	844 x 10 =	8440
M— " " " " " " "	273 x 14 =	3822
Total		12262

Gain as a result of interchange = 14546 — 12262 = 2284 units

The new total for all letters would therefore be		92534
	minus	2284
		90250 units

The ratio of the new value to the old value is 90250 : 92534 = 1:1.025
The increase in speed expressed in percentage is 2.5%

For Squier Alphabet:		
Present value of these letters:		
O—frequency in 10,000, times length of signal	844 x 4 =	3376
M— " " " " " " "	273 x 3 =	819
Total		4195
Values if interchanged:		
O—frequency in 10,000, times length of signal	844 x 3 =	2532
M— " " " " " " "	273 x 4 =	1092
Total		3624

Gain as a result of interchange = 4195 —3624= 571 units

The new total for all letters would therefore be		35741
	Minus	571
		35170 units

The ratio of the new value to the old value is 35170 : 35741 = 1:1.016
The increase in speed expressed in percentage is 1.6%

The system described here by General Squier does not disclose the additional advantage to be gained by changing the code characters for each letter of the alphabet. Some idea of the importance of such a revision may be seen from a consideration of "O" and "M". Other letters may be similarly transposed, as the system provides, with an additional saving

be the International Continental code and the code—well, I often wonder why its revision has not been taken in hand long ago."

Here indeed was an interesting side light on this great industry of ours. I wondered too. The thought is not an entirely new one. I had thought of it several times during some of the long hours of a night watch, when at sea as an operator. It had occurred to me when the change was made from the American Morse Code to the Continental Code, shortly after American ships began carrying radio as a regular thing. I'll wager the same thought has occurred to thousands of radio men at one time or another. The psychological analysis of this condition is, as the General puts it "worthy of a James."

"That," continued the General, is my argument, in a nutshell. In this little pamphlet, a reprint of a short paper I delivered on this subject before the National Academy of Sciences last May, you will find the outline of one system which I am sure may be used to great advantage in any form of electrical signalling."

The following paragraphs, taken directly from the pamphlet, outline just what revisions of our code General Squier advocates and indicate some of the advantages he claims for such a system.

CONSIDER THE CODE

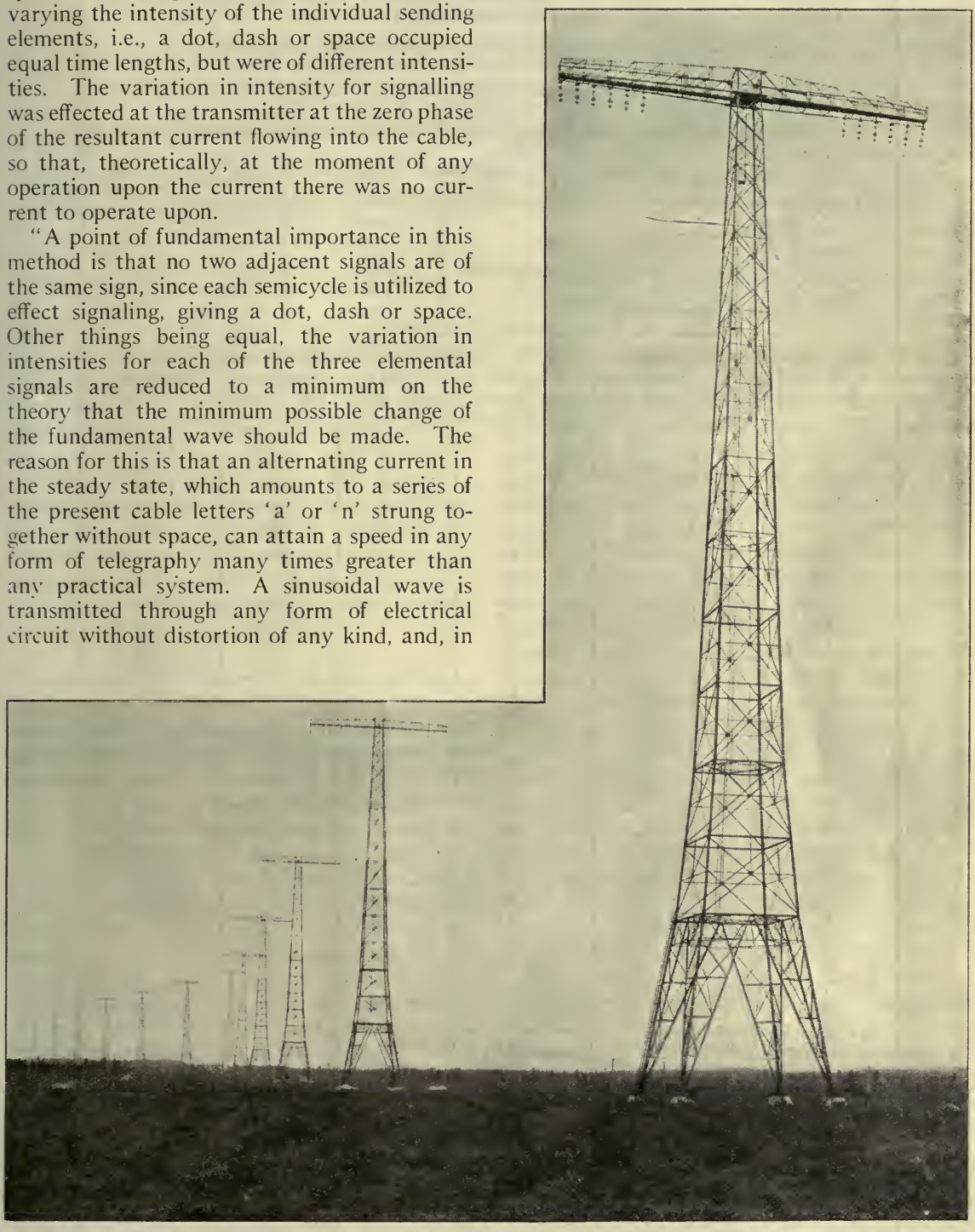
"IN THE Morse alphabet we find the principle of different time units for dots, dashes and spaces, as the basic idea of the system. In Standard Morse a dash is three times the length of time of a dot, and the spaces between letters and words are timed correspondingly.

"These signals in International Morse (Continental), are universally emitted into the ether from the transmitting antenna in the form of sudden interruptions in the antenna current, or sudden variations in this current. This method produces about the worst possible source of disturbances in the ether space for the reason, among others, that the disturbance has no regularity of any kind, and the speed of operating the sending key has a marked influence on the whole phenomena. Present practice is drifting away from the complete interruption of the antenna current which is the worst from an interference standpoint, but even the present methods of irregular and sudden variations of the current are still a long way from the possible scientific solution.

"In 1915 the writer was considering t e general problem of improving the transmission system for submarine cables, and in connection therewith gave study to a new form of alphabet suitable to such a circuit. The system devised at that time may be described briefly as a continuous wave system: 'C. W. *versus* the 'spark' system of the present cable practice. A method was developed of sending an unbroken alternating current through the cable, and means provided for interpreting this alternating current into intelligible signals. This system abandoned the Morse principle of different lengths of time for the signals as being fundamentally inefficient, and adopted the plan that all individual signal units should occupy

equal lengths of time and have equal importance, whether they were dots, dashes or spaces. The signals were distinguished by varying the intensity of the individual sending elements, i.e., a dot, dash or space occupied equal time lengths, but were of different intensities. The variation in intensity for signalling was effected at the transmitter at the zero phase of the resultant current flowing into the cable, so that, theoretically, at the moment of any operation upon the current there was no current to operate upon.

"A point of fundamental importance in this method is that no two adjacent signals are of the same sign, since each semicycle is utilized to effect signaling, giving a dot, dash or space. Other things being equal, the variation in intensities for each of the three elemental signals are reduced to a minimum on the theory that the minimum possible change of the fundamental wave should be made. The reason for this is that an alternating current in the steady state, which amounts to a series of the present cable letters 'a' or 'n' strung together without space, can attain a speed in any form of telegraphy many times greater than any practical system. A sinusoidal wave is transmitted through any form of electrical circuit without distortion of any kind, and, in fact, is the only type of wave that is so transmitted.



ARE TRANSOCEANIC RADIO STATIONS WASTING MONEY WITH A NEEDLESSLY SLOW CODE?
The photograph shows the towers of the Radio Corporation of America station at Rocky Point, Long Island, which communicates with England, France, Norway, Poland, Germany, and Italy

TABLE II

COMPARATIVE SIGNALING SPEEDS OF INTERNATIONAL MORSE AND SQUIER ALPHABETS

(Weighted according to the frequency of letters in telegraphic English as given by Hitt, based on an actual count of 10,000 letters.)

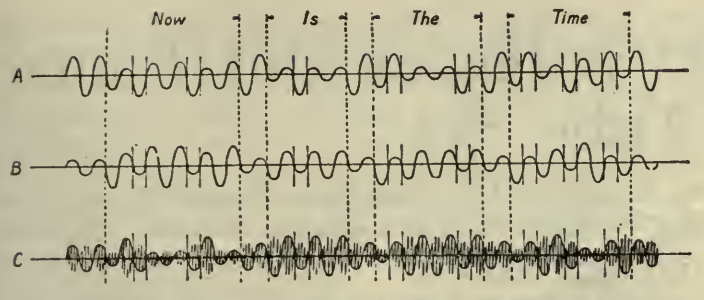
The following bases for comparison as regards spacing and length of signals are employed: (See page 22, Univeral Electrical Communications Union, Washington, 1920).

Element	International Morse	Squier Alphabet
Dot	1 unit	1 unit
Dash	3 units	1 unit
Space between parts of same character	1 unit	0 unit
Space between letters	3 units	1 unit
Space between words	5 units	2 units

Letter	Signals	Frequency in 10,000	Units in Int. Morse	Units in Squier Alph.	Weighted Int. Morse	Weighted Squier Alph.
A	·–	813	8	3	6504	2439
B	–···	149	12	5	1788	745
C	–·–·	306	14	5	4284	1530
D	–··	417	10	4	4170	1668
E	·	1319	4	2	5276	2638
F	··–·	205	12	5	2460	1025
G	––·	201	12	4	2412	804
H	····	386	10	5	3860	1930
I	··	711	6	3	4266	2133
J	·–––	42	16	5	672	210
K	–·–	88	12	4	1056	352
L	·–··	392	12	5	4704	1960
M	––	273	10	3	2730	819
N	–·	718	8	3	5744	2154
O	–––	844	14	4	11816	3376
P	·––·	243	14	5	3402	1215
Q	––·–	38	16	5	608	190
R	·–·	677	10	4	6770	2708
S	···	656	8	4	5248	2624
T	–	634	6	2	3804	1268
U	··–	321	10	4	3210	1284
V	···–	136	12	5	1632	680
W	·––	166	12	4	1992	664
X	–··–	51	14	5	714	255
Y	–·––	208	16	5	3328	1040
Z	––··	6	14	5	84	30
TOTALS		10000	292	108	92534	35741
			Add for spaces between words, 10,000 letters = 2,000 words		3998	1999
				GRAND TOTALS	96532	37740
			Average number of units per word		48.266	18.870

Ratio = 48.266 : 18.870 = 2.56 Squier Alphabet is 156% faster than International Morse

Both tables were prepared under the direction of General Squier by Captain Friedman, Chief of the Code Section of the Signal Corps. It is the result of many months of research



(*A*) Dot—smallest amplitude. Dash—medium amplitude. Space—largest amplitude.
(*B*) Space—smallest amplitude. Dot—medium amplitude. Dash—largest amplitude.
(*C*) Dash—smallest amplitude. Space—medium amplitude. Dot—largest amplitude.
There are three other possible permutations of amplitudes not shown here. Ratio of amplitudes of signalling units arbitrarily assumed as 1: 2: 3.

FIG. 1

HOW THE SQUIER SYSTEM WOULD WORK

A STILL more important point to be considered is the transmission of the largest volume of telegraphic business with a minimum number of signals, and from this angle the new form of alphabet has most striking advantages.

. . . . . .

"Fig. 1 illustrates graphically this method of modulating a single-frequency wave, and shows the words 'Now is the time' as they would be transmitted by this method, in which we arbitrarily assign the largest amplitude for a dash, the next size amplitude for a dot, and the smallest for the spaces between.

. . . . . .

It is well known that the sudden breaking or introduction of high impedances in an alternating current circuit produces transient phenomena which results in a whole group of harmonics being transmitted. Add to this the practical condition of performing this operation upon a current ranging all the way from zero to hundreds of amperes, and it is easily seen that the ether of space is bombarded with a mass of frequencies never twice alike even in the same letter. It is little wonder, therefore, that no method has yet been devised to prevent such a disturbance from interfering radically with the reception of radio signals. Entirely apart, therefore, from a gain of more than 150 per cent. in the transmission speed, from an interference standpoint the present method is about as bad as it could well be.

. . . . . .

"At present the radio engineer has utilized and made his own all of the audio-frequency range and at least several octaves of the radio-frequency range, and has devised apparatus for the amplification and rectification of both of these ranges, audio and radio. This plan proposes to enter the unused infra-audio range, which would not only add a most useful band of frequencies to those now used, but would give a band below the range of the human ear. If this band were employed for telegraph, an additional advantage would be that it could not interfere with any radio receiving. This method of eliminating interference would be most effective.

"Finally, it is seen that by the method proposed here it is possible to modulate a single frequency by a number of modulating frequencies, and thus multiply the capacity of each radio frequency channel.

"In 1921 the writer attended at Paris an international technical conference on outstanding radio problems, and for two months special delegates of the five great powers gave consideration to technical points connected with international radio telephony and telegraphy. Such matters as interference, logarithmic decrements, disposition and allocation of wavelengths, radiation, etc., were considered. It is now proposed that the general subject of a suitable method for transmitting telegraphic signals either for radio, land lines or submarine cables be considered at the next international technical conference, with a view, if possible, of unifying all branches of telegraphy using the same system of modulation for the signals."

From all this we may rest assured that the next international conference which undertakes radio problems will devote much of its energy to a revision of the telegraphic code. It is quite possible that some effort in this direction will be made at the Pan American Congress to be held in Mexico City within the next few months. It will be well to consider General Squier's work very thoroughly.

The radio amateur, whose transmitter and efficient receiver make it possible for him to chat with his neighbor over a distance of several thousand miles is beginning to feel the need for a universal language. He may well direct his effort to constructive work in revising his method of operation to conform with this more efficient vehicle and last but not least our great radio companies carrying on, as they do, about a quarter of our communication with Europe cannot afford to overlook the opportunity which General Squier points out as being capable of increasing their output by some 150 per cent.

How to Build a Knock-Out Four-Tube Set

Incorporating with the Knock-Out One-Tube Reflex Receiver a Quiet, Inexpensive and Dependable Resistance-Coupled Amplifier

By ZEH BOUCK

THE outstanding characteristic of crystal rectified (detected) receivers, such as the single tube reflex set described with variations in recent issues of RADIO BROADCAST, is the good quality and clarity of the output. The remarkably clear tone reproduction of the crystal detector is due to the rectifying properties of the mineral, which delivers an audio-frequency current varying directly with the potential of the applied voltage. This is not the case in detection by the three-element vacuum tube. It is doubtful if this naturalness of tone will ever be improved upon, and the enthusiast who is satisfied with the volume of a single tube reflex, need search no further for perfection in detecting fidelity.

However, it is difficult to preserve this clarity when amplifying in the conventional manner. This close approach to perfection cannot be carried through two ordinary stages of transformer-coupled audio intensification. Though the output is still superior to that delivered by most amplified regenerative receivers, it has lost that subtle quality that stamped it as perfect. This is particularly noticeable in amplifying the single tube reflex receiver, due to the capacitative feedback between the external amplifier and the tuning unit. The measures taken to stabilize the whole, such as condensers connected to the amplifying grids and grounded, lessen amplification and, in some particularly obdurate cases, tend to increase the distortion prevalent, if not inherent, in transformer-coupled amplifiers.

The push-pull amplifier probably represents the nearest approach to perfection yet achieved in transformer-coupled audio amplifiers.

THE RESISTANCE-COUPLED AMPLIFIER

WHILE it is possible, in the laboratory, by means of certain balancing and corrective measures, such as the Campbell filter, to obtain perfect transformer-coupled amplification, the writer has never heard a two-stage amplifier with an output quality equal to that of a three-stage resistance-coupled audio intensifier. It is significant, that in many broadcasting stations, where perfect amplification is essential in the speech amplifiers, the simple resistance-coupled method is often used in preference to complicated transformer circuits, which their financial and laboratory resources make available.

The reader will better appreciate the possibilities of the apparatus we are going to describe, if, first, we make clear the theoretical functioning of such amplifiers, one of the most interesting of radio phenomena, quite easily comprehended.

The resistance-coupled amplifier is *not* new. On the contrary, the chances are that it is the oldest form of amplifier, the system being probably the direct and logical outcome of early experiments to determine the voltage amplification of the three element vacuum tube. However, until the very recent advent of telephonic radio broadcasting during those twelve years when telegraphy was ninety-five per cent. of wireless, distortionless amplification was actually

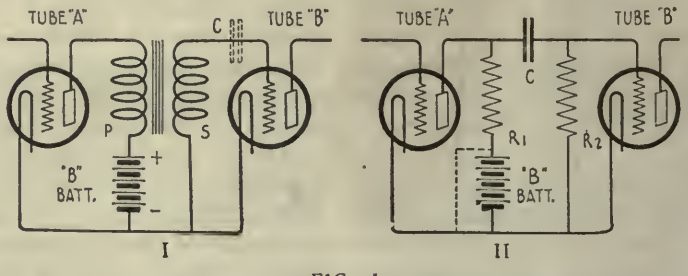


FIG. 1

Comparing the theories of resistance- and transformer-coupled audio amplifiers. There is not a great deal of difference

undesirable, and so, without the recommendation of its predominant and only advantage, the resistance-coupled audio amplifier was practically forgotten. The transformer-coupled type gave greater amplification per stage, particularly when the windings were designed to pass the narrow band of audio frequencies to which telegraphic tones were confined. It is only now, after three years of redesigning and rewinding of the old code amplifying transformers, that the resistance-coupled amplifier is being salvaged from the radio junk pile.

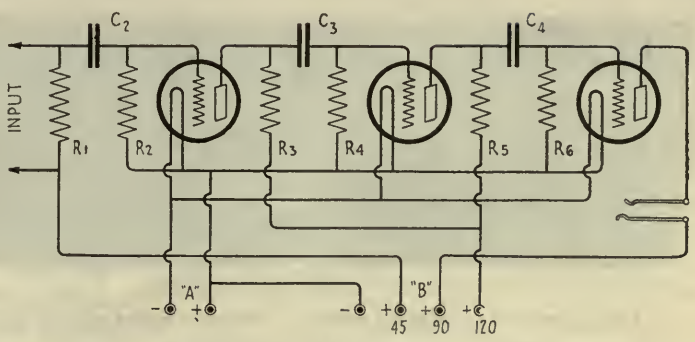


FIG. 2

The fundamental circuit of a three stage resistance-coupled amplifier

Fig. 1 is divided into two parts, showing amplifying tubes coupled in two systems, A and B, respectively transformer-coupling, which we all know, and resistance coupling which, I hope, the reader will soon know and appreciate.

Amplifier A functions in a manner very easily understood. The plate current, set up by the potential of the B battery, flows through the primary, P, of the audio amplifying transformer. This current is made to vary by signal impulses applied to the grid of tube A. When this current fluctuates, a potential, or voltage, varying with the strength of the plate current of tube A, is induced in the secondary winding. This secondary potential is applied to the grid of tube B—that is, the voltage is impressed across the grid and filament. Condenser C, drawn in with dotted lines, is suggested in order to make the action of circuit B clearer a little later on. The amplifier would function quite nicely with this condenser (about .0025 mfd. or greater) in the circuit, but, as there is no necessity for it, we do not include it in the conventional transformer amplifier.

We may therefore sum up amplification by stating that its requirements are a potential,* varying with the plate current of the preceding tube (A), which can be applied to the grid circuit of the succeeding tube (B). If we comply with these conditions, we have amplification.

Bearing this in mind, we proceed to circuit B, which depicts two similar bulbs coupled by a resistance, R1. Condenser C is placed in this circuit to isolate the grid from the high

*This potential must, of course, exceed that applied to the grid of the preceding tube. The amplifying ability of the tube automatically takes care of this.

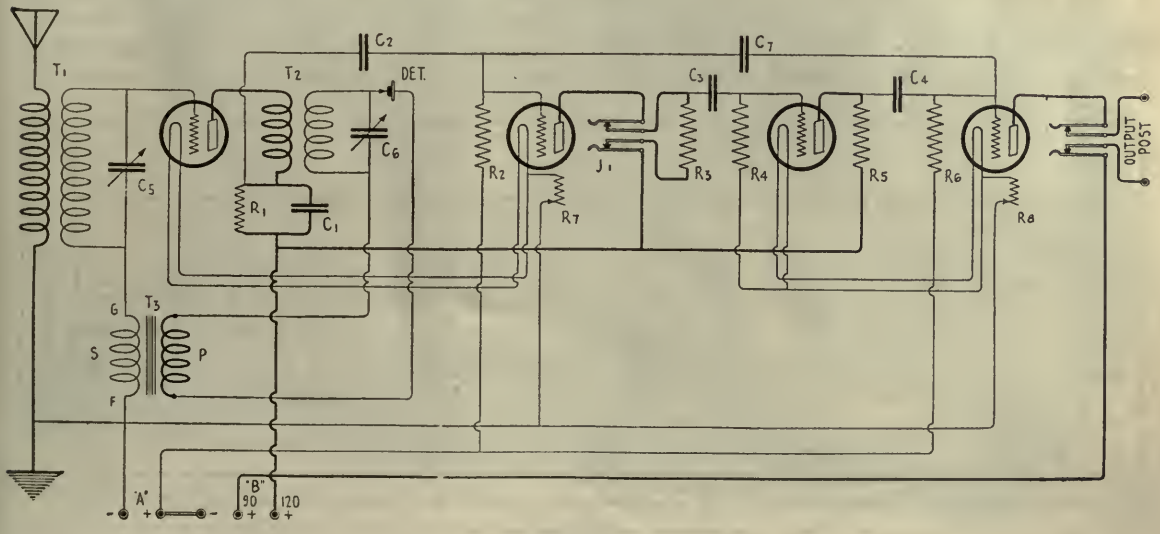


FIG. 3

The complete circuit of the receiver described in this article

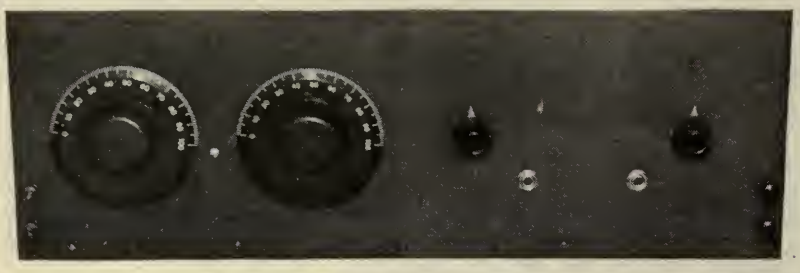


FIG. 4
Front view of the completed receiver. Only two tuning controls as usual

plate potential. This circuit is quite similar to circuit A, though the unpracticed eye may not at first recognize the numerous relations. We have our plate circuit in tube A, from the plate, through the resistance R1 (instead of the primary of the amplifying transformer), the plate battery, and from there, down to the filament. We also have our grid circuit—the grid of tube B, through condenser C and down resistance R1. Resistance R1 is therefore common to both the plate circuit of tube A and the grid circuit of tube B, acting more or less as a double substitute for primary *and secondary of the audio transformer.* Hence, if we can show that there is a varying potential across this resistance, which changes with the grid variation of tube A, we shall have established the fact that circuit B is an amplifying system, in which the functioning automatically becomes quite clear.

Ohm's law states that the current is always equal to the voltage divided by the resistance —I (current) equals E (voltage) over R (resistance), i. e., $I = \frac{E}{R}$. Transposing, this very fundamental law also postulates that the voltage across any resistance is equal to the current times the resistance, in other words, $E = I \times R$.

E, in the case we are proving, will be the plate voltage; I the plate current; and R the coupling resistance, R1. The plate current varies with the grid potential of tube A. Thus, as the potential across R1 is always equal to the momentary value of the current times its resistance in ohms, this potential will vary directly with the grid impulses. That is, this circuit amplifies.

THE FUNDAMENTAL CIRCUIT

FIG. 2 shows the fundamental circuit of a three stage resistance-coupled audio amplifier. This amplifier is about equal to two stages of the best transformer-coupled amplification, as far as volume is concerned, and is noticeably superior to the best in quality. Its extraordinary purity of tone will be especially noticed in the reproduction of a woman's singing voice. Barring any distortion at the transmitting end, the notes will come through liquid and pleasing, a marked contrast to some of the strident reproductions of the vocal attempts of a broadcasting coloratura soprano.

The resistance of the coupling resistance, R1, R3, and R5 varies in the opinions of individual experts, and also from the theoretically correct value (which is infinitely high). However, experience has indicated that 100,000 ohms is the best value when using the amplifying

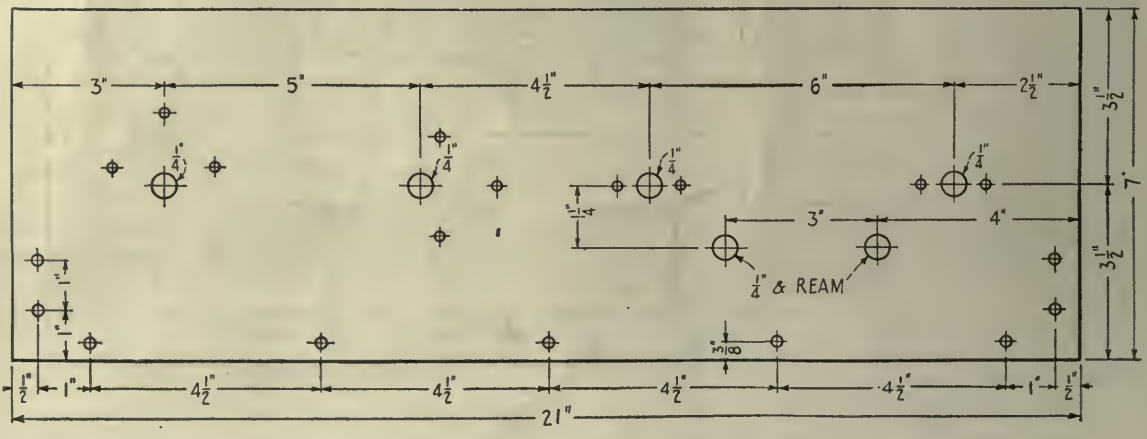


FIG. 5
The panel layout for the Four-Tube Knock-Out

tubes now available to the broadcast receiving public.

It will be noticed that there are three separate B battery taps—one for detector (about forty-five volts, compensating for the extra plate resistance, R1), the second (ninety volts) to the plate of the last tube, which circuit contains only the comparatively low resistance of the loud-speaker winding, and the third and highest voltage tap to the plates of the amplifying tubes through the high resistance coupling units. Using the UV-201-A tubes, this voltage arrangement will result in approximately the same total current consumption as a two step transformer-coupled amplifier, operating without a negative grid bias, and with ninety volts on the plate. Each amplifying tube with a plate coupling-resistance, will draw about one one-thousandth of an ampere.

Considering the current consumption, as well as the extra tube and B battery, but balancing with the economy of coupling-resistances as compared with the cost of good amplifying transformers, the two systems break about even on an economic basis. (This is somewhat contrary to the general idea, which has always held the resistance-coupled amplifier to be a wasteful and expensive proposition.)

Condensers C2, C3, and C4 are included in the circuit, as before explained, to isolate the grid from the plus side of the B battery. Resistances R2, R4, and R6 are grid leaks, between .05 and 2 megohms, the values of which are best determined by experiment. Experience has demonstrated that while the grid leak value is not critical, there are many cases in which variation of this resistance will improve the tone quality of the received signal. One half megohm is about the average proper value.

RESISTANCE COUPLING AND OUR ONE-TUBE REFLEX

AS SUGGESTED early in this article, the single tube crystal detected reflex set, plus three stages of resistance-coupled audio-frequency amplification, is an ideal arrangement. The writer has effected this combination quite satisfactorily in the manner illustrated in Figs. 3, 4, 5, 6, and 7.

Fig. 3 is the circuit followed in detail. Fig. 5 is a plan of the panel. The remaining illustrations are photographs of the completed receiver. It will be noticed that two jacks and two rheostats, controlling the first two and the last two tubes, have been added to the fundamental amplifying circuit. The jacks plug in on the first stage and last stage. Jack 1 will give powerful loudspeaker intensity on local stations, while J2 may be used for dancing in a medium size hall, and on distant stations. *The last jack should never be used with telephone receivers.* Signals so weak as to necessitate amplification are better enjoyed on a

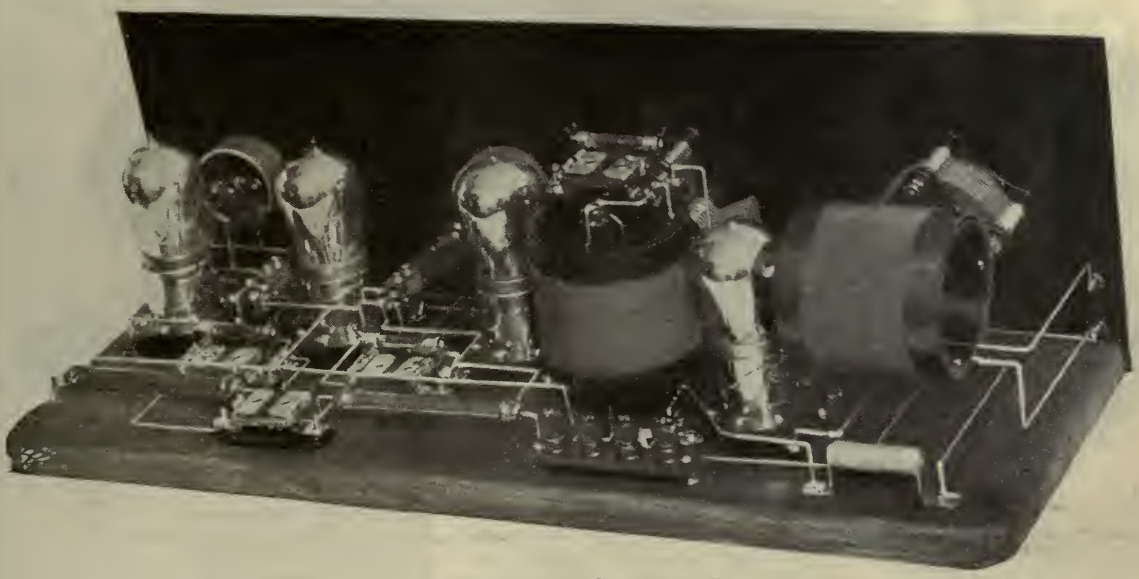


FIG. 6

Behind the scenes. Rewound neutroformer- type coils are used as inductances. This simplifies mounting for the beginner by eliminating machine work

single stage of amplification. Output binding-posts shunt the last jack when closed.

THE PANEL

A STANDARD panel was used—7″ x 21″. Figure 5 indicates the layout and drilling. All holes, excepting those with specially designated sizes, are drilled to pass a No. 8 screw—the diameter found on dry cells and large binding-posts. The appearance of the completed receiver is greatly improved by graining the panel after drilling—i. e., sandpapering it in one direction, and wiping with an oiled cloth.

THE PARTS

THE required parts are quite plainly shown on the diagram, Fig. 3, and are further listed in the following descriptions:

T1 and T2, respectively coupler and R. F. transformer, may be wound by the experimenter as described in the "Knock-out Single Tube" article appearing in the April Radio Broadcast, or they may be neutroformer type coils with rewound primaries as suggested in the Laboratory Department of the June number. C5 and C6 are variable condensers with about 17 plates, giving a maximum capacity of .00035 mfd. This capacity need only be approximated.

T3 is a good audio amplifying transformer having a turn ratio of about four or five to one. Observe the connection initials on the secondary.

Det. is the crystal detector, preferably a fixed crystal such as the Erla or Star, or Celerundum.

R7 and R8 are thirty ohm rheostats. Three coupling resistances of 100,000 ohms each (R1, R3, and R5), as well as three grid leaks (R2, R4 and R6) are necessary. These resistances will be treated in more detail later.

C1 is a small bypass condenser, a Micadon, .0025 mfd. capacity. C2, C3, and C4 may be any convenient capacity Micadon between .0025 and .006 mfds., inclusive. The first capacity was used in the receiver under discussion. C7 is a stabilizing condenser. A low capacity, .00025, or .0005 at the most, is very effective.

J1 and J2 are standard double circuit jacks. Carter jacks were selected by the author for this set.

The reader will observe from photographs 6 and 7, that all condensers and leaks have been mounted in neat clips, which permit instantaneous change of resistances and capacities. This is very desirable in the preliminary operation of the apparatus. It is important that these mountings be of a reliable manufacture, with no resistance losses through the bases.

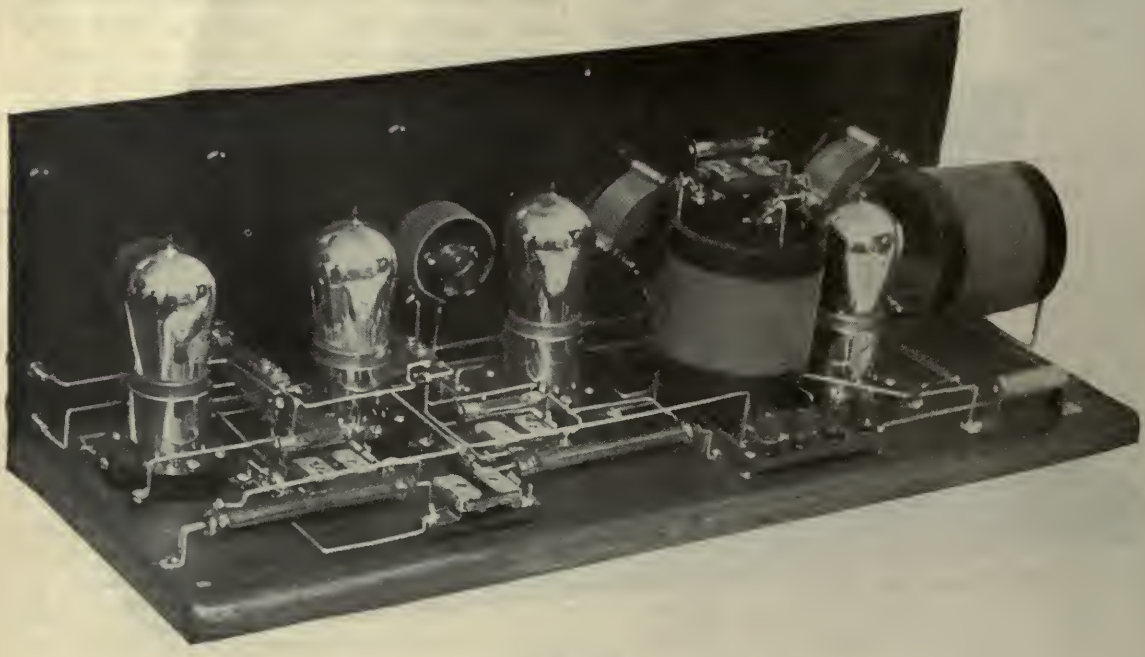


FIG. 7

Note the mountings into which the grid leaks and Micadons are clipped. These permit adjustments which are always desirable, and often necessary

Daven mountings (Daven Radio Company, Newark, N. J.) were used for both condensers and grid leaks. Three grid leak mountings and four condenser mountings are required.

BUILDING THE SET

ALL instruments, excepting T1, T2, T3 and the variable condensers, are mounted on the base board, which was a $\frac{3}{4}$" board cut down to $7\frac{1}{4}$" x 21."

The photographs show the back of panel layout. The sockets are mounted with the filament connections toward the panel. This arrangement makes possible the most convenient connections to grid and plate.

The filaments are completely wired before the resistance and condenser mountings, the jacks and inductances are placed in their respective positions. The amplifier is next wired, starting with the last step and running toward the antenna. The tuning units are last to be mounted and wired.

Keep all wiring as close to the base as possible. This makes for a neater appearance, more rigid wiring, and facilitates the clipping in and out of condensers and leaks.

THE RESISTANCES

RELIABLE resistances should, of course, be used throughout the receiver. However, reliability is to be particularly emphasized in the case of the 100,000 ohm coupling-resistances and the grid leak to the last tube (R6).

The coupling-resistances may be any one of three possibilities. The Ward-Leonard resistances obtainable from well stocked radio supply houses, are shown in the photographs, Figs. 6 and 7. Lavite resistances, made by the Western Electric Company, and by the Crescent Radio Company, Jamaica, N.Y. have been found equally satisfactory. The third possibility, and perhaps the simplest is to use a low resistance grid leak. This last, however, must be accurately measured for resistance, capable of passing three milliamperes, and must have a constant resistance. The writer has tested the Daven Radio Resistors (Daven Radio Company, Newark, N. J.) and found them quite equal for this purpose to the more expensive resistances. This particular make can be obtained in resistances from 50,000 ohms up.

List of Parts Used in Making This Four-Tube Knock-Out Receiver

Two neutroformer type coils with condensers	$14.00
Four General Radio* sockets	4.00
One Amertran* audio transformer (5 to 1 ratio)	7.00
Two General Radio* rheostats (20 ohms)	2.50
One Pryatek* fixed crystal detector (*see article*)	1.25
Two jacks	.75
Nine Eby binding-posts	1.80
Two Pathe* dials	1.20
Three grid leaks (*see article*)	1.50
Coupling resistances (*see article*) at $5.00	15.00
Three Daven grid leak mountings*	1.20
Three Daven clip condenser mountings	1.20
One panel, 7" by 21"	1.75
Four Dubilier Micadons .0025 mfd.	2.00
Approximate cost	$55.65

*Other high grade makes may be substituted for the designated manufacture with equally good results.

OPERATION

THE operation of the resistance-coupled amplifier is quite consistent and as reliable as the transformer-coupled type. The only adjustments that may be necessary to secure the most efficient operation of the amplifier, is the change in the stabilizing condenser, C7 and the grid leaks (not the coupling resistances).

If, on very loud signals, using the full amplification, distortion or blasting is noticed, reduce the resistances of the grid leaks in the last two tubes. In the receiver just described, the writer uses 2. meg., .5 meg. and .05 meg. in the respective cases of R2, R4, and R6.

On local stations, it may be desirable to eliminate the high voltage tap, operating all tubes at a plate potential of ninety volts or less.

USING VARIABLE GRID LEAKS

THERE are some variable grid leaks now on the market which have a minimum resistance of approximately 50,000 ohms and are capable of carrying the current in the plate circuit of a standard tube used in a resistance coupled amplifier. Variable grid leaks having a minimum resistance above 100,000 ohms, or incapable of carrying a plate current of approximately two milliamperes, should not be used *as the coupling resistors*, but any good variable grid leak may be used in place of the fixed grid leaks R2, R4, and R6.—THE EDITOR.

Some Remarks in Passing

By J. P. McQUAIDE
Vice President, Moon Radio Corporation

RECEIVING distant stations depends greatly on weather conditions. If you receive many different stations one night and not the next, don't blame your set. If you do not think the trouble is in the weather, look at your batteries. They may be run down or one of your tubes may be losing sensitivity. As a general rule there is nothing in a radio set to wear out and once it is working satisfactorily, the trouble is usually in either the tubes, batteries or weather conditions.

Don't use any higher voltage than is necessary on your B batteries, as the more voltage you use the faster your batteries will give out.

Some people think that because their tubes light, they must be all right, but this is not always the case, as the filament of your tube may light long after your tube has become defective. Every so often, it is a good plan to take out your tubes and clean the points. Good electrical contact is highly important in the tube socket. Particular trouble may be encountered at the plate or grid socket contacts, and this is the hardest to find since even if the pins are not making contact, things look all right.

If you have just bought a set and you know it is of good manufacture, do not become dissatisfied because you have not obtained the results that some friend of yours is getting.

In large cities where there are many so-called dead spots, it is quite possible for a set to work much better in one room than it does in another due to the steel construction in the building. Try moving your set from one room to another, if you are not getting good results.

A voltmeter for your B battery registering 0-50 volts, and also a hydrometer, are good accessories to have around.

Don't try to make a lot of noise with your set. Good clear reception with less volume is far better than reception with distortion and great volume.

If you are getting good results from your receiving set, write and tell the manufacturer. He will be very glad to know it. If you are not getting the proper results, he will want to know that too. Perhaps he can help you.

Receiving sets are becoming easier to operate, and the manufacturers are doing all in their power to help you enjoy radio concerts. Receivers are not automatic, however, and should be given some care and not knocked around from place to place.

VERITABLE multitudes of radio listeners in the eastern and central parts of the United States who count that Sunday lost when they do not hear "Roxie" and his gang from the Capitol Theatre, New York, will be much interested in James C. Young's excellent story about "Roxie" (S. L. Rothafel), his gang, and his theories, which we will print in July.

What's in a Name?

A Brief Guide Book to the Radio Gallery of Names, Telling Why "Dynes" and "Plexes" Need Not Be Greek to Almost Everyone

By JULIAN KAY

If you are new to radio—or at least a present stranger to radio theory, the series by Zeh Bouck, "Various Circuits and What They Mean" is well worth consulting. In this magazine for December, 1923, appeared the first of his articles on How to Analyze a Diagram. In January, 1924, Mr. Bouck's article explained what inductance is and how it is used. The February article explained how radio circuits are tuned. "What Makes the Wheels Go 'Round" W. Van B. Roberts' serial explaining radio theory should also be consulted. It began in March.

OF ALL the pests the worst is probably the chap who has a positive mania for radio. He follows you around talking about super this or dyner that. He has a habit of pushing you into a corner to tell you of the latest tricks he has played on his Neutroreflex. He knows more circuits than you can shake a stick at; he eats, sleeps, and orates radio.

Do you know this chap? He is always worrying about his plex, or his auto, or his dingus circuit. He rushes madly from one radio fad to another, speaking hazily about "quality" or "radio-freq." His usual conversational ability can be measured by:

"Say, I tried out those Fussyform coils on my Superwhoosis last night. I had twenty-eight turns of double covered green silk magnet wire on the secondary and a double naught two five condenser across—" and so on *ad libitum* until you go.

Suppose for instance that you were a master of the violin, that you loved your instrument, that you knew it better than anything else. Suppose that you had made it a lifelong companion, that it soothed and piqued you and gave you immeasurable joy and pleasure. With fellow devotees of the violin you shared your secrets and your dreams.

And then some morning suppose that you found everyone talking of your violin in the most off-hand fashion, not as the instrument that you loved but as a "fiddle"; and that people seemed more interested in the fact that it was made of Spanish cedar and LePage's glue than in the beautiful tones with which it responded to your touch.

SUPER-FIDDLES AND FIDDLE-DYNES

SUPPOSE even, that the big brothers of the violin were mentioned as super-fiddles and fiddle-dynes instead of their proper names; that everyone could play them as easily as though they were tin horns; that everyone talked in the most glib manner about species of violins of which you had never heard.

In fact, if you suddenly awoke to the fact that your hobby was no longer an individual affair, but that the whole world owned it, a world that thought you out of date—how would you feel about it?

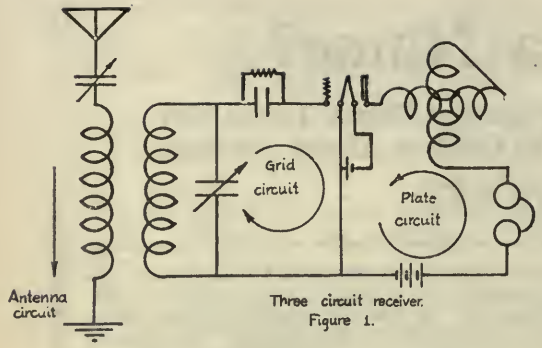
Do you see how the old timer in radio feels about all this business of names, and new

What Does That Mean?

Is an often repeated question addressed to those who know and those who seem to know, more than the rest of us about radio. The answer may be correct or it may be some hazy attempt at explanation that leaves the questioner in a greater confusion and uncertainty than ever. And when the question turns to receivers and their names, well indeed can the question be "What Does It Mean?" There are many who recite the various name-tags glibly, knowing precious little whereof they speak.

This article attempts to sort out and classify the receivers in present use, to show what they are, and how they are electrically related, and what they are designed to accomplish. No effort is made to give a technical or even popular explanation of their working, for that is task enough for a book. This series aims to cast at least a faint light in the present dark forest of ponderous hyphenated radio names.

—THE EDITOR.



Three circuit receiver.
Figure 1.

circuits, and the smug acceptance with which radio is viewed to-day?

Or, if you are a new comer, are you bewildered by the claims of the various dynes and plexes and supers and the personal monuments like the "Jones" or the "Smith" circuits?

To classify the types of receiving circuits now being used, the Family Tree on page 112 may be useful. It will be seen that there are three broad groups of radio receiving equipment, and it may be said at once that all of the modern types may be found there, or may be a hybrid product of two or even all three of these groups. So when your friend says that he had a new circuit see how it fits into the Circuit Family Tree, and if it cannot be found there, if it is not a detector or an amplifier, rush your friend to the patent office, for he has something the world needs.

ALL RECEIVERS MUST BELONG TO ONE OF THREE CLASSES

THESE three great groups into which all receiving equipment naturally falls are dependent upon each other, and a really good outfit is a proper combination of apparatus from each of the groups. The name it bears is no criterion of its effectiveness as a receiver. Indeed "a rose by any other name would smell as sweet."

The first requisite for a receiving set is a detector serving the same purpose as our own physical organs for "detecting" the sounds that exist in the air, organs we call ears. Now everyone knows that there are sounds that are too weak for us to hear, and that we can remedy our inability to detect these minute sounds by proper means of magnification, say by an ear trumpet. If our human organism possessed a device between the ear and the brain for again amplifying the sounds that the ear detects, we would have a more or less complete analogy for the three groups of radio receiving equipment.

Radio-frequency amplifiers magnify the incoming energy before it is passed through the detector, and following the detector, come audio-frequency amplifiers which again magnify the energy.

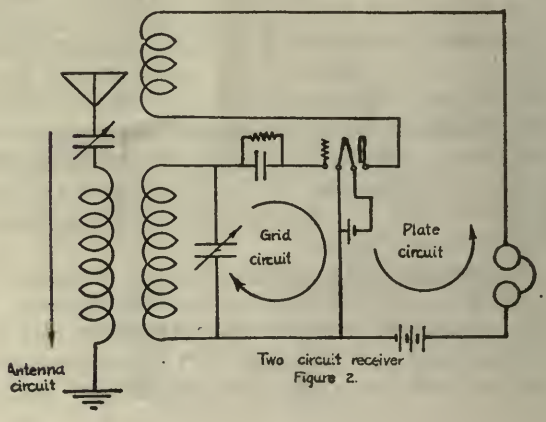
ABOUT DETECTORS

DETECTORS naturally fall into two classes, non-regenerative and regenerative. The first group comprises the simplest of all receiving circuits. Crystal detectors are very old, going back to the earliest days of wireless telegraphy. The simple audion connection was used for a considerable time before Armstrong demonstrated his remarkable discoveries leading to the regenerative detector.

The last two years have seen the advent of vacuum tube detectors on shipboard, but on many vessels at the present time, the operators still wrestle with old "catwhisker" crystals. Among the amateurs, however, the crystal of the past few years, is as good as dead, and would be completely out of date to-day were it not for the recent broadcasting development.

The non-regenerative detectors are marked by certain inherent disadvantages, but contrary to common opinion have other advantages which are becoming more and more important.

A crystal or simple non-regenerative tube detector without some means of amplification will not respond to signals from very great distances nor will it give much volume. On the other hand, the quality of music or speech produced by such a detector is far better than the usual regenerative equipment is capable of producing, particularly when handled by one unaccustomed to tuning it. With a stage



Two circuit receiver
Figure 2.

or two of radio-frequency amplification to boost the incoming energy, and a stage or two of audio-frequency amplification to bring up the signals to the required volume, a simple non-distorting detector is unequalled.

The outstanding features representative of this group are, that they are

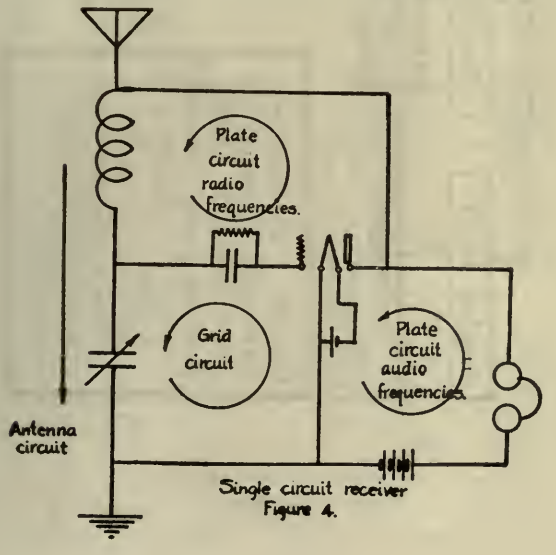
1. Non-distorting.
2. Of low cost.
3. Capable of short distance reception.
4. Of low upkeep.
5. Simple.
6. Non-selective.
7. Non-radiating.

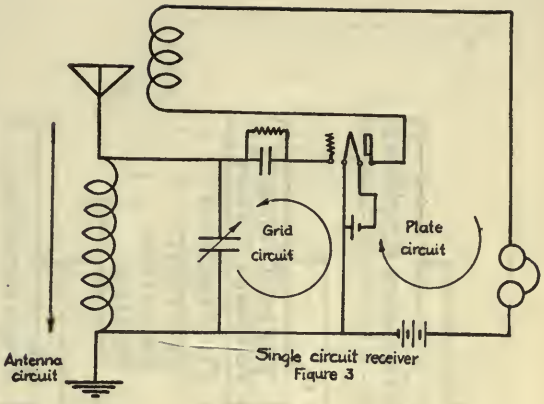
The principles underlying the regenerative receiving circuits are the foundations upon which present day radio is built. Were it not for what vacuum tube experts call "regeneration"—whence comes the name of these receivers—radio broadcasting would probably not exist to-day.

WHERE THE VACUUM TUBE COMES IN

THIS discovery seems simple in the light of our present knowledge. Suppose we have a device that has more energy in its output than in its input circuit. If some of this excess energy is fed back into the input, it will reappear at the output, amplified by the action within the device. If the excess output is sufficient to make up for the losses due to resistance in the circuit, continuous oscillations are built up and we say that the system "oscillates."

The immediate result is a remarkable increase in signal strength due to the fact that





regeneration is apparently a method of decreasing resistance to a very low value, which permits large currents to flow. Another important result is the increase in selectivity also due to the lowered effective resistance.

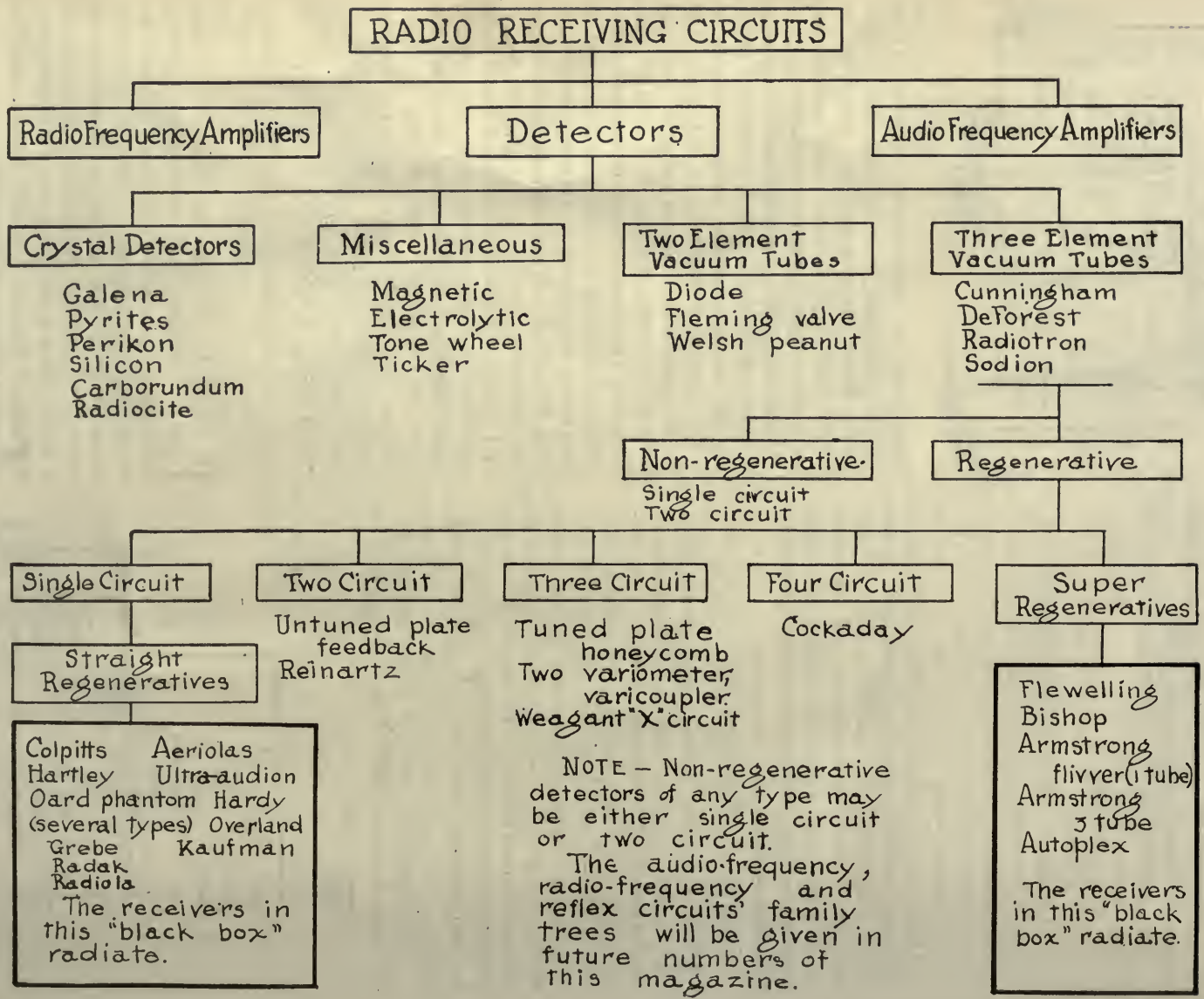
In general it may be said that regenerative receivers are highly sensitive, reasonably selective, giving considerably greater strength of signals than non-regenerative detectors. On the other hand, this type of detector is critical in its adjustment, is likely to distort so that music and the voice are not reproduced accurately and pleasantly. The great objection to this type of detector is its certainty to disturb fellow listeners by its self radiation unless carefully handled.

At the present time the tendency seems to be away from regenerative detectors and toward radio-frequency amplification, so that the future may see the birth of new receivers utilizing other methods of detection giving the same sensitivity but none of the distortion or interference defects of regenerators. The Sodion tube is a decided step in this direction.

ONE WAY "NEW CIRCUITS" AND "NEW" NAMES START

IN ACTUAL practice the plate circuit (output) is coupled back to the grid (input) either through a resistance, an inductance, or by means of a condenser. In fact if the experimenter is ambitious and wishes to combat all manners of coupling he may use combinations of all of these methods. And each time that someone "discovers" anew these coupling methods a new name is given it.

It will be noticed that the chart divides regenerators into several groups depending upon the complexity of the equipment. Any complete receiving set must comprise three


RADIO RECEIVING CIRCUITS
Radio Frequency Amplifiers
Detectors
Audio Frequency Amplifiers
Crystal Detectors
Galena
Pyrites
Perikon
Silicon
Carborundum
Radiocite
Miscellaneous
Magnetic
Electrolytic
Tone wheel
Ticker
Two Element Vacuum Tubes
Diode
Fleming valve
Welsh peanut
Three Element Vacuum Tubes
Cunningham
DeForest
Radiotron
Sodion
Non-regenerative
Single circuit
Two circuit
Regenerative
Single Circuit
Straight Regeneratives
Colpitts
Hartley
Oard phantom
(several types)
Grebe
Radak
Radiola
Aeriolas
Ultra-audion
Hardy
Overland
Kaufman
The receivers in this "black box" radiate.
Two Circuit
Untuned plate
feedback
Reinartz
Three Circuit
Tuned plate
honeycomb
Two variometer,
varicoupler
Weagant "X" circuit
Four Circuit
Cockaday
NOTE – Non-regenerative detectors of any type may be either single circuit or two circuit.
The audio-frequency, radio-frequency and reflex circuits' family trees will be given in future numbers of this magazine.
Super Regeneratives
Flewelling
Bishop
Armstrong
flivver (1 tube)
Armstrong
3 tube
Autoplex
The receivers in this "black box" radiate.

radio-frequency circuits: the antenna and ground, the secondary or input of the detecting device, and the output. If the output is not tuned, that is, if there is no attempt to resonate it with the radio-frequency signals, the system becomes a two-circuit tuner. If the antenna to ground circuit is combined with the input, the combination is known as a "single circuit" receiver.

Of the latter, RADIO BROADCAST has already said plenty. This receiver is like the neighbor's dog that howls under your window at the moon. It causes the horrendous squeaks and howls; the little fellow around the corner that swishes across your wave, breaking into your concerts, and offending your musical ears. In England it is unlawful to do anything with one of these outfits except, as someone has suggested:

"Use it as an anchor."

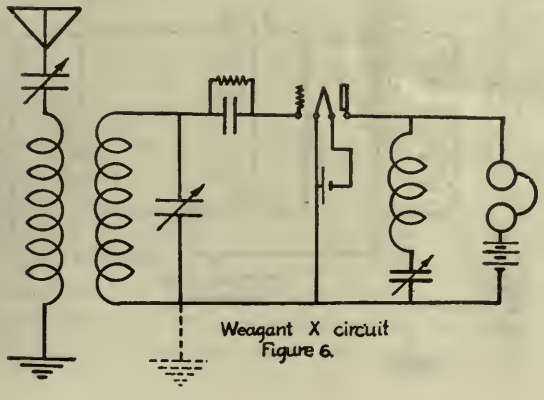
On the circuit Family Tree they are enclosed in a black box of mourning and they should be dead.

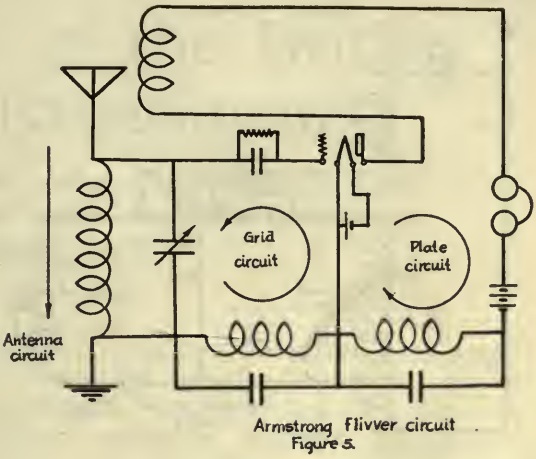
WHY THE MULTI-CIRCUIT SETS ARE GOOD

THE two-circuit tuner is a great improvement over the single circuit owing to its greater selectivity.

The three-circuit outfit in which the plate radio-frequency path is also tuned is naturally the most efficient of all, for oscillations occurring in this circuit may be controlled—a feature which the simpler systems do not possess. In connection with this type of equipment it must be said that close coupling between the antenna and secondary circuits may produce just as malignant interference to one's neighbor as any improperly operated single circuit regenerator.

In these various schemes, it does not matter whether an inductance or a condenser is used for the feed back or the tuning, the process is





one of obtaining resonance or of conveying energy from one circuit to another. For instance the "X" circuit in which the plate is tuned with a fixed coil in series with a variable condenser in place of the usual variometer is still a tuned plate arrangement.

In fact the capacity element of a complete radio path may not be apparent at all, but may exist within the tube, or as distributed capacity of windings, or as the capacity of the antenna to ground.

The ultra-audion has the input circuit attached directly to the plate; the "tickler" outfit uses a coil in series with the plate and placed near the grid coil to affect the feedback; the Reinartz employs a condenser between grid and plate—and there you are. They all do the same thing but in a different way.

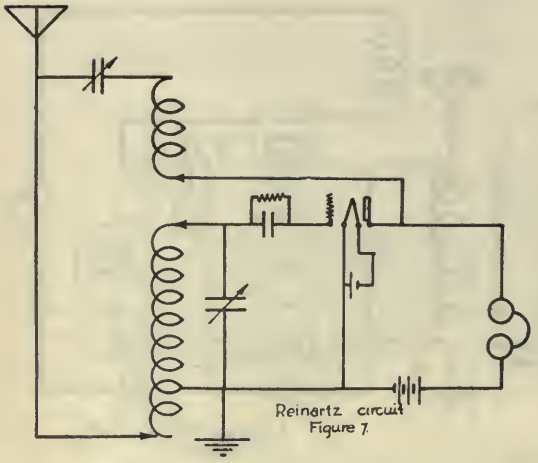
The Four-Circuit tuner is apparently an adaptation of the ultra-audion in which an extra absorption circuit is placed near the grid inductance. The idea is to extract enough energy from that circuit to prevent oscillation with its accompanying distortion. It is better than the straight ultra-audion on this account.

The Reinartz circuit was developed by a prominent amateur for use in receiving continuous wave stations operating on short wavelengths. It is most efficient when the tube oscillates, and is simple to adjust. The feedback control is nicely adjustable.

When improperly handled it has a tendency to radiate.

SUPER-HETERODYNE AND SUPER-REGENERATOR ARE THE ONLY NEW DEVELOPMENTS

THE latest application of regeneration, the super-regenerator is a member of the type of detector under discussion. The principle



is rather unique and the development of this system marks the only "new" thing that has appeared since the super-heterodyne.

As any one knows who has operated a regenerative receiver, the most sensitive operating condition is at the point where the tube is about to break into actual oscillation. Many schemes might be devised for actually letting the tube oscillate a small fraction of a second, and then to shut it off. This is what was actually accomplished in the super-regenerator. As usual there are several methods of carrying out this idea, and many of the "trick" circuits that exist to-day may be traced to some obscure super-regenerator function.

In practice, this type of receiver proves to be noisy and critical, and it is one of the most powerful radiators. It has not proved to be of great value in the reception of music, although it is useful in code receivers.

Without a doubt the regenerative receiver is one of the most sensitive and efficient devices ever discovered, but its use in radio seems limited to the time when equally efficient radio-frequency amplifying systems are developed—schemes which will be discussed in a future article. Under this head fall the neutrodyne, the superdyne, and the super-heterodyne.

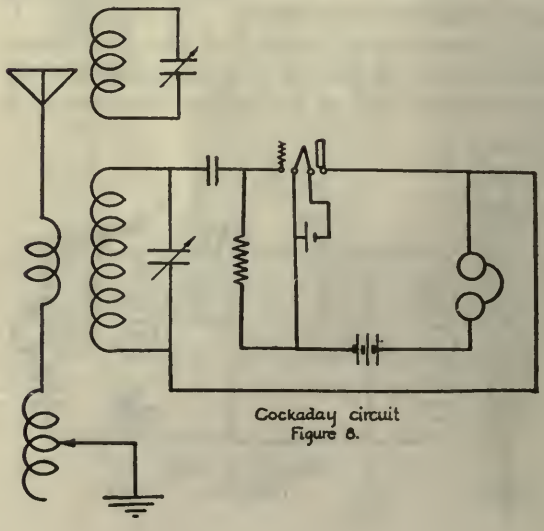
In order to get sufficient energy from any type of receiving equipment to operate a loud speaker it is necessary to use one or more stages of audio-frequency amplification. To increase the range of a given receiving set, a stage of radio-frequency amplification may be added before the detector, and when one adds this equipment it is a fairly simple matter to make the extra vacuum tube do double duty—in other words to reflex it. Reflex systems in which the audio and radio amplifiers are combined are the most economical arrangements used to-day, and as usual are of several varieties, each with a different name. This group will be discussed in subsequent articles.

ABOUT RADIO-FREQUENCY AMPLIFICATION

MANY names have been applied to the many schemes for amplifying radio-frequency energy. Sometimes these names signify what is going on in the device, but usually they are colorful handles added to otherwise colorless circuits. It is much easier to invent a new name for an old circuit, than to invent a new circuit. The next article in this series will develop the radio-frequency family tree, and show how the various methods work.

By properly designing a radio-frequency amplifier and carefully *neutralizing* it, one can add considerable volume to the signals. This is contrary to the common supposition that a noticeable addition of volume can only be attained by audio-frequency amplification. The two-tube receiver described in RADIO BROADCAST for April and May is an excellent example of what one can do with a small amount of equipment. Here is a detector, a radio- and an audio-frequency amplifier, a "neutrodyne" and a "reflex"—all with two tubes.

In following articles in this series, the various circuits which involve the use of radio-frequency amplification will be discussed. The radio newcomer should preserve these circuit "family trees", for they will help him analyze the many circuits which plague his bewildered eye.



The Inside Story of the British Broadcasting Experiments

How Success Came After Many and Long Experiments to Link America and Great Britain, by One of the Staff of 2AC at Manchester

By W. J. BROWN
Metropolitan-Vickers Company, Manchester

SO MUCH interest has been aroused by the recent American rebroadcasting tests that the following account of the preliminary experimental work which was necessary before the tests could be conducted should be of some interest. It is probably not generally realized that the relaying of KDKA, the Pittsburgh station of the Westinghouse Electric & Manufacturing Company, was only rendered possible by a tremendous amount of experimental work between this Company and the Metropolitan-Vickers Electrical Company of Manchester. There was no mystery about the excellent results which have been obtained on 100 meters. These were in fact the culmination of plans which were made many months ago.

The Metropolitan-Vickers Company is in very close technical association with the Westinghouse Company, and several months ago it was agreed that a combined attempt should be made to relay the KDKA broadcasting programs in this country. The Westinghouse Company had been experimenting with short wavelengths around 100 meters and had found that they promised well for long-distance reception, though of course this is all against the theory of excessive absorption on short wavelengths. In September, 1923, they commenced experiments with the Metropolitan-Vickers Company by transmitting their ordinary broadcast programs on 100 meters as well as on their normal broadcast wavelength of 326 meters. The Metropolitan-Vickers Co. built up a 100 meter receiver and listened to the transmissions at their experimental station at Altrincham in Cheshire.

The Future—Which Way?

It is manifestly impossible for every radio listener to own a highly sensitive receiver. And it is also true that as radio grows older, broadcasting will be more used in politics, in government, and all branches of the national life. So it is that the long-visioned ones in radio have wondered how it is economically and electrically possible to bind together some of our powerful and important broadcasting stations located at strategic points in the country, so that an event of national importance could be broadcast nationally. Most of our readers know of the recent successful experiments which have taken place within the last six months.

Now there are two ways to link broadcasting stations. One is by direct land wire, and the other is by radio itself, using extremely short wavelengths. In this country, the American Telephone and Telegraph Company has done much with the land line method, while the Westinghouse Electric and Manufacturing Company has taken the opposite course and done a great deal of research with transmission over long distances with short waves. We described these experiments from the American angle in our February number. This is the English side of the story.

—THE EDITOR

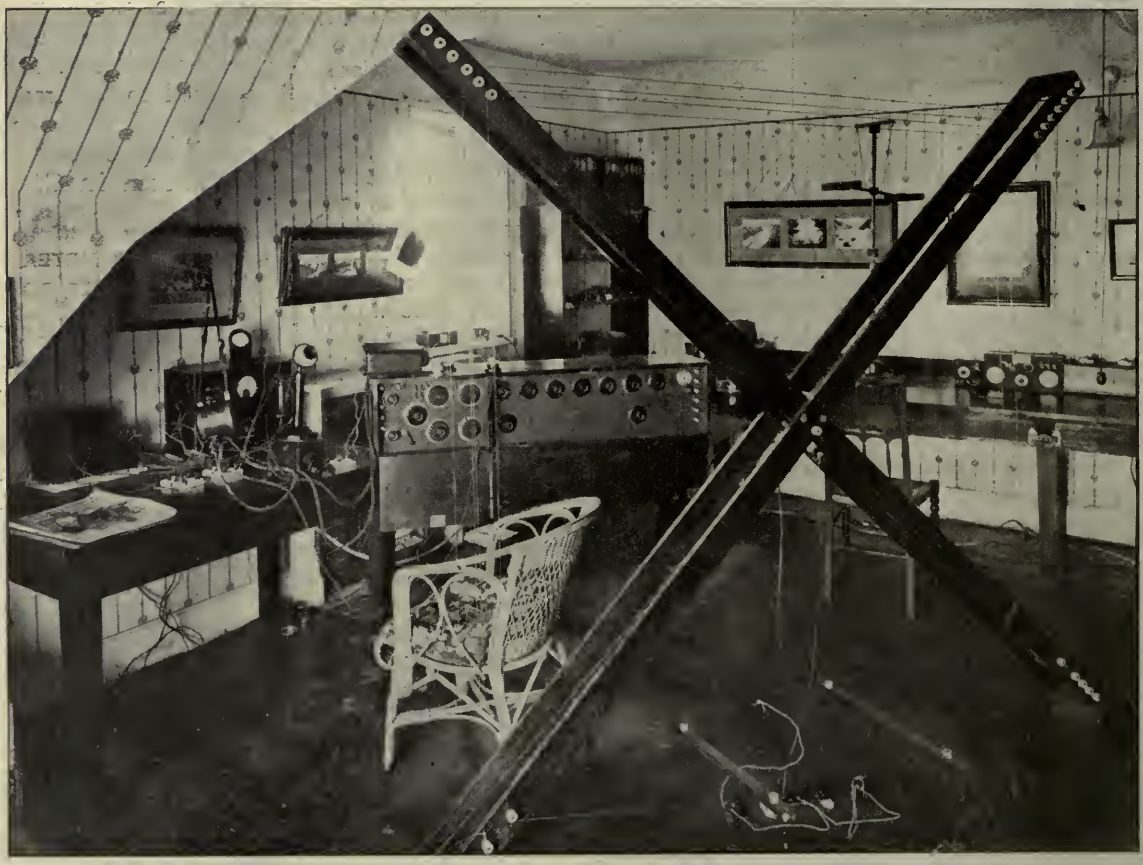
WHAT 100 METER WAVES WOULD DO

IT WAS immediately apparent that the 100 meter transmissions came over the Atlantic better than the 326 meter wavelength. The chief improvements noticed were firstly, greater consistency of results, secondly, freedom from interference by spark stations, "mush" and static, and thirdly, the comparatively small amount of fading experienced. As regards consistency of results, the improvement was particularly noticeable, and it was found possible to receive signals much earlier in the night than was possible with the 300-500 meter American transmissions.

The experiments being so far successful, the Westinghouse Company built a new transmitter operating at nearly 30 kilowatts input. This transmitter represents absolutely the latest radio engineering practice. It employs special high-power tungsten valves with an elaborate system of water-cooling, whereby quite a small valve can be made to handle an enormous amount of power. Most elaborate precautions are taken to prevent slight changes of wavelength which at the exceptionally high frequency of 3,000,000 cycles per second would have a very serious effect. The antenna system is designed to have absolute rigidity, as are the high frequency connections of the transmitter itself. The inductances are wound on rigid formers and as a final precaution the whole of the high frequency portion of the transmitter is mounted in a framework suspended by springs.

Statements have recently appeared in the press to the effect that KDKA has been making no special effort to broadcast their signals over the Atlantic, and also that their 100 meter transmission is of lower power than that of a British Broadcasting Company station. When it is realized that KDKA has been working with Metropolitan-Vickers for months past, and that they built a transmitter specially for transatlantic work which is *probably greater in power than all the British Broadcasting Company stations put together* the inaccuracy of such statements will be appreciated.

The first tests on the new transmitter were made in October, 1923, and naturally it was found that signals were coming over a good bit more strongly than before. Other troubles became evident however, chief of which was "night distortion" which is caused by slight changes in the carrier frequency of the transmitter, together with changing propagation conditions. In many cases this distortion was



WHERE AMERICAN BROADCAST PROGRAMS ARE HEARD ALMOST NIGHTLY

The extremely sensitive receiver at the Trafford Park Laboratories of the British Broadcasting Company near Manchester. The six foot loop in the foreground is used constantly in receiving 94 meter waves from KDKA, and, recently, the 104 meter wave of WGY. A wire line connects this station with the operating room and studio of the Manchester station 2 AC

so bad that speech was rendered quite unintelligible.

It must again be emphasized that, working with wavelengths as short as 100 meters, a very much greater constancy of wavelength is required than with the 300-500 meter transmissions, and also this constancy is much more difficult to obtain.

Many experiments were carried out with a view to eliminating this trouble. These experiments were carried on usually in the early (or rather, late) hours of the morning after the American broadcast program had ceased, and special forms of modulation were employed for the purpose of analyzing the effect. Great difficulties were met, particularly at the transmission end, and these resulted in an almost continuous flow of cablegrams between the two companies. In the end, on December 27, 1923, a fairly good transmission through was achieved, and on the following day rebroadcasting of KDKA to listeners in Great Britain was an accomplished fact.

During the following seven or eight days the Metropolitan-Vickers Company carried out a series of rebroadcasting tests, so as to gauge the possibilities of their system as it then stood. The repeating was done from the Company's station 2AC at their research laboratories, Trafford Park, Manchester. An experimental 1½ kilowatt transmitter was employed, operating at a wavelength of 400 meters. Reception was still carried out at the Altrincham Station. The two stations were connected by land-line.

THE MANCHESTER EQUIPMENT

DURING the preceding two months many different forms of receiver and various antenna systems had been tried out, to determine the most satisfactory method of reception. During the whole of the relaying period, however, a frame aerial some six feet square was used for picking up the signals while the receiving set employed a number of high frequency stages varying from six to twelve according to the prevailing conditions of reception. After detection, the signals were passed through two stages of low frequency power amplification before passing them on to the line leading to the microphone transmission.

At the beginning of the week, the whole of the controlling and announcing from Altrincham was done over telephone lines, but this was found to be rather unsatisfactory since there was no suitable non-resonant room for speech purposes at the Altrincham station; hence these functions were transferred to



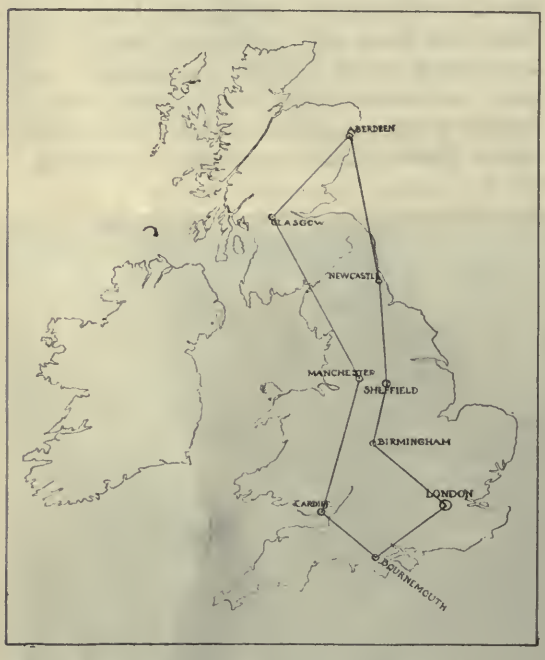
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CAPTAIN A. G. D. WEST

Assistant chief engineer of the British Broadcasting Company. Captain West has supervised the successful rebroadcasting of American programs from WGY and KDKA on a number of occasions. "We have some difficulty in regard to distortion," says Captain West, "The announcer is usually quite intelligible, but in some speeches, not a word can be understood, and this is perhaps when they are an "outside broadcast" . . . One of our chief troubles is from French amateur transmitters working on about 100 meters. Some of them spend their time tuning up and down for hours on end"

Trafford Park before the end of the week. In order to keep a check on the quality of the landline tranmission from 2AC, a 400 meter receiver was rigged up at Altrincham. The "control operator" was equipped with a pair of phones which he could connect at will either to KDKA direct or else to KDKA via 2AC and thus he could immediately detect any transmission or line faults.

A portion of the receiving station is shown in the accompanying photograph. The frame



THE NINE BRITISH BROADCASTING STATIONS are connected by land line to the central London station

antenna is seen in the foreground. Behind, to the left, is seen the control and announcing table and the low frequency amplifiers. Immediately behind the frame antenna is seen one of the receiving sets.

During the period of approximately one week the Metropolitan-Vickers Company succeeded in relaying the Westinghouse transmissions for an aggregate time of 18 hours. In two or three cases relaying commenced about 11.30 Greenwich Time, but the best results were undoubtedly obtained between the hour of 4 A. M. and 7 A. M. as had been anticipated from previous results. In fact one or two of these early morning transmissions were almost perfect in their reproduction—nearly as good as a first hand broadcast transmission.

ARLINGTON SIGNALS TWICE RETRANSMITTED

DURING the week a complete American program was successfully relayed right from the first item by the Westinghouse Band at 11:20 P. M. up to the relaying of the Arlington time signals at 3:00 A.M. The relaying of the Arlington time signals was in itself something of a novelty, since it reached the ears of British listeners through no less than three stages of transmission. The signals, which are the American equivalent of the famous Paris time signals, were transmitted from Arlington on a wavelength of 2650 meters at 10:00 P.M. New York time. They were picked up by the Westinghouse Company at Pittsburgh, 200 miles distant, and sent over the Atlantic to Manchester on the 100 meter wavelength, who received them and transmitted them for the third time on their 400 meter wave at 3:00 A. M. Greenwich Time. (Greenwich time is 5 hours later than that in New York).

Anxious to obtain all possible information and experimental data concerning the relaying, the Metropolitan-Vickers Company asked for reports, and got them. They were numbered first by hundreds and then in four figures. With scarcely an exception, they were all complimentary, most of them enthusiastically so. Many of these reports came from the Continent, some of them from as far off as Switzerland and even Italy. When it is considered that the power input at 2AC is somewhere about half the average power of a British Broadcasting Company station and that the actual relaying of KDKA was clearly heard at these distances, the results of the experiments were very gratifying. It has been possible to reply by post to only a very small percentage of the reports received, and the Metropolitan-Vickers and Westinghouse companies would like to take this opportunity of recording their thanks to all those listeners who have been good enough to send in their reports and comments.

A few details of the ordinary broadcasting activities of the Westinghouse Company may be interesting. In November, 1920, they opened the pioneer broadcasting station of the world, KDKA, at East Pittsburgh. The first transmitter was of comparatively low power—100 watts were delivered to the antenna. This was increased by stages to its present value of 1000 antenna-watts, corresponding to

a D. C. input of four or five kilowatts. The main studio at KDKA is situated half a mile from the transmitting station. There are also two other studios in the city, 14 miles distant, all of which are elaborately equipped. Land-line transmissions are an important feature; there are 45 permanent landlines covering an area of 225 square miles. These take in every church, theatre, public hall, and auditorium of any pretensions in the Pittsburgh section.

SOME CONCLUSIONS ABOUT SHORT WAVE BROADCASTING

IN CONCLUSION it is interesting to compare the results obtained with this 100 meter experimental transmission with those which might be expected with the ordinary 300-500 meter American broadcasting. As indicated earlier in this article it proved possible to relay the 100 meter signals for 18 hours during little more than a week, whereas in all probability sufficiently good reception of the 300-500 meter signals for relaying purposes would not be obtained for more than 2 or 3 hours per week. Thus it may be claimed that these experiments with the Westinghouse Company have increased the chances of American relaying probably about ten times. Also they have rendered it practicable to start such relaying at about 11:00 P.M. during the winter months, as compared with the impossible hour (for most people) of 1:00 or 2:00 o'clock in the morning.

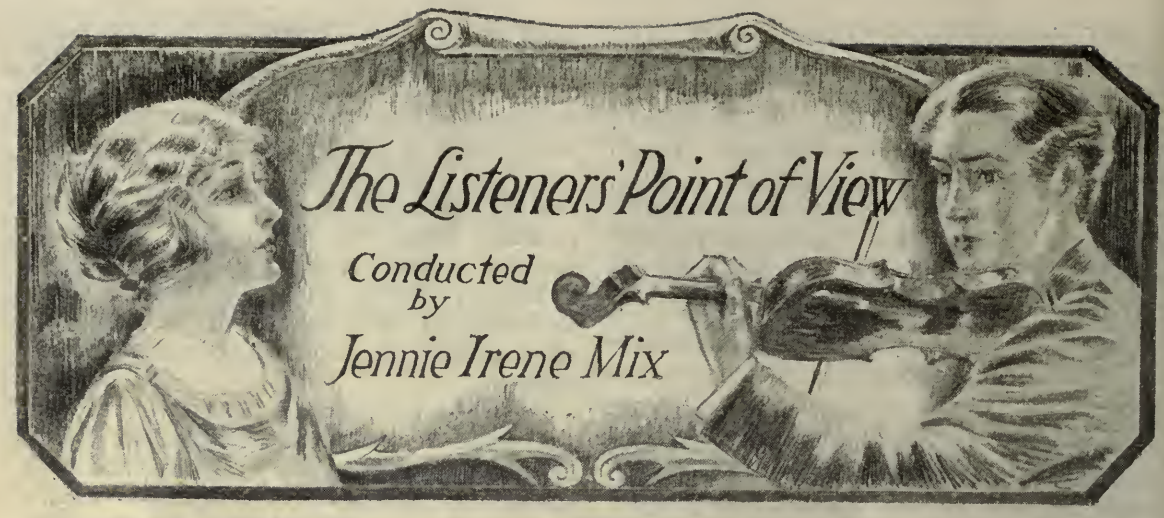
Of course perfection is not nearly reached, but some of the greatest difficulties which existed have been largely overcome, and with further developments the relaying of intelligence and entertainment from America may in the fairly near future become a matter of everyday fact.



© Keystone

THE HOTEL SAVOY BAND

—a well known dance orchestra from a well known London hotel, whose excellent programs have been broadcast for the especial benefit of American listeners from 2 LO and the other eight BBC stations



What Does the Public Want in Radio Music?

BROADCAST directors seem to be losing much sleep worrying over the question, "What does the public want in radio music"? In their well-intentioned attempts to find a solution to this problem they send out questionnaires, or they ask at the end of a program if the listeners will please be so very kind as to let it be known by letter what numbers they most enjoyed. "Only through such means," comes the explanation, "can we give you what you want."

One would think from this that until radio came into existence the American public had given no indication of what it wants in music. On the contrary this question was quite definitely answered—so many people believe—long before a broadcast station was thought of.

In order to find a partial answer, broadcast directors might examine the attendance of concerts and opera and thus find out what kind of music the public pays to hear. They might well listen . . . as one among these audiences and note how the music is received.



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IGNAZ FRIEDMAN

To hear such an artist as Mr. Friedman over the radio wipes out the memory of many mediocre performances sent through the air. The New York recital of this internationally famed pianist was broadcast by station WEAF

Through these means an idea can be gained of what large numbers of people want in radio music. For one's musical taste does not change simply by tuning-in a receiving set. Many people listen over radio for the same kind of music that



—Nicholas Muray, New York

EVA LE GALLIENNE

This picture shows this famous young actress as she appears in "The Swan" at the Cort Theater, New York. Miss Le Gallienne was recently introduced to a radio audience through station WOR. After giving a short talk, she read some of the most widely known of the poems written by her father, Richard Le Gallienne. From the picture, one concludes that those who could hear but not see Miss Le Gallienne lost as much as they gained

they have long enjoyed through the established concert channels.

To facilitate knowledge of what sort of music a large public pays to enjoy, here are some facts.

There are in this country ten or a dozen permanently established symphony orchestras of the first rank, maintained solely for the purpose of presenting only the best in orchestral music supplemented at times by soloists capable of playing or singing works of a standard in keeping with the rest of the program. There are about forty other orchestras maintained for the same purpose and all steadily advancing into the same rank. This means that in fifty or more cities, and in the communities adjacent to these cities, there is a public eager to hear the greatest music ever written. For the foremost instrumental works of the worlds' foremost composers may be found in orchestral literature.

To hear these orchestras and other musical attractions of equal standard the American public spends more each year than for attendance at all the sports combined, even including those years when championship prize fights are staged.

The music students who are scattered all over the country pay millions of dollars yearly for serious musical instruction. Their teachers add to the aggregate of these figures by themselves spending money to study whenever possible under the great concert artists who, at stated periods, conduct master classes.

There is scarcely a college of any importance throughout the entire land that does not maintain a music department.

In well nigh every city, and also in large numbers of towns, pupils in the public schools are given opportunity to study music under expert instruction, this study including also classes in musical appreciation so that the pupils may be made familiar with the classics. In Cleveland, Ohio, for example, thirty members of the Symphony orchestra—and each one of these thirty a master on his instrument—give instruction to school children, the cost of these lessons being paid out of the Community Chest.

In practically every city where a symphony orchestra is maintained, special concerts are given for children of school age, and although only music of high standard is played, the difficulty is to find accommodation for all who want to attend. In New York, Walter Damrosch, who for years has given such concerts, was obliged last fall to transfer them from Aeolian Hall to Carnegie Hall of far larger capacity. Philadelphia, Cincinnati, Detroit, Chicago, Minneapolis, and San Francisco, are a few among the other cities where the attendance at such concerts is limited only by the seating capacity of the auditorium.



—Moffett, Chicago

CLAUDIA MUZIO

One of the greatest among living operatic sopranos and now with the Chicago Civic Opera Company. She has been heard in solos over the radio and affirms that she enjoys singing for her unseen listeners as much as they seem to enjoy hearing her, judging from the letters she has received from these listeners. Mme. Muzio's broadcast performances have been given at the Zenith Station now operated by the Chicago *Tribune* (WGN)

America leads all the other countries in its patronage of music. This is why every concert artist who can pay his way across the Atlantic comes here with the hope of making a living.

Nor are these artists heard only in the cities. Towns of no more than a few thousand population engage, year after year, some of the best talent that good music may be heard rightly presented. And when these people cannot hear an artist in their own town they journey at much expense to some near-by city to enjoy this privilege when the opportunity to do so presents itself.

The sum total of the money thus spent each year for good music in the United States is estimated by some authorities in the billions.

Be that as it may, the amount is quite sufficient to prove to every broadcast director that there is a large public that wants the best music and nothing but the best over the radio. By this is not meant only the old classics, but also the lighter works with which good musical literature abounds.

On the other hand, enormous sums are yearly spent to hear the so-called popular music, some of which is very good of its kind and has its legitimate use as a means of entertainment. Still larger sums are spent to hear out-and-out trash. These two sums total far more than that spent to hear music of high standard.

But this does not necessarily mean that this sort of music should dominate the radio.

Upon every broadcast director rests the responsibility of using for a constructive purpose this greatest musical opportunity that has ever been available to the public. These directors have no doubt had many unaccustomed problems to solve, and these difficulties must be taken into consideration when judging their programs. But they will never *rightly* solve the problem of radio music by appealing to the public to find out what is wanted. The majority of those who want good music will not trouble to express their desire. They will simply cease listening to the musical programs. Many of them have already done so because they think that very often the average musical program broadcasted is of a kind, both as regards the quality of the music and of the performers, that no one of discriminating taste can tolerate.

There must also be an elimination as to quantity, for there are not enough singers or players capable of giving public performances to justify even half the number of musical programs now sent out through the air. But that is another story.



—Campbell Studios, New York

WILLEM MENGELBERG

For many weeks thousands of radio listeners heard the New York Philharmonic Orchestra every Wednesday evening give a program under the baton of the great Dutch conductor, Willem Mengelberg. With the closing of the Philharmonic's season came the end of what was one of the most remarkable musical opportunities ever afforded the radio public. The programs were broadcast from station WEAF

The "Radio Trio" and Old Time Songs

FOLLOWING the comment made in this department last month regarding the grateful custom of some broadcast stations in featuring programs of old fashioned songs, comes the information that the first concert of this kind heard by radio was broadcast from station KDKA, Pittsburgh, the singers being Clara Huhn, soprano, Mabel King, contralto, and Roy Strayer, tenor.

These singers have been so in demand by radio audiences that they are now known as, "The Radio Trio." But singing before the microphone is only an incident in their musical lives as they are all professionals occupying important choir positions and also filling out of town concert engagements.

Anne Griffiths, in whose studio these singers have received practically their entire training, is known throughout the Pittsburgh district as a musician of the highest ideals yet ever ready to seek new paths provided they give promise of leading to an artistic goal. This is why she was one of the first teachers of prominence in the country to encourage her artist pupils to broadcast. In response to the inquiry, "But don't they have to cheapen their work in order to be popular?" her reply was:

"Never! And let me add that the singer who must cheapen his or her art in order to please should not sing at all."

The popularity of this trio, as evidenced from the large number of letters received whenever they have broadcast, is indisputable proof that if you do a good thing well enough it will please both the connoisseur and the layman.



THE RADIO TRIO OF PITTSBURGH

Music Students before the Microphone

RETURNING to the subject of programs—commendation is due those broadcast directors who now and then present concerts given by the students of some well known school of music. Such programs offer a valuable opportunity to other music students in that they make possible a comparison of achievement that is often worth more than the stereotyped lesson.

A case in point was the concert given a short time ago by students at the Sherwood Music School of Chicago and broadcast through station KYW. It was an ambitious program consisting of numbers universally studied by advanced pupils, and in its execution was sufficiently good to be enjoyable apart from its special interest. Those students in other localities who heard it had a good chance to judge of the standard of instruction given in one of the largest music centers in the world.

And speaking of Chicago, since the *Tribune* of that city has taken over the Zenith station (now WGN), that station is fairly eating the air. And its musical programs are improving. The other night, just as this station was tuned-in, there came the surprise of hearing the opening phrases of what was immediately recognized as Debussy's "The Maid with the Flaxen Hair." To be sure, the piano tone did not have the desired warmth, but for all that it was a joy to hear this charming number. The pianist proved to be Miss Caroline Johnson. Congratulations, Miss Johnson, for giving radio listeners a chance to hear this ingratiating number by the French composer who was the first great musical impressionist!

Debussy leads us to comment on the programs received from the Compagnie Française de Radiophone, of Paris. They recently featured a concert called, "Festival Erik Satie." What it must have sounded like via radio it is impossible to imagine. For Erik Satie is a leader among those Moderns who cast aside all musical rules and go their own wild and erratic way when they compose. Key signatures, the division of the music into bars, time signatures, these and all other rules mean nothing to him. And as for harmony, he evolves his own. Yet fundamentally Satie is a sound musician. But to hear him by radio would very likely cause more amazement than pleasure.

These French programs contain, in addition to works by native composers, others by the masters of German and Russian music. But, in the dozen or more programs at hand at this writing, America is represented only by, "Yes, We Have No Bananas," "Mr. Gallagher and Mr. Shean," "I Am Just a Little Blue," "I Want my Mammy," "Perfect Day," and "Swet Henry." Is "Swet" a misprint, or is

there a fox trot with such a title? One should never be ashamed to confess ignorance where knowledge should be bliss—hence this inquiry.

These numbers, compared with the remainder of the programs on which they appear, show all too clearly what the French think of American music.

The Funereal Star Spangled Banner

WHY broadcast "The Star Spangled Banner" at a tempo that makes it sound like a funeral hymn? Twice in one evening it came through the air at such a mournful pace one imagined that every flag in the country would be lowered at half mast in the belief that some terrible catastrophe had overtaken the nation.

In the name of all that is patriotic, speed it up, you who broadcast this national song!

EVERY announcer in the country might well follow the example set by the man at station WHAA, Iowa City, who spells the names of those heard during the program. We all know how difficult it is to understand perfectly a proper name the first time we hear it. Although speech sounds clearer over the radio—when you have the right kind of a receiving set properly adjusted—than it does otherwise, yet one cannot always be certain that the name is correctly heard. So we herewith present our thanks to that WHAA announcer who first speaks a name and then spells it. There was the case of the program of old hymns given at this station recently. They were sung with a simplicity so free from sentimentality that they sounded almost like folk songs. And the announcer made it perfectly clear that the singer's name was Jeanne Wolfe.



—Nicholas Hay

WILLY POGANY

You could never guess his occupation from this picture, so we will enlighten you by explaining that he is a celebrated illustrator and decorator. He was born in Hungary, studied in Paris, spent ten years in London, and now lives in this country. He has illustrated more than one hundred books and decorated many famous buildings. He gave a broadcast talk at station WOR not long ago

WLAG, the Twin City station, Minneapolis, has a woman announcer (and, indeed, executive director)—Miss Eleanor Poehler—who is the equal of any man announcer in the country and the superior of some.

And it was something of a surprise to hear recently a woman's voice announcing the number of an afternoon program broadcast from Ohio State University, Columbus.

After all, why not? Women have successfully competed with men in nearly every branch of work.—Why shouldn't they be not only announcers but also broadcast directors? Why shouldn't every large broadcast station have both a man and a woman director? Such an arrangement would contribute toward giving the programs a wider appeal. Men know some things about how to get satisfactory contacts with the public that women do not know; and by the same token, women know some things regarding this same matter that men have never learned and probably never will.

This suggestion is offered to broadcast directors for contemplation, if indeed they ever have a chance in these hectic radio days to do any quiet detached thinking.

And Now—Programs in Spanish

IT WILL soon be quite the vogue to broadcast special programs given entirely in Spanish for the benefit of the Latin-American countries. The first complete program of this character was given at station KDKA by Mrs. Leora Sage McKennan who, during her studies abroad, specialized in Spanish music, and by Victor Saudek and his Little Symphony orchestra. Mrs. McKennan sang a group of traditional Pyrenese songs and the orchestra numbers were either by Spanish composers or works based on Spanish themes but written by composers of other nations. The an-

nouncer on this occasion was D. Santini, of Santa Fe, Argentina.

Then, a few days later, station WGR at Buffalo gave a Spanish program in which all the performers, with the exception of the piano accompanist, were Spaniards. It was not necessary that the accompanist be of this nationality as the piano can speak in all languages with equal facility.

And now it's up to someone to write a song about, "Hands Across the Air."

Dramatic Celebrities —Alone

STATION WOR, L. Bamberger & Co., Newark, has been carrying a fine feature in the presentation of many dramatic celebrities in short talks or readings. This series, which has also included celebrities in other lines of endeavor, has been received with such enthusiasm as to prove beyond all doubt that people want something more than ephemeral entertainment over the radio. These talks have been instructive. And it seems the only desirable way for dramatic artists to broadcast.



ANNE GRIFFITHS

Whose achievements as voice teacher and coach in interpretation have done much to raise the standard of singing in Pittsburgh and vicinity. Miss Griffiths is a firm champion of the radio, and equally firm in her belief that it should be used to elevate musical taste rather than simply to entertain

It may be that the giving of plays by radio will sometime prove a practical method of producing drama, but at present, to some of us, it presents difficulties that make for dissatisfaction. WGY at Schenectady put on the comedy "Snowball," about a month ago, and although it came through clear, with every accent in speech plainly brought out, it all seemed fragmentary and confused. Like grand opera, drama appeals to more than the sense of hearing. It seems as if it were over-straining the resources of the radio to expect effective results when either opera or drama is broadcast. But perhaps time will bring out developments along these lines that will astonish us. Indeed, nothing is impossible of execution of which the human mind can conceive.

WHEN station WOAW at Omaha celebrated its first anniversary in April, a portion of the program was given by members of the Chicago Bush Conservatory of Music faculty. The concert proved one of the best musical features heard via radio in many a day, and made some of those who listened to it lament that programs of this kind are not broadcast frequently.

THE monthly recital given by the Euterpean Club of Fort Worth through station WBAP is well worth listening to, not only because of the excellent performances given but also because they afford opportunity to realize the local talent available in that progressive Southern city. But for that matter, all who are closely in touch with musical development in this country know that Texas is ever abreast of the times in this respect. There is not a concert artist before the public to-day who does not jump at the chance to get Texas engagements. And it is also a field that yields golden harvests to grand opera companies.

COMMENT made in this department last month on the inspiring effect of hearing by radio the choir of St. Paul's Cathedral at Detroit, has brought the information that the organist and musical director of the cathedral is the widely known musician, Francis A. Mackay. It is again a pleasure to speak of the vitally artistic quality of the choir's singing under his guidance.



DON WALLACE

An amateur radio operator of Minneapolis at his station 9 ZT. He was recently awarded the prize cup offered annually by Secretary of Commerce Hoover for the best amateur radio station in the country

The March of Radio

Hoover on Broadcasting Control

THE furor started by the "monopoly control" cries of station WHN when the A. T. & T. suit against it was started naturally would call for some statement from those government officials responsible for issuing radio station licenses. Perusal of the license law may not at once disclose clauses under which the Secretary of Commerce could act, to revoke licenses "for cause," but judging by the way in which Congress can act when it thinks of losing the soldier vote, it would not take more than a day or two to enact any law which the radio public might demand, provided their demands were backed by as powerful an organization as the American Legion.

Evidently feeling that the action of the A. T. & T. Company in starting suit to close unlicensed stations called for some action on his part Secretary Hoover made public the following statement:

I am in receipt of many requests for my views as to issues now before the Courts bearing on the control of radio broadcasting. While it is impossible for me to express any opinion on particular issues that are before the Courts or the Federal Trade Commission, I can state emphatically that it would be most unfortunate for the people of this country to whom broadcasting has become an important incident of life if its control should come into the hands of any single corporation, individual, or combination. It would be in principle the same as though the entire press of the country were so controlled. The effect would be identical whether this control arose under a patent monopoly or under any form of combina-



RUNNING ASHORE ON A COAST LIKE THIS

Is not to be relished, and it would happen more frequently were it not for the radio signals which supplement the warning flashes from the ever-vigilant outposts of our lighthouse service

tion, and from the standpoint of the people's interest the question of whether or not the broadcasting is for profit is immaterial. In the licensing system put in force by this Department, the life of broadcasting licenses is limited to three months so that no vested right can be obtained either in a wavelength or a license. I believe it is safe to say irrespective of claims under patent rights on apparatus that broadcasting will not cease and neither will our public policy allow it to become monopolized.

We heartily agree with the general sentiment of this statement. It is an excellent thing for United States radio that the department which grants broadcast licenses is supervised by such a secretary. We are not at all sure that the statement, "from the standpoint of the people's interest the question of whether or not the broadcasting is for profit is immaterial," is to be taken at its face value. Probably Mr. Hoover has not thought this thing through. We are not convinced that in this sentence the whole question as to how radio is to develop does not rest. "Radio for profit," the Secretary's statement notwithstanding, does not sound as though it promised much for the listener.

London Has Hard Work Getting Through to U. S.

WE HAVE yet to learn much about radio transmission. In the most recent attempt to bridge the Atlantic westward there were nine stations operating, all connected by wire to radiate the same program. Each of the stations was on a different wavelength. The power any one listener in America could pick up was that from one station only.

Although some elaborate preparations had been made to receive this transmission, very meager results were obtained. The RADIO BROADCAST super-heterodyne seems to have done as well as, if not better than, any other, but even this was successful in picking up music only; Marconi's message of greeting was apparently cast into a barren waste in so far as America was concerned.

It is Marconi's idea that this trans-oceanic transmission should be carried out by his ray radio, and we thoroughly agree with him. Could "mirror" stations be put up on both sides of the Atlantic there is no doubt that transmission would be altogether successful. What information we have on the method shows that if suitable mirrors were used at both transmitting and receiving stations the signal strength would be increased at least two hundred times.

When we think of KDKA's consistently successful 94 meter channel and WGY's recent transmission on 104 meters across the Atlantic it seems strange that the waves traveling in the opposite direction should encounter so formidable a barrier. We may discover why some day.

Squealing Sets to Go Surely

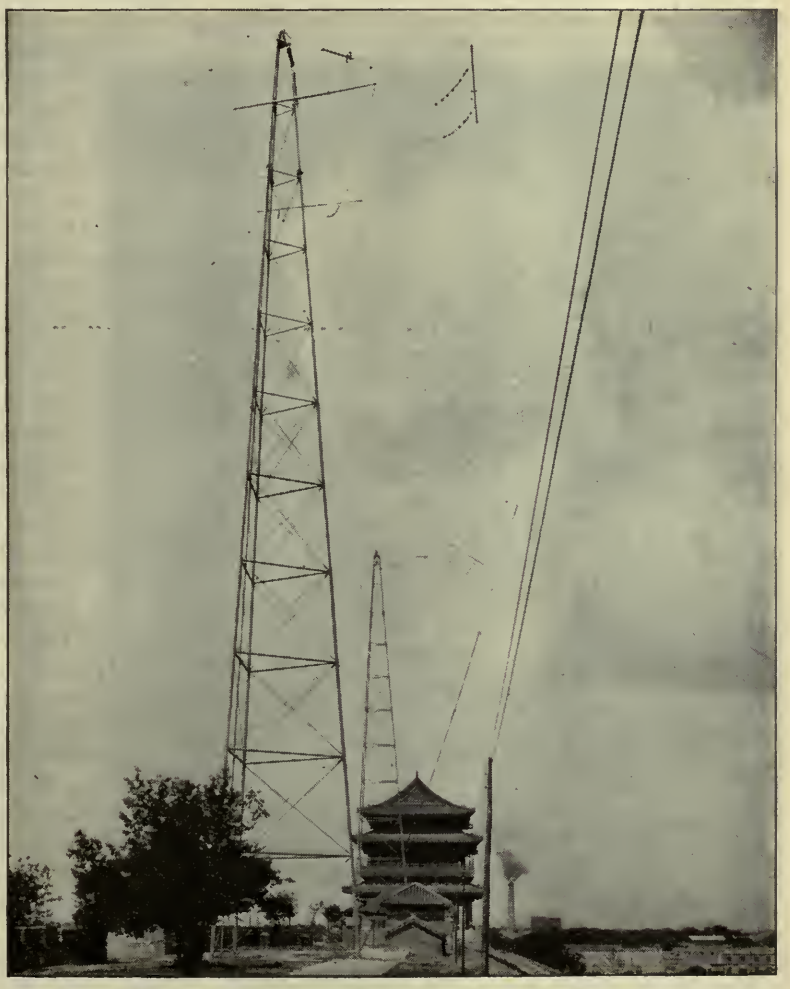
THERE is now no doubt that the single circuit regenerative receiver, against which RADIO BROADCAST has consistently waged war, is doomed to go. The dissatisfaction of the listening public has at last penetrated high places, and we now hear Mr. Sarnoff of the Radio Corporation tell a Congressional Committee that "the Radio Corporation recognized the problem of radiation and favored a law prohibiting the sale of receivers which produced audible interference with others in close proximity." Within a period of two years he would make it unlawful for any one to use a radiating receiver!

It is with great satisfaction that we see this company, many of whose sets constitute one of the greatest causes of interference, finally change its attitude on this question. It is, it seems likely, more satisfactory to us to think of this law prohibiting radiating receivers than it is to those hundreds of thousands who paid high prices to the Radio Corporation for the single circuit regenerative receivers which it so ardently advocated a short time back. It seems as though Mr. Sarnoff ought, in all fairness, to offer some sort of a reasonable "swap" with the former customers to whom he sold these sets, now condemned by him. It is hardly fair to sell a man something and then agitate for a law to make it illegal for him to use the apparatus.

Praiseworthy Broadcast Engineering

AT A recent dinner of the alumni of Massachusetts Institute of Technology, a feat of broadcasting was successfully accomplished. There was a notable list of speakers. The pick-up in the banquet hall operated WJZ. From this operated WGY. KDKA intercepted WGY's transmission and started the program out again on two waves, one for its listeners and one to actuate its KFKX Hastings station as well as station 2 AC in Manchester, England. Hastings further relayed the program to KGO in San Francisco, which then threw it out over the West Coast and the Pacific Ocean.

As a result of this network control, cablegrams were received during the progress of the banquet so General Harbord, President of the Radio Corporation, was able to say that the speakers had been heard from Melbourne to Constantinople. Real broadcasting, which completely covers the civilized parts of the globe, is evidently not far distant.



THE OLD AND THE NEW

The towers of the United States Naval radio station NPP at Peking show in decided contrast to the good old Chinese roof in the background

Outlaw Stations to be Closed

QUITE some time ago we were talking to an engineer of the American Telephone and Telegraph Company about the development of radio and the part his Company was playing in this development. At that time the Radio Corporation had been formed, and, as is now common knowledge, the Telephone Company had been given a virtual monopoly in selling transmitting equipment for broadcasting purposes. To offset this concession, the Telephone Company agreed to keep out of the radio receiver business. As a result of this agreement we have seen no A. T. & T. radio receivers on the market, although their well known amplifier unit to operate a loud speaker, convinces us that the Company certainly could design and build very excellent radio receivers. The amplifier is evidently not construed in the Corporation agreement as "radio receiving equipment."

It seemed at once evident that the other members of the Corporation "put it over" on the A. T. & T. signatories. Greater profits are possible in the sale of millions of receivers which are used compared with those arising from the very few transmitting stations required to cover the country. Matters which seem so obvious are frequently not. Perhaps those responsible for the policies of the A. T. & T. Company looked farther than the immediately visible dollar of profit.

There is no doubt about the tremendous profits to be had from the sale of radio receivers —by merely glancing over the advertisements in any paper it is easy to see that any of the standard sets could be materially reduced in price and still leave a handsome profit for the manufacturer. In fact we predict this very thing will come about in the next few months. But of all the millions of receivers which the American people have bought and which have yielded many million dollars of profit to the Radio Corporation (other than the A. T. & T.) depend upon transmitting stations for their utility, and all the transmitting stations, according to the agreement, are to be furnished, and to a certain extent controlled by the Telephone Company.

There is apparently at least one objectionable clause in the contract which the purchaser of the transmitting set has to sign which compels the purchaser to agree not to use the station for profit, as WEAF, the Telephone Company's own station is continually doing. For sending out the concert of The Happiness Boys or Chicklet Trio and whatnot, some firm is paying the Telephone Company about $400.00 an hour. Naturally the managers of other stations would like to use theirs for a few hours each week in this fashion, but according to the contract they can't. There may be other conditions imposed upon the purchaser which seem to him unwarranted, but we hear more about this one than any other.



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HUGH S. POCOCK

Editor of the *Wireless World and Radio Review* of London. Mr. Pocock, in coöperation with the engineers of the British Broadcasting Company, had much to do with the success of the transatlantic broadcasting tests conducted last November by his magazine, the "B. B. C." and RADIO BROADCAST

The reader is very likely to conclude that in this matter the Telephone Company is monopolistically culpable, that it intends to keep a tight hand on any possible profit which may accrue from regular broadcasting. But the answer of our engineer friend to whom the question was put, shows that the gain of profit is at least not the only motive controlling the moves of the Telephone Company, if in fact it is the prime motive. Perhaps they feel that more profits may possibly be derived in an indirect rather than in a direct way. "The Telephone Company," said the engineer, "sees that radio broadcasting is very likely to develop into one of the most vital communication schemes of the age"—and his company is a communication company. The proper and reasonable development of the art, rather than any immediate profit, he thought, would be the force which decided the company's course.

He told of a case of a New York church asking for a broadcast set—the minister was badly infected with the "fundamentalist" germ and itched to spread his Sunday sermons beyond the walls of his edifice. Now to spread the teachings of Christ is surely the most noble task to which broadcasting can be put, but it is not at all evident that such would be the use of this set. So many preachers to-day insist on *their version* of what Christ taught. Views on the subject are so diversified that many times they seem almost opposed to one another. If this minister were allowed to broadcast, how about his "modernist" brother who professes Christianity as ardently? Shall he be refused a transmitting set, or shall the Telephone Company give him a set also and let the Sunday air be filled with conflicting ideas of Darwin and Bryan? And the conflict would be as bad in subject matter as in wavelength, since probably both would have to transmit at the same frequency.

Foreseeing this imminent battle of the ether if it sold a broadcasting set to any who apply, the A. T. & T. Company refused to sell a set to this church—with what result? The church is now operating a "bootleg set!" Dispensing the gospel over a channel which is operated against the laws of the United States—for the Government regulation, giving protection to a patentee, is as much a part of our Constitutional law as is that granting "life, liberty, and the pursuit of happiness." There are undoubtedly many broadcasting stations operating to-day in violation of law, for no matter what arrangement of apparatus is used, all of them must use an oscillating triode as their source of power. The patent covering the use of oscillating tubes is owned by the Radio Corporation.

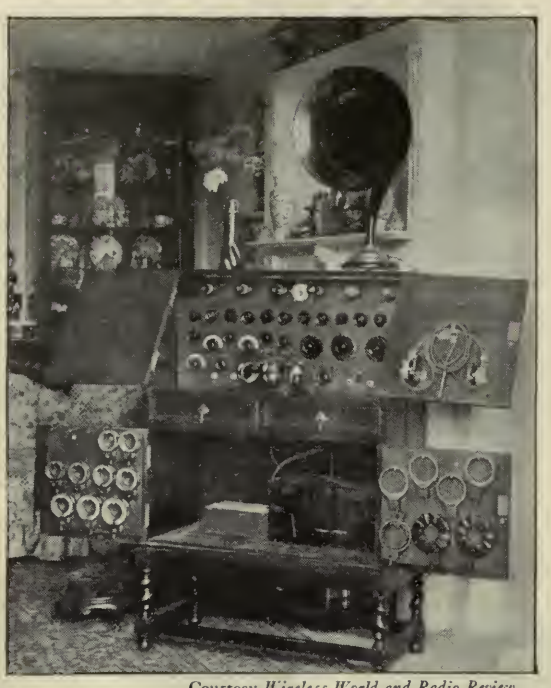


WILLIAM GIBBS McADOO

Addressing the radio audience before a Los Angeles microphone. Mr. McAdoo is another candidate for the Presidency who says he intends to use radio in the campaign

What then is to be done to these stations which are operating in defiance of the patent law? Are they to be left alone, or shall the patent law be enforced? The A. T. & T. Company proceeding legally against infringers, requested the Court to compel one of these outlaw stations, WHN, to cease operation or comply with the agreements under which the Telephone Company permits the use of its patents. This WHN settled out of court, acknowledging the validity of the patents and signing a license agreement.

This suit has started much loose talk about "freedom of the ether," "monopoly of broadcasting," but the public should not be misled by any such statements. The question at issue is a very simple one. Is the owner of a patent entitled to legal protection? If it appears that this question of broadcasting is so revolutionary in its service and requirements that the present patent law can be enforced only at the expense of the interests of the people then undoubtedly our patent law requires revision. But until that revision is enacted into law we can see no other solution to the broadcasting problem than compliance with the agreements the Telephone Company sees fit to incorporate in its licenses.



Courtesy *Wireless World and Radio Review*

AN ELABORATE BRITISH AMATEUR RECEIVER

Which is fairly characteristic of present day English amateur construction

It is probably fortunate for the broadcast listener that this question is at present in the hands of the A. T. & T. Company. This gigantic corporation with its hundreds of thousands of stockholders is subject to all kinds of governmental inquiry because of its interstate character. And if there is anything this corporation does not want to start it is a popular demand for government ownership of the American telephone system. Such a movement might gain considerable momentum under guidance of the radicals of North Dakota, for example, if it could be reinforced by the talk of "controlling the religious, educational, entertainment, and political destinies of the nation" which the management of station WHN asserted to be the aim of the Telephone Company.

We feel that some revision of the patent law is probably required; as it stands the people of the country give the patentee the opportunity to fleece them as much as he desires. If it is a cure for tuberculosis that the inventor discovers, he could legally collect hundreds of millions of dollars from the sufferers. Perhaps a patent on a device or idea which fills a great public need should have such extra governmental control exercised to insure to the people (who themselves grant the patent) of its reasonable use. But the fact that WHN, by signing the agreement with the A. T. & T. Company, is not allowed to do advertising for money, cannot well be classed as an oppressive measure, as the manager of WHN seems to regard it. We think that the interests of the radio public are being conserved when such stations are prohibited from broadcasting for direct monetary profit. Direct advertising by radio is highly questionable even when tried by so excellent a station as WEAF.

A Municipal Broadcasting Station for New York City

VOLUMINOUS correspondence from Commissioner Grover A. Whalen of New York, has arrived. He mourns the difficulties he has had in trying to establish a municipal broadcasting station for his city. As he is apparently entirely dissatisfied with the manner in which the Western Electric Company is willing to sell and install its broadcasting apparatus, he has written at length on the subject, asking the Federal Trade Commission to investigate the "monopoly of the air" which he asserts the A. T. & T. Co. is maintaining. He explains the reasons for his actions in this matter in the last sentence of his letter to the Board of Aldermen—"I believe that the people of the City of New York, with its millions of radio fans, should be acquainted with the commercial aims and monopolistic tendencies of this Company to coerce the City which is endeavoring by means of the establishment of this broadcasting station to give maximum service and greater happiness to its citizens."

At the request of the city, the A. T. & T. engineers had estimated the cost of this station. It was due to their preliminary tests that the location proposed by the city (on the top of the Municipal Building) was found to be a very unsatisfactory one, and that another, much more efficient electrically, was found. This new location, however, seemed to be very poor, from the city's standpoint, because it required a wire connection with the City Hall and these wires would be owned by the Telephone Company. Altogether it seems to the Commissioner that this company is maliciously hindering the city's radio venture so he loudly calls for Federal vengeance.

The real facts of the case are not all brought out in the Commissioner's correspondence, but

he has apparently disturbed the Radio Corporation officials sufficiently to have them instruct the Westinghouse Co. to offer a broadcasting set to the city. Mr. Whalen is rejoiced that now he may broadcast without objectionable controlling agreements. Just how the city is going to use the set after it is obtained is not clear, neither is it apparent, we desire to point out to the Commissioner, that the stuff which is likely to be sent out from his station will "give greater happiness to the citizens" as he fondly hopes. If he would take the trouble to inquire, he would find out that most of his "million fans" are pretty well satisfied with the programs the other stations of the Metropolitan area have been furnishing them for the last year. He will have to extend himself a good deal to make the average citizen feel that the municipal station is not a nuisance, if it interferes in any way with these other stations.

The tone of the city administration's criticism of WEAF's managers is well shown by the stand taken on the acquirement by this station of permission to carry on experimental work of development during the hours from 2 A. M. to 2 P. M. In getting from Secretary Hoover this special Class D station privilege, he "finds this doministic (whatever that word may mean) company securing the one remaining concession that was needed in order to completely dominate and control the air. This appeared in the form of an order from the Secretary of Commerce notifying broadcasters that after this date there would be in existence Class D. or Broadcast Improvement Class, stations. So evidently this "doministic" company has hoodwinked Secretary Hoover and he too, is "agin the city."

Annual Report of the Radio Corporation

THE immense growth in the country's radio is indicated by the report of the Radio Corporation for the year just past. From a gross income of about $15,000,000 in 1922, the business of the company increased to more than $26,000,000 in 1923. The net income of the Corporation has grown in a manner which should be very satisfying to the stockholders. It was $426,799 in 1921, $2,974,579 in 1922, and $4,737,774 in 1923. Practically all of the increase in business resulted from the sale of receiving sets, many of them now to be outlawed, thus making way for others. Of the net income of the company only 9.5 per cent. increase occurred in transoceanic telegraphy and 17 per cent. in the marine traffic of the company.

Current assets of the corporation exceed the liabilities by more than eight million dollars and the 7 per cent. dividend on the preferred stock has been made cumulative. Two additional radio channels have been put into operation dur-



MUNICIPAL BUILDING

New York, where the City of New York is soon to install a 1000 watt broadcasting station. The old City Hall in the foreground

ing the past year, one to Italy and one to Poland. New circuits to South America are planned, in addition to which there are at present nine channels in service, to Great Britain, Norway, Germany, France, Italy, Poland, Hawaii, and Japan.

The report concludes with the statement that the company's engineers are devoting themselves to the solution of the broadcasting situation "with the ambition of perfecting the service to the satisfaction and benefit of the American people."

Armstrong to the Front Again

ON MORE than one occasion the radio receiver has received tremendous impetus from the contributions of E. H. Armstrong, the patentee of regeneration, super-regeneration, and the super-heterodyne. Now he has designed a new set which the Radio Corporation is selling under the name of the Regenoflex.

Seldom has it occurred in any field that one experimenter has contributed so richly. The regenerative receiver, with its ultra-sensitivity in the hands of a skilled operator, did more than any one other thing in the decade 1910-1920 to advance the art of radio communication. By it European signals were consistently copied in the laboratory at Columbia University, using one triode. Ten years ago in the same laboratory it was generally possible to hear the West Coast stations talking to Honolulu (by code, of course) and to copy these messages when the stations themselves were continually calling for repeats.

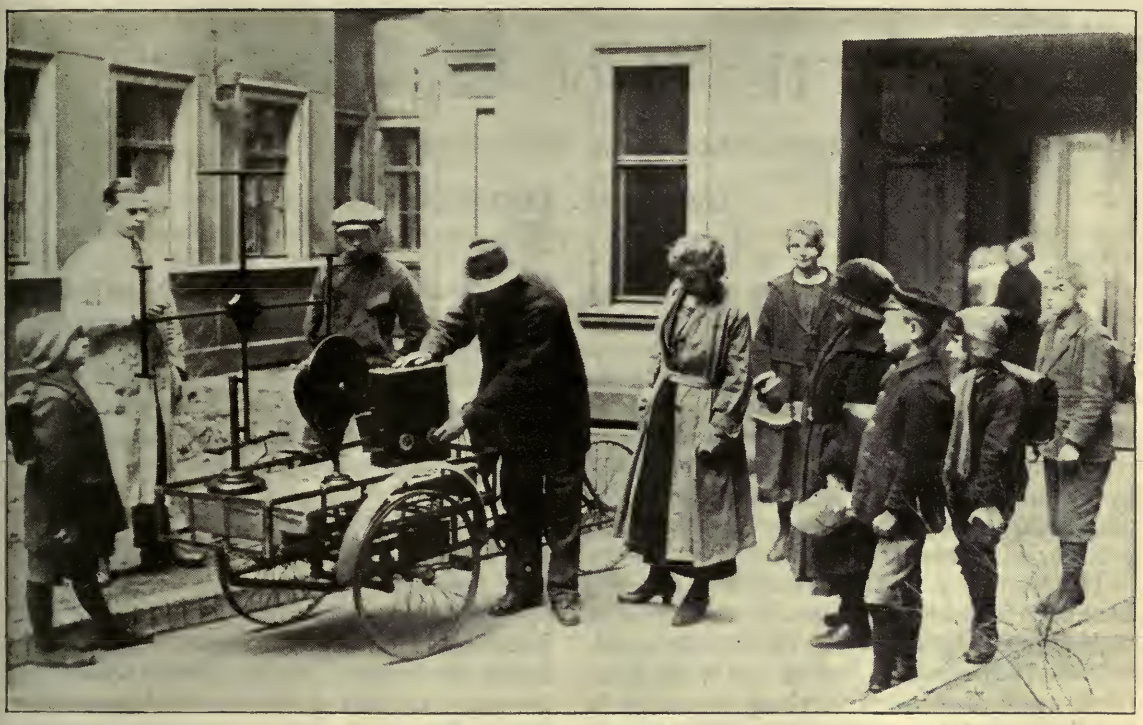
His next contribution, the super-heterodyne, makes possible a most remarkable receiving set. This principle offers apparently the best method of getting high amplification of weak radio signals, and we have always recommended it as the best receiver, for those who could afford it. Its control is fairly simple, it is non-radiating, and it can be made to bring in the most distant stations, apparently still desirable to many broadcast listeners.

For his super-regenerator we cannot say so much. When properly built and adjusted this set produces a lot of noise, but that apparently is about what it is good for. As usually employed this super-regenerator amplifying arrangement gives very poor quality reproduction. Quality, is the one feature which the radio receiver manufacturer must strive for more and more. Radio transmission, *per se*, permits of almost perfect reproduction of voice and music, whatever distortion occurs is due to the



AT WHN

Billy West and Billy Murray broadcasting. WEAF's suit against this station for alleged violation of American Telegraph and Telephone vacuum tube patents was recently adjusted out of court



A MODERN ONE-MAN GERMAN BAND

Has been evolved by this rather ingenious German who has mounted this radio set on a cart, which may have before held his hand organ. He tunes in Berlin programs and depends on the financial appreciation of his audiences for support

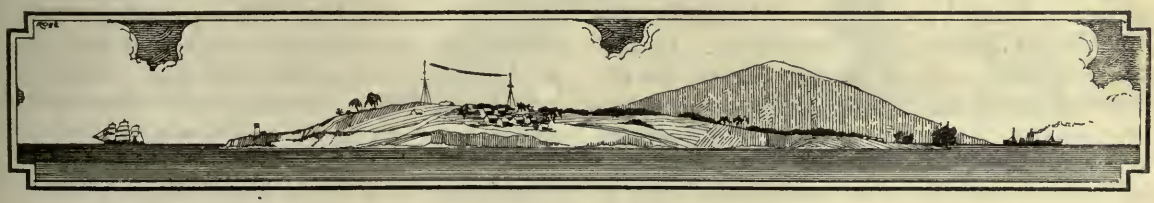
imperfect electrical apparatus employed at the transmitting and receiving stations and the super-regenerator did not contribute much to the solution of this problem.

He has lately been endeavoring to make the operation of the super-heterodyne more simple and has apparently succeeded—at the same time lessening the number of tubes required from eight to six. He is of the opinion that his latest arrangement, in which regeneration and reflexing are employed, as well as the double detection idea, gives as good results (in so far as amplification is concerned) with its six tubes as is obtained with the ordinary circuit using eight tubes. The internal capacity of the triodes, between the grid and plate, is partly compensated as is done in the Hazeltine neutrodyne sets.

To make the adjustment of the local oscillator more independent of the loop antenna tuning, a "second harmonic" oscillator is used; the oscillator, instead of generating a frequency nearly the same as the incoming frequency, generates about one half this frequency and the intermediate frequency, for the intermediate frequency amplifier, is obtained by the beat note between the signal frequency and the second harmonic of the local oscillator.

The engineers of the Radio Corporation have done an excellent piece of design and construction on the new set, and if it is anywhere near as good in performance as the inventor claims for it, the Regenoflex should prove to be a popular receiver—provided the price is kept as low as the amount of material used in the set justifies.

J. H. M.



Pity the Poor Broadcaster

An Intimate Confession, Wrung from One of Them

By CARL DREHER

Drawings by F. F. STRATFORD

"HOW fortunate you are to be in such an interesting business as broadcasting!" A professional broadcaster is doubtfully blessed by being forced to hear this remark, or something very similar, at least twice a day.

Well, it is not the worst business in the world, by any means. At the same time it has its drawbacks. Being in a gloomy mood, I purpose to enumerate a few of them.

The wonder and mystery of broadcasting have been so much cried abroad in the land that many people expect miracles of the poor broadcasters. For example, the matter of the placing of microphones. Everybody wants to be broadcast, but the microphones must not be visible, oh dear no. Hide them in the footlights, or hang them as high as Haman in the proscenium arch, or keep them warm behind the boilers in the engine room, but don't let any of the soloists, or speakers, or even the audience, suspect that there is a microphone in the house. If they do, all is lost, including honor. "What," I can hear them say, "the microphones have to be placed in certain definite places?" A long argument usually ensues, the broadcasting station's representative explaining that a microphone picks up only what comes to it in the form of sound energy, and that the operators, far from being able to make it behave otherwise, are different from other people only in knowing what the microphone will do and what it will not do. Thus, if it is placed on the floor under the piano, the piano will sound on the air like the merry bouncing of ash cans on urban sidewalks, and the rest of the show will be conspicuous by its absence, and the station will receive fifty-six hundred threatening letters the next morning from irate listeners, including the friends and families of the performers. Finally an agreement is almost always reached, for the representatives of the artists discover that the microphone is merely a round black object considerably smaller than a man's hand, on a slim stand, and that the broadcasters want to place it only about waist high, and not, as was feared, right in front of the prima donna's nose. But in some cases, when it develops that the microphone must be somewhere, and there is no way of making it invisible like the air, all bets are called off, and the radio audience has to listen to something else.

IN THE STUDIO IT'S NOT SO BAD

ALL this applies only to outside broadcasting. In the studio, of course, the operators have things more their own way. But even in the studio, in the matter of placing bands, for example, it is sometimes found that the musicians balk at the positions selected for them. We must then compromise so that a fairly good orchestral balance can be had on the air with the musicians lined up so that they can play together. Usually this is accomplished by getting the different pieces to play with special loudness or softness, the music sounding better on the air, very likely, than in the studio. But it requires considerable persistence and tact to explain this to people.

Some performers are microphone-shy. This is often the result of exposure to a squawking loud-speaker overloaded to about ten times its proper capacity; hearing the result the listener resolves, rationally enough, never to let himself be broadcast. The worst of it is that the higher a man's musical competence, the more severe will the case of micro-phobia be, and the greater the loss to the broadcasting art during its duration. The broadcasters who try to do uniformly good work, and succeed almost all the time, have to carry the handicap of poor broadcasting by other stations, and incompetent amateur and professional receiver demonstrations. The prejudices thus engendered injure the art as a whole, and the good stations suffer with the bad. Possibly it was after hearing the braying of some radio store's horn, trying to make enough noise to get over street traffic, that M. Clemenceau, on his recent visit to the United States, flung a

public address microphone to the floor on one occasion. It makes little difference whether or not the report is true. One can hardly blame his feeling.

TRYING TO MOVE AN AMBASSADOR

SOME listeners have an exaggerated idea of the power and influence of the technical staff of a broadcasting station. Recently, while WJZ was broadcasting the retiring British Ambassador, Sir Auckland Geddes, speaking at the Pilgrims' Society dinner from the Hotel Plaza in New York City, an irate listener called up the station to complain that the ambassador was talking too slowly, and was there no way to speed him up? On being told that ambassadors were in the habit of talking as fast or as slowly as they pleased, he hung up with a loud "Bah!" and is no doubt now going around telling the populace what dubs those broadcast fellows are, that not one of them had the nerve to step up to Sir Auckland and say "Hey, Ambassador, speed it up a little, wontcher?"

Every broadcasting station of any size is bombarded with requests from people who want to be mentioned on the air. Usually they are holding a party in honor of someone, and they explain that it would be so nice to turn on the radio and hear it tell the world that this is Mr. Ignatz Verplatz's birthday, and that they are giving a party in honor of the same at his residence on President Street, Brooklyn. This is, of course, a matter of intense public interest.

WHY READ TELEGRAMS?

THE larger stations, as a matter of fact, are discontinuing the practice of reading or acknowledging telegrams via the air. This was perhaps justified in the early days of the art, when it was a subject for great amazement that a certain station had been heard in Oshkosh, 400 miles away; but now this is such an everyday occurrence that no further novelty or interest attaches to it. The stations are glad to get word from their listeners, of course, but the proper way to acknowledge them is by letter. The ether, it is becoming more and more evident, should be reserved for public entertainment.

Occasionally people send in technical queries, accompanied by hook-ups, and want them answered on the air. Just how this is to be done is not clear; at least until radio television or telephotography becomes a reality; talking about wiring diagrams, without a pencil and paper handy, is too much like lecturing on the fourth dimension. It is bad practice, in general, to send technical inquiries to a broadcasting station. The broadcasting engineers and operators have to worry about keeping the station on the air, and meggering wire lines, and doctoring microphones, and maintaining good quality, and it is hardly fair to ask them to diagnose the ills of individual receiving sets, when there are several radio periodicals with facilities for this service and willingness to extend these facilities to their readers.



"THEN THE PIANO SOUNDS LIKE THE MERRY BOUNCING OF ASHCANS ON URBAN SIDEWALKS"



"SOME PERFORMERS ARE MICROPHONE-SHY"

Keeping advertising off the air is another extra responsibility in operating a non-toll broadcasting station. Most of the performers understand the necessity for this and coöperate in good faith. Occasionally an attempt is made to put something over. One instance is on record where a singer of popular song hits started working in the name of a dance hall. He was promptly taken off the air—unknown to him, it is interesting to observe—for the balance of the number. Constant vigilance, and the exercise of quick judgment, are prime necessities in the operation of a broadcasting station.

SIMON SAYS YES, BUT SIMEON—NO

A BROADCASTING transmitter, like all mundane objects, has to be located somewhere, but, judging by the complaints of some of its patrons, one would not take this to be the case. The listeners who happen to be close by complain of the intensity of the signals, and request that the power be cut to one fourth, to make it easier to tune out the signals. Listeners at more remote points want louder signals, and urge that the station be made four times as powerful. It is very hard to please everyone, and broadcasting is preeminently a business in which one must try to please everyone. This brings up the question of dead spots in urban broadcasting. Every city station has areas, sometimes quite close by, where its signal is weak. There is sure to be a constant deluge of complaints from listeners in these neighborhoods who want to know why the other station, with no more power, and perhaps farther away, is louder. There are neighborhoods in New York City where signals from one or more of the local stations are below the intensity of WGY at Schenectady or KDKA at Pittsburgh or WDAP at Chicago. It is hard to explain to people that this is an act of God, that the city was laid out or grew up naturally and more or less aimlessly, and certainly without any thought of broadcasting, and that the combination of man-made structures and the topography of the region, put together, make the transmission what it is in any particular locality.

THE BROADCASTING STATION: BLAME HEADQUARTERS

THE broadcasting interests, like other public utilities, are blamed for a great many things for which they are in no wise responsible, as well as for their actual shortcomings. Besides dead spots, they are blamed for everything from high tension induction to static. When anything is wrong with the reception, most of the listeners can be trusted to be fairly discriminating and to put the responsibility where it belongs, but a minority can be trusted equally to make a scapegoat of the broadcasting station. Of course the staff of a broadcasting station is composed of human beings; they are willing to be condemned for their sins of omission and commission, but they do not relish being castigated indiscriminately. In the nature of their situation all their errors become public as soon as they are made—not a very enviable position at best. They may broadcast beautifully for weeks, and nothing is thought of it, but let there be a two-minute difficulty, and a few score of listeners who never thought of giving them a word of praise, let fly with both fists.

Radio has one other drawback; now that it has become a public plaything, one can never drop it. One's best girl insists on discussing the causes of blasting in loud speakers, one's brother-in-law wants to know how to get some tubes at a discount, the superintendent's set, which is out of order, has to be fixed before he can be persuaded to send up a little heat, the very bus boys and bootblacks inquire what is the best set to buy, how much it will cost, and whether it will receive Mars every night. Popularity has its disadvantages. A high official of one of the great corporations in the

field, leaving on his vacation for parts unknown, remarked gloomily:

"No one's been told where I'm going, and I don't know a soul there. I'm going to tell everybody I'm a plumber, so they won't talk to me about radio."

There are few radio men who would not sympathize with this sentiment—at times. At bottom all of them including the writer of this jeremiad, like the business, "business," observe, not "game,"—for none of them is observed leaving it. Like newspaper work, it is fast, eventful, and fascinating. So we leave plumbing to the plumbers, who don't seem to mind.

A Correction

WE REPRODUCE in Fig. 1 the Kauffman circuit as originally published, by Mr. Kauffman, in a recent issue of *The Radio Globe*, the Saturday radio supplement of what was then the New York *Evening Globe*. We regret that this circuit was incorrectly drawn in the trick circuit article, which appeared in the March RADIO BROADCAST.

The principal electrical difference between Fig. 2 and the circuit first published, is the failure to indicate the inductive relation between the plate and grid coils—which, however, was described in the text of "The Truth About Trick Circuits." The interested reader will find it worth while comparing the circuit in Fig. 2 with the original text.

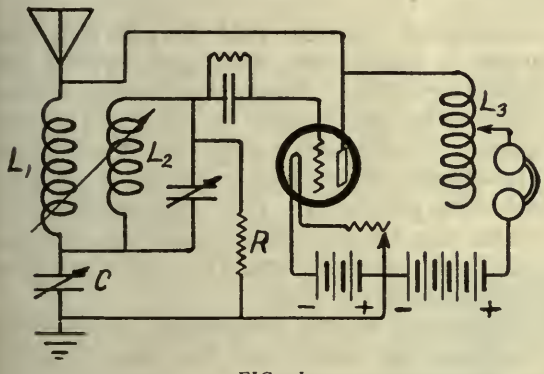
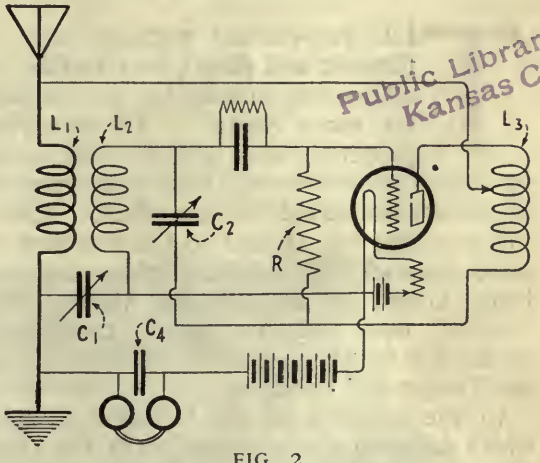


FIG. 1

The diagram, Fig. 6 in "The Truth About Trick Circuits" in RADIO BROADCAST for March. This was published as the Kauffman circuit. See Fig. 2

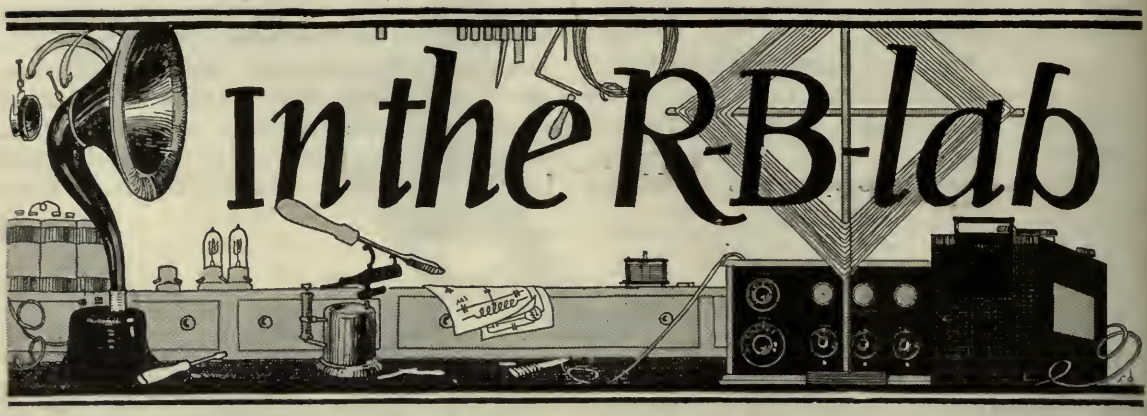


Public Library, Kansas City

FIG. 2

The corrected Kauffman circuit

WHAT the English listener hears, what he has to hear it with, how much it costs, and some remarks about the radio climate are in W. H. Cary's "England's Venture into Broadcasting" which will appear in July.



The "lab" department has been inaugurated by RADIO BROADCAST in order that its readers may benefit from the many experiments which are necessarily carried on by the makers of this magazine in their endeavor to publish only "fact articles" backed by their personal observations.

THE TWO-ELECTRODE VALVE AND REFLEX SETS

THE two-element vacuum tube (a filament and plate), as a rectifier of alternating current, has been known for many years. Its rectifying properties were probably first noted by Edison several decades back whereupon its action was named the "Edison effect." Later, this principle was applied to the detection of radio signals by Fleming, in England, his tube being known as the Fleming Valve. This "valve" now finds its largest commercial application in storage battery chargers such as the Tungar and Rectigon.

In the triumph of the DeForest audion, which followed the introduction of the third element or grid, the Fleming valve practically disappeared from the field of radio detection when it had barely developed beyond the laboratory stage. However, when the crystal detector became popular in reflex and certain other radio-frequency amplified circuits, the two-element bulb again suggested itself as a detecting possibility. It is more sensitive and stable than the crystal, and possesses the same admirable rectifying qualities which result in absolute purity of tone.

There are several commercial two-element valves on the market, and they may be added to any crystal rectified set by substituting for the mineral as shown in Fig. 1. The leads A and B should be reversed in order to determine the correct directional flow of current.

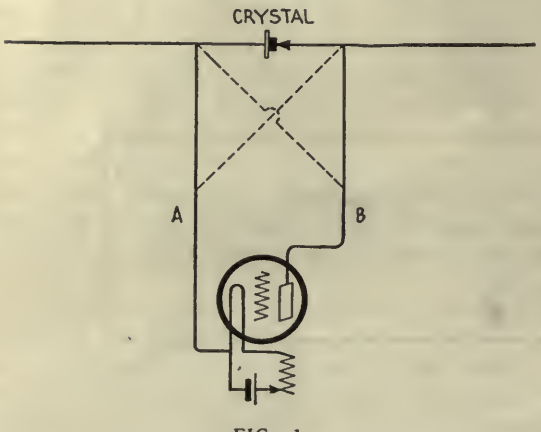


FIG. 1

The principle which may be followed in substituting a two element valve for the crystal detector in any circuit

Though an extra A battery is indicated in Fig. 1, it will often be possible to utilize the same battery that lights the amplifying tubes—but this may require some experimenting. In using the common A battery, our tests have shown that the best results are secured by means of an unusual series filament connection, (Fig. 2). The filament of the two-element bulb is placed in series with the negative filament lead to the regular amplifying tubes. A 30-ohm rheostat is placed in shunt with the valve to regulate the current passing through it. Operated in this manner, the extra bulb is lighted *entirely without additional cost.* The energy which ordinarily would be dissipated and wasted in heating the rheostat, now lights the extra filament.

The remaining rectifying connections must

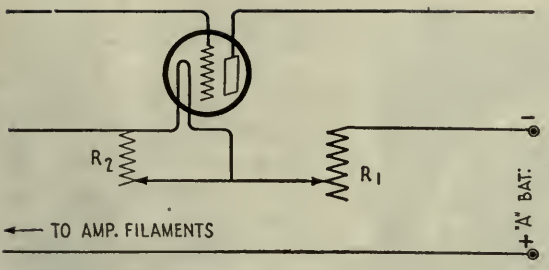


FIG. 2

The series filament connection recommended by the R. B. Lab. R1 is the regular filament rheostat. Connected in this manner, the extra rectifying tube is operated with absolutely no additional expense

be "doped out" by the operators of individual sets, by following out the principle suggested in Fig. 1, and by noting the manner in which this laboratory has effected the change in the famous one-tube reflex circuit.

THE TWO-ELEMENT VALVE—AND THE KNOCK-OUT REFLEX

IN THE first place, the use of the commercial types of two-element valves is not practical in the case of single tube reflex sets. It is not possible to take advantage of the big jump in efficiency by the "free" lighting of the additional filament. The commercial diodes consume in the neighborhood of $\frac{1}{2}$ ampere, while the tubes used in these sets draw $\frac{1}{4}$ ampere or less.

It is obvious that to operate most efficiently (the best result at the lowest possible cost), the one-tube reflex with a two-element bulb rectifier, the rectifier must be of the same amperage as the main tube, and of a lower voltage, so that it may be lighted in series with the main tube—using up the spare voltage difference that exists between the battery voltage and the operating voltage of the tube. The operating voltage of the UV–201–A is $4\frac{1}{2}$, and, when a six volt storage battery is used to light the filament, $1\frac{1}{2}$ volts are left over, generally to be wasted in the rheostat.

Even though commercial two-element valves, meeting these requirements, are not to be had, the matter is easily solved by making your own rectifying tubes, with the correct amperage to order.

"MAKING" YOUR OWN TWO-ELEMENT TUBE

IT IS only necessary to procure a standard three element tube of the required voltage and amperage. *The plate and grid are connected together, and this common connection is used as the plate terminal of the rectifier.* The result is a rectifying tube that our experiments have shown to be superior to the usual commercial two-element valve.

If the UV-201–A, or the C–301–A, operated from a six volt battery, is the main tube in the single bulb reflex (which, incidentally, is the best possible arrangement, for voltages up to a hundred and twenty may be used without distortion), the rectifier tube may be a WD-11 or -12, or a Western Electric "N" tube (Fig. 3), with the plate and grid bridged as we have directed. The connections for this ultra efficient arrangement are indicated in Fig. 4.

The use of the WD tubes and the UV–199, as a main-tube-rectifier combination is not so practical due to filament complications. How-

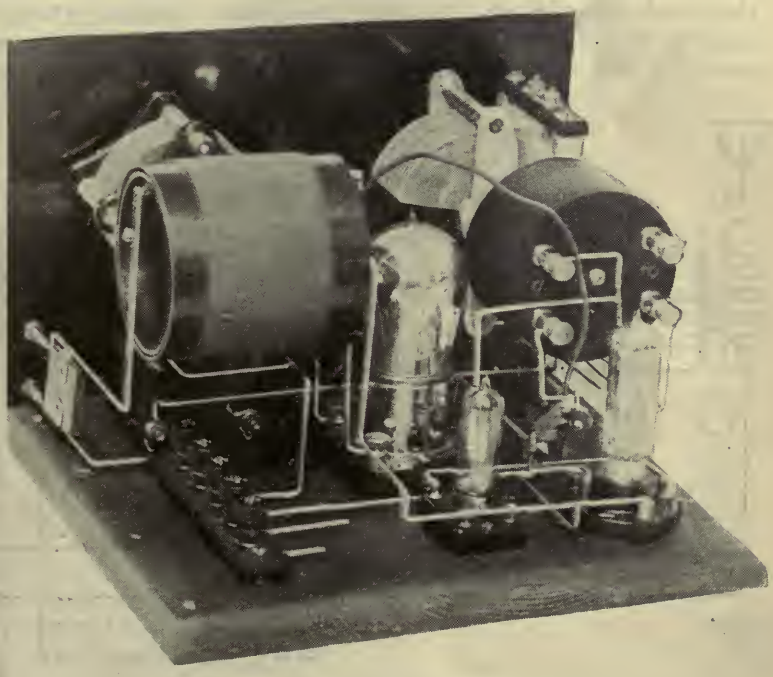


FIG. 3

Back view of the R. B. test set. Comparing a commercial two element valve with a Western Electric "N" tube and crystal. Note the two unused binding posts. This being a test set, room was provided for expansion

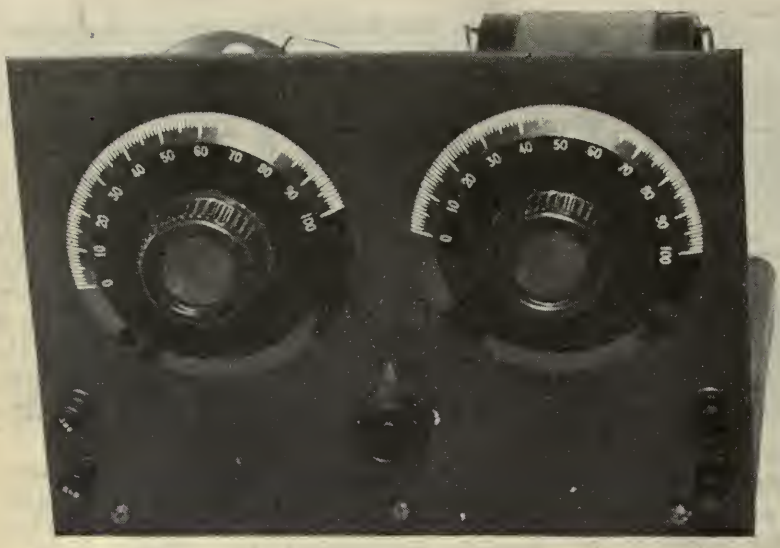


FIG. 5

A front view of our experimental set. A very neat layout, using a seven by ten standard panel. Antenna and ground binding posts are on the left, with output posts on the right

ever, if the possession of these tubes makes this combination particularly convenient, the UV–199 should be used as the main tube, and the WD-11 or -12 as the rectifier, with an extra dry cell connected as shown by the dotted line in Fig. 4. *Be sure to follow the indicated polarities.* The two A batteries are "bucking" each other (positive to positive), but are connected purposely in this manner. This extra battery connection also applies to the use of the commercial two-element valve such as the "Diode." (Employ our connections rather than those suggested in the circular accompanying that tube.)

If identical tubes are employed, for instance a WD–12 for main tube and another, with plate and grid bridged, for rectifying, the *series filament connection* is still used, but the A battery voltage is doubled.

The best possible combination is that first mentioned, i.e., the UV–201–A as the main tube, and a $1\frac{1}{2}$-volt, $\frac{1}{4}$-ampere tube as the rectifier, the series filament being lighted from a single six volt battery.

Care must be observed to follow the initialed connections to the audio-frequency amplifying transformer, T3.

A marked improvement in selectivity, due to increased functioning on the part of T2, is noticed when using tube rectification. The circuit is also more stable, and the telephone shunt condenser, C3, a .002 mfd. Micadon,

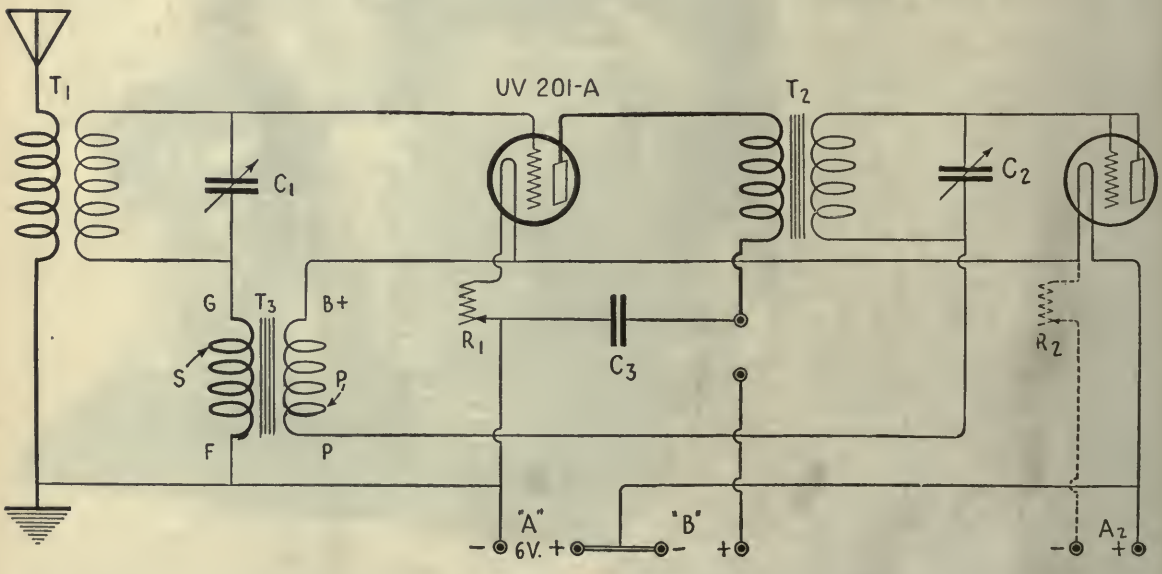


FIG. 4

The circuit of our one-tube reflex plus two element valve detection, a more selective and sensitive set than the former "Knock-Out" set with a crystal detector. The extra filament costs nothing to operate

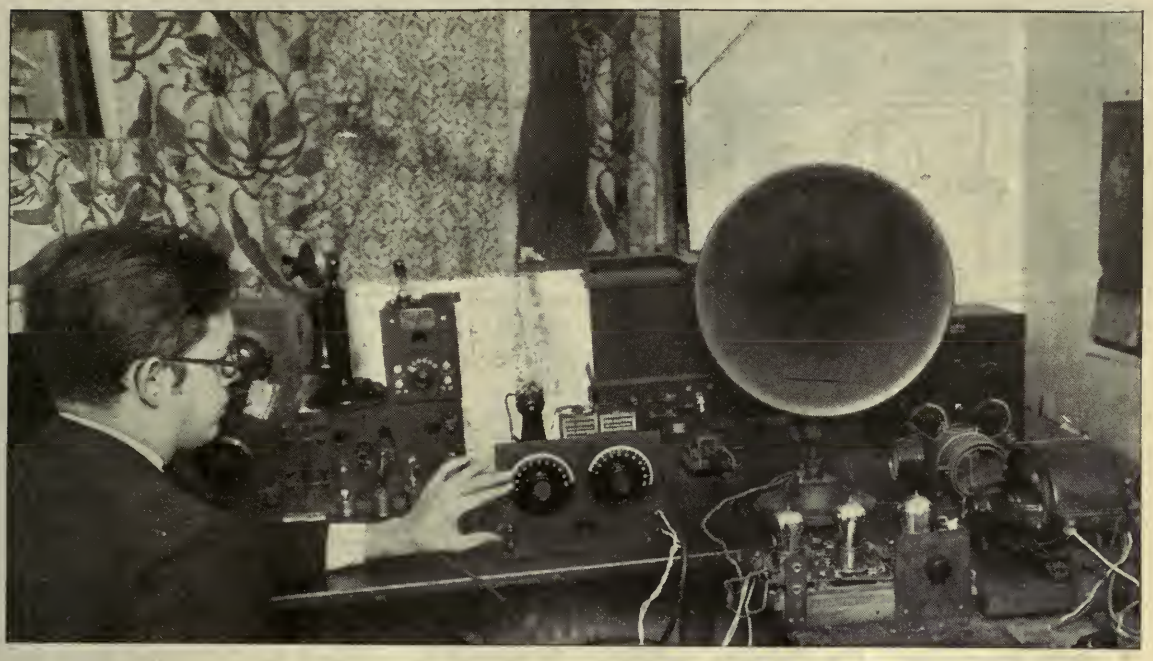


FIG. 6

Testing the two element valve arrangement, plus a three stage resistance-coupled audio amplifier — the ideal combination. Incidentally, a partial view of radio station 2 PI

may be used with beneficial results, without inclining the circuit toward oscillation.

COMMERCIAL INDUCTANCES AND THE ONE-TUBE REFLEX

THE windings T1 and T2 of diagram Fig. 4 may be those described in the One Tube Knock-Out Reflex article appearing in the April RADIO BROADCAST, or may be two of several types of commercial inductances now on the market. These latter will appeal to enthusiasts who, for various reasons, do not care to wind their own coils.

T1 (right, in Fig. 3) is an enclosed inductance made by the Ray-Dee-Artcraft Instrument Company, Redlands, California, known as a "Tuned R. F. Reflex Transformer." T2 is a standard neutroformer type coil, purchased from the Teale Supply Company, New York City, with the primary rewound. While we have found that the boxed inductance used as T1 is best suited as the antenna coupler, neutroformer type coils, with rewound primaries, may be employed both as T1 and T2. The primaries should be rewound (assuming an approximate winding diameter of $2\frac{5}{8}$ inches) with 15 and 35 turns respectively T1 and T2.

Due to the small space provided for primary winding on the Workrite neutroformer, the primary of T2 is best wound over the outside of the secondary.

Figs. 3, 5 and 6 show various views of the set on which the tests described in this article were made. A clip, shown in Fig. 3, was used in changing quickly from crystal to diode detector.

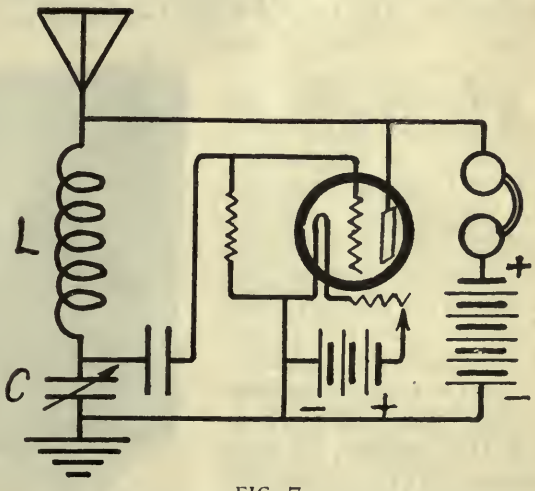


FIG. 7

The Colpitts Oscillator, which can be changed to a very efficient circuit by adding the Reflexit

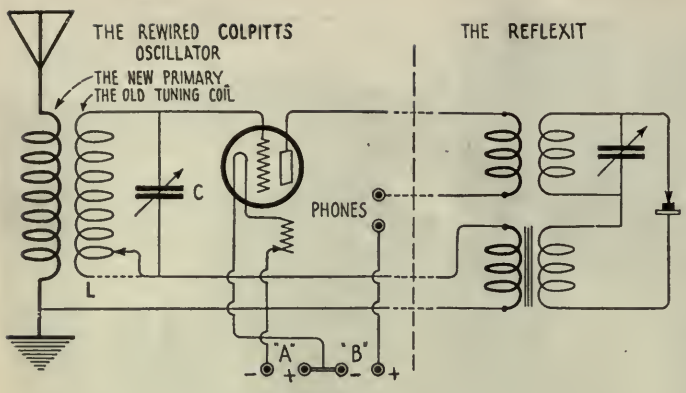


FIG. 8

The complete circuit—the re-wired blooper plus the Reflexit. This is a real receiver

THE REFLEXIT AND THE COLPITTS OSCILLATOR

IN THE early days of broadcasting, before the evil possibilities of radiating receivers were appreciated, the Colpitts oscillator became very popular as a receiving circuit. Particularly recommended to home builders by its simplicity, it being probably the most easily constructed of all receivers, it was widely described under a hundred different names, and built by a hundred thousand enthusiasts. This circuit (which is actually a transmitting system, and designed as such) is shown in Fig. 7, and some of the names under which it has insinuated itself into an all too general use are, "The Simplex," "The Peterson Automatic Regenerative," "The Flivver," etc. A fuller description of its characteristics and evils will be found in "The Truth About Trick Circuits," appearing in the March Radio Broadcast.

This circuit, which has been exiled by all considerate enthusiasts and dealers, can be reclaimed from the ash-can by the use of the Reflexit, described in this magazine last month. By making a few changes in the Colpitts circuit, and adding the Reflexit, this radiating receiver is transformed into a single tube reflex set—a real DX receiver, of marvelous quality, signal strength, and superior selectivity.

The May Radio Broadcast contains detailed instructions on how to make the Reflexit, and adapt it to the tickler feedback single-circuit blooper. It may be added to the Colpitts Oscillator with equal simplicity.

REWIRING A COLPITTS SET

THE first thing to be done is to disconnect all instruments in the set—leaving the receiver as if it had never been wired. In the Colpitts Oscillator, Fig. 7, L is generally a coil of wire, wound with one hundred turns on a three inch form, and tapped, perhaps, every ten turns. Sometimes L is an untapped coil of about sixty turns of wire, tuning being accomplished by varying the capacity of condenser, C. In either case, a layer of paper is placed over this coil, L, and a primary of twelve turns is wound with about No. 22 wire, over the paper. If a two and a half inch tube was originally used as the winding form, wind the primary with fifteen turns of wire; if a three and a half inch form, wind ten turns.

It now remains only to rewire the set according to the diagram, Fig. 8. If L is an untapped coil, it is connected across the condenser (the former capacity feedback variable) as shown by the dotted line. The instruments to the left of the vertical dotted line represent those salvaged from the old single-circuit blooper. Flexible leads, in the rear, connect the reflexit with the rebuilt tuner.

The Reflexit combinations will work best

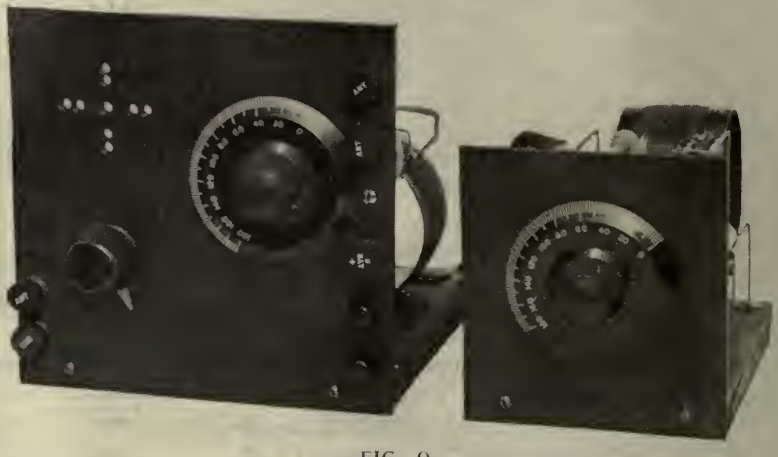


FIG. 9

The new set. The Reflexit is on the right

with the UV–199, C–299, UV–201–A and the C–301–A tubes.

Figs. 9 and 10 show front and rear views of the completed combination, which is the famous single-tube reflex circuit. The apparatus photographed and described possesses remarkable selectivity and volume, far exceeding those qualities in the original single circuit receiver. In our laboratory, it brought in all local stations on the loudspeaker (with real intensity) and not merely permitted excellent selectivity among WEAF, WJZ, WJY, and WHN (all locals), transmitting at the same time, but brought in KDKA on phones, through the local bedlam.



FIG. 11
A small torch, but one capable of quite heavy work

BUILDING YOUR OWN LAB

THE gasoline torch is a laboratory essential, and this month, it is our suggested addition to the growing laboratory. A small torch will cost between three and five dollars. Do not compromise with quality, but purchase a reliable torch, paying a higher price for it if necessary. Nothing but the very best should go into the equipment of the radio laboratory. It is cheaper in the long run, and safer all the way around.

Fig. 11 shows a torch of the most convenient size. It is small, as compared with the hand holding it, and yet is capable of very heavy work. Its uses are many, but it will probably prove its genuine value on out-of-doors soldering. Engineers have reiterated the necessity of soldered joints in the antenna and lead-in connections, which, however, are almost impossible to effect with a rapidly cooling iron, working on the unheated wire. The gasoline torch may be described as indispensable in the erection of an efficient antenna.

It also has many laboratory uses. The torch is generally fitted with an iron holder, for the heating of the ordinary soldering iron. This is particularly convenient for experimenters, whose shops are not equipped with electric soldering apparatus. The electric soldering iron, however, is much to be preferred wherever practicable.

The iron can only be used efficiently when soldering small objects. For soldering on wire of size lower than No. 8, B. & S., and on fire escapes, waterpipes, etc., the torch is absolutely necessary if a good joint is to be made.

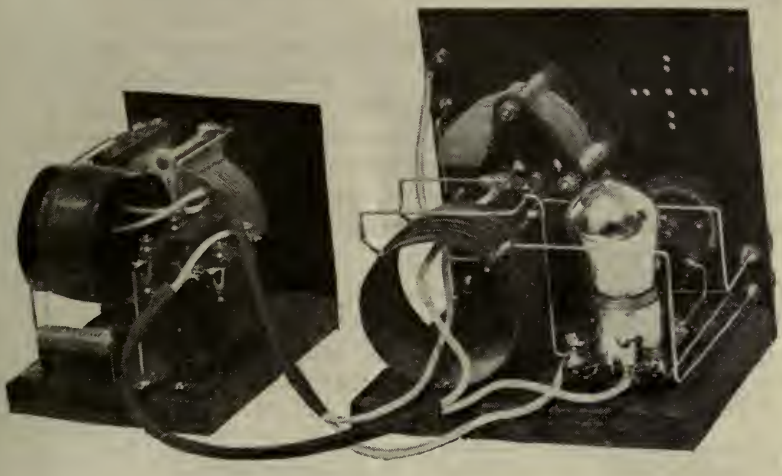


FIG. 10
The rear view of the Reflexit combination

USING THE TORCH

THE individual instructions of each manufacturer for the operation of his torch should be carefully observed and followed. When the basin is first lighted, the gasoline will

probably have trickled down along the torch, to the floor, and for a moment there will be an alarming and general conflagration. However, count ten before you send in the fire alarm, and all will be well.

In soldering large and cold objects, the metal should be enveloped in the tip of the flame, and warmed until it will melt solder. The flame is then moved slightly to one side, or played upon it from a distance, so that the hot metal, and not the flame, melts the solder.

The flame should be used at full blast only on very cold or large objects.

An asthmatic or sputtering flame indicates that gasoline is low. A weak but constant flame means lack of pressure—a few swift pumps are necessary.

In operating the torch out-of-doors, the blast should be maintained considerably higher than in the laboratory, even on small work. This is to keep the needle valve from cooling in the cold air and wind.

Market Information and Weather Forecasts from Central States Radio Stations

U. S. Department of Agriculture, Weather Bureau.

Program for Broadcasting Weather Forecasts and Reports by Radio—Illinois Section

90th Meridian Standard Time
All are Radio Telephone Except Great Lakes

NAJ, Great Lakes: (telegraph) (151 Kilocycles) 9:15 A. M.—morning lake forecasts, aviation forecasts; 4:00 P. M.—special warnings; 9:30 P. M.—evening lake forecasts, aviation forecasts.

KYW, Chicago: (560 Kc.) 12:00 noon, (11:00 A. M. during local "Daylight Saving")—morning local forecast, state forecasts, lake forecast; special warnings at 2:15 and 4:15 P. M.; 9:25 to 9:30 P. M.—evening local forecast, state forecasts, lake forecast. Monday, "silent night."

WAAF, Chicago: (1049 Kc.) 10:30 A. M.—morning local forecast, state forecasts, general forecast, general weather conditions, aviation forecasts, shippers' advices during winter season, national weather-crop summary and state summaries on Wednesday during crop season; 12:30 P. M.—repeats the 10:30 A. M. information, also weekly outlook issued on Saturday.

WDAP, Chicago: (833 Kc.) 10:00 A. M.—morning local forecast, state forecasts; 10:00 P. M. or later, at end of regular program—evening local forecast, state forecasts, lake forecasts, general forecast, general weather conditions. Monday, "silent night."

WOC, Davenport: (620 KC.) 11:00 A. M.—morning local forecast, state forecasts, river forecast, general weather conditions, state weather-crop summaries on Wednesday; special cold wave warnings sent as flashes. Tuesday, "silent night."

WJAN, Peoria: (1170 Kc.) 9:15 A. M.—morning local forecast, state forecast, shippers' forecasts; repeated at 11:30 A. M.

WEW, St. Louis: (1150 Kc.) 10:00 A. M.—morning local forecast, state forecasts, general weather conditions, river forecasts; special warnings at 5:00 P. M.

KSD, St. Louis: (550 Kc.) 10:40 A. M.—morning local forecast, state forecasts, general weather conditions, river forecasts and stages; special warnings at 12:40 P. M., 1:40 P. M and 3:00 P. M.; 10:00 P. M.—evening state forecasts.

Amateurs receiving weather forecasts are requested to advise (by mail) Weather Bureau Office, Springfield, Ill., of the quality of service received and how distinctly the stations are heard.

Adventures of a Wireless Free-Lance

A Thrill that Came Thrice in a Night-time

By GEORGE F. WORTS

WHAT tales they could tell—if wireless operators only dared! No wide-awake lad can hammer brass on the high seas for very long without collecting a fund of delicate information which he will refrain from putting into his memoirs. The oath of secrecy to which he solemnly swore when he obtained his license placed a seal upon his lips and an emergency brake upon his pen. If he confided his secrets to the public, his license might be revoked; he might be summoned to answer embarrassing questions in court; he might even spend some time manufacturing brooms or automobile license plates. He might, in any event, cause some one a great deal of trouble.



The traveling public has always looked upon the wireless man as a mystery man; and that attitude is the correct one for the traveling public to take. A wireless operator is, in a sense, a walking Pandora's box!

I know one operator, now on a Transpacific run, who dares not tell what he knows concerning a certain shipwreck in which several lives were lost because of another operator's negligence. The negligent operator went to a salty death proclaimed a hero. Further details in that case I cannot safely divulge.

The war came after my time, at sea, but I am sure that a great many of the wireless men who served during that adventurous period must fairly be bursting with secrets.

What goes on inside an operator's headphones is sacred. Wild horses could not drag from me some of the things I have plucked out of the air; but I do not believe I will be violating the spirit of my old oath in relating the story of the three distress signals that came my way in a single night. It happened a good many years ago; the actors in that far-flung drama are scattered now to the four quarters of the globe; no one, so far as I am aware, made any mistakes; and, just to be on the safe side, I will refrain from mentioning the names of the ships which took part. Some facts I will disguise, but the conditions and sensations of that night I will reproduce as faithfully as I know how.

I was at that time the second operator on a large fast ship which we will call the *Saurian*, although any Pacific coast operator who chances to read this article will penetrate my secret in a jiffy.

The *Saurian* had the honorary title, in wireless circles, of "supervisor ship." She ran on a regular, close schedule between San Francisco and Honolulu. Her wireless house was a square bump on the boat deck just abaft the funnel and it boasted a wireless installation probably very similar to the one with which Noah equipped the Ark. Judged by present standards it was, at all events, antique and quaint. The transmitting set comprised a two-kilowatt open core transformer of the United Wireless type, a battery of Leyden jars mounted in a handsome imitation mahogany cabinet for a condenser, a helix of silver-plated copper tubing, and a rotary spark gap driven at about three thousand r. p. m. and producing, when received, a mellow melancholy note. It was the sweetest spark I ever heard. Our wavelength was somewhere in the neighborhood of 600 meters, although nobody knew and nobody cared. The set was a freak. It had a tremendous range. That antique transformer consumed, I am sure, more than forty amperes; and we had amazing radiation. Because of our phenomonal sending range and the express-train regularity of our schedule, the *Saurian* had become the Pacific supervisor ship. That is to say, we had the authority of a land station over other ships within range. We relayed an immense amount of traffic and were supposed to supervise the radio manners of our brethren. It goes without saying that the operators on the *Saurian* were keenly aware

of their importance, and heartily disliked by all.

On the run with which this chronicle is concerned, we pulled out of San Francisco on a nasty gray day in the teeth of a stiff head wind. Wind pressure ran up to fifty miles an hour before we were abreast of the Farallones; and two days later, as we plunged and wallowed westward, we ran head-first into a howling eighty-mile gale. All afternoon we plunged and pitched and corkscrewed. The first operator came off watch at midnight, limp and greenish of complexion, and I went on the job in a state of mind and stomach even more pronounced.



Everything that could come loose in the wireless cabin had already come loose. Spume was flying the length of the ship with the stinging force of hail. The full-gale howled in the funnel guys and aerial wires. The wireless cabin rose and fell with that swooping sensation peculiar to express elevators in forty-story buildings. We were five decks above the water line.

It was a bad night on the air as well. When I put on the phones and adjusted our carborundum detector, static came sputtering in. It was faint and distant but persistent enough to interfere with long distance work. KPH and KPJ, the San Francisco and San Pedro shore stations, were droning out storm warnings for the entire Pacific coast; but business proceeded as usual. I relayed a string from an incoming Jap boat to KPH and another batch from KPH to the *Sonoma*, a Union Liner in the Australian service, a day out of Honolulu, eastbound.

Then quiet, save for the static, descended for almost an hour. A copy of my log for that night, which I preserved for years, was destroyed recently in a fire, and I must rely upon a somewhat unreliable memory. Shortly before two o'clock everybody seemed to get busy at once. The Jap had another string for me to shoot along to KPH. KHK (Honolulu Marconi) wanted me to relay a batch to KPH—he couldn't work him direct because of the static—and ships all over the Pacific were buzzing away. As I recall it, from two to three o'clock in the morning was always the busiest hour of the night on the Pacific.

And through that busy buzzing I suddenly heard a far-away, whispery SOS——or believed I did. I immediately called Frisco and asked him if he had heard an SOS. He replied that he had not, and told me to send a "CQ" which meant, in those days, "All stations stand by!" The list of international "Q abbreviations" had not then been adopted. But a CQ was not needed. Following my brief query to KPH and his answer, the air cleared magically.

THE NIGHT: THREE S O S CALLS

I STOOD by for orders from Frisco, and after a moment he told me that he still heard nothing. I knew he had not heard, for, long before he started to send, the faint, far-away, whispery spark was calling again. It was so faint that the shuddering of our ship obliterated it; so faint that it hardly reached me through the scratching of the static. Somehow I had always pictured a ship in distress as being conveniently near, and the faintness of this spark made me believe that the whole Pacific Ocean lay between us. For all practical purposes, it did.

While I was straining my ears to catch his call letters, a vigorous, clear, crisp buzz filled my 'phones.

"SOS—SOS—SOS—de—W——"

A second ship calling for help before I could even identify the first one! The next half hour was destined to be the busiest I had ever lived. Within that half-hour, there were three of them. The gale must have dropped down from the sky and struck the entire Pacific at a single blow.

If you will glance at a map of the Pacific Ocean and make a mark one third of the way from San Francisco to Honolulu on the course which ships on that route follow, you will know the approximate position of the *Saurian* on that terrible night.

"Can you hear either of them?" I snapped at Frisco.

"Don't hear anything but static!" Frisco snapped back.

In an interlude between splashes of static I caught the call letter that the far-away whispery spark was sending, and a glance at my list of calls identified it as a fishing boat. The second distress call had been despatched by a tramp freighter.

For a moment I didn't know what to do. Then I sent a general CQ; told the tramp to stand by and the fishing boat to report his position; and I will never forget the agonizing

faintness of that distant, husky, faltering spark.

It was necessary for him to repeat each word three times, and even this laborious procedure left blanks that I filled by guesswork. Repetition in transmission when you are in a hurry is always irritating, always nerve-wracking; and on that occasion, as I tried to read that whisper of a sound and to shelter it with cupped hands from the rumbling of the *Saurian*, the squeaking of the wireless room woodwork and the shouting of the wind, it was maddening.

"Have not seen the sun in days," he painfully pounded out, "and have been blown so far off our course we can only guess where we are. Captain says we are about Lat.——; Long.——"

The exact position figures I do not recall. It does not matter, for no one ever verified them. At all events, the distressed fishing boat was about seven hundred miles north of us. I asked him about his condition.

"We are in very bad shape," the faint whisper answered. "Forward cabin smashed in. All boats gone and only one raft left. Pumps can't keep up with water. Fireroom is flooding. We are lying to, with engine turning only enough to head us into it. Old man wants to know how soon you can get help to us. We won't hold together many hours."

asking for a report from any ship within running distance of the distressed fishing boat—and no one answered. For ten minutes I pounded away, trying to raise some one; and that was the beginning of the most real tragedy I have ever experienced. Perhaps my imagination cut the thing out of whole cloth, but, as I saw it, there was I, carrying on conversation with a man who might, in the next breath, be strangling to death in icy salt water; and the *Saurian*, apparently the nearest source of help, was two days at full sea speed away from him!

In answer to my further calls, presently a shrill whine was heard. It was a Nippon Yusan Kaisha boat, a Jap, on the Seattle-Yokohama-Hong-Kong run.

"Four hundred miles due south of him. Advise," said the Jap.

"Keep in touch with him and try to raise some ship nearer to him," I answered.

And it was then that the third SOS of that packed half-hour came droning in—this time an oil tanker. The operator gave me his position without having to be asked for it.

"Away off our course, but estimate Lat.——; Long.——"

Form 763

NOTICE

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
RADIO SERVICE

SECRECY OF MESSAGES—FALSE SIGNALS

The act of Congress to regulate radio communication, approved August 13, 1912, provides in the nineteenth regulation and in the seventh section, respectively, as follows:

Nineteenth. No person or persons engaged in or having knowledge of the operation of any station or stations, shall divulge or publish the contents of any messages transmitted or received by such station, except to the person or persons to whom the same may be directed, or their authorized agent, or to another station employed to forward such message to its destination, unless legally required so to do by the court of competent jurisdiction or other competent authority. Any person guilty of divulging or publishing any message, except as herein provided, shall, on conviction thereof, be punishable by a fine of not more than two hundred and fifty dollars or imprisonment for a period of not exceeding three months, or both fine and imprisonment, in the discretion of the court.

* * * * * * *

SEC. 7. That a person, company, or corporation within the jurisdiction of the United States shall not knowingly utter or transmit, or cause to be uttered or transmitted, any false or fraudulent distress signal or call or false or fraudulent signal, call, or other radiogram of any kind. The penalty for so uttering or transmitting a false or fraudulent distress signal or call shall be a fine of not more than two thousand five hundred dollars or imprisonment for not more than five years, or both, in the discretion of the court, for each and every such offense, and the penalty for so uttering or transmitting, or causing to be uttered or transmitted, any other false or fraudulent signal, call, or other radiogram shall be a fine of not more than one thousand dollars or imprisonment for not more than two years, or both, in the discretion of the court, for each and every such offense.

11—4866

(TO BE POSTED IN RADIO STATIONS)

A FACSIMILE OF THE ORDER OF SECRECY
Which is displayed in every radio operating cabin

TRAGEDY—700 MILES AWAY

IMAGINE having that responsibility placed personally on your shoulders by a man seven hundred miles away! I sent out a query

I reached up and made another mark on our chart of the Pacific. The oil tanker was approximately five hundred miles away, in a southeast by south direction.

"KPH," I called, "can you hear W—?"

"Can't hear anything but static," Frisco replied. "Handle them all."

I called for a condition report from the tanker.

"Rudder is jammed," was the answer. "On our beam ends in the trough. Danger acute. *SOS—SOS!* Must have help at once!"

Then:

"*SOS!—SOS!—SOS!*" buzzed the tramp "Sinking! Send help!"

The shrill whine of the Jap stopped and I could hear the fishing boat's despairing whisper:

"*SOS!—SOS!—SOS! Somebody—please—answer!*"

It was dreadful! I desperately told the fishing boat to continue calling; the oil tankers to shut up and stand by; the tramp to give me position and condition.



He gave his position, and I made another mark on our chart of the Pacific. He was approximately twelve hundred miles northwest by west of Cape San Lucas, which is the lowermost extremity of the peninsula of Lower California, or about six hundred miles southwest of the *Saurian*.

"Wave stove in hatch-cover in forward deck-well hour ago. Hold flooding. Bow almost submerged. Waves breaking all over us. All boats smashed or lost. Must have help quick."

I asked if any ship was near him. There was a prompt answer from a Pacific Mail passenger boat in the San Francisco-Panama express service.

"Am about forty miles southeast of him. Any one any nearer?"

It appeared that no one was nearer. I instructed the Mail boat to deal with him; then went to work on the oil tanker. I sent out the usual query, asking any ship near him to answer. There were three replies. The nearest ship was a Blue Funnel, a British freighter, between fifty and sixty miles northwest of him. I told the Blue Funnel and the oil tanker to work it out between them.

You may be wondering why the *Saurian* acted in a supervisory capacity in the handling of those three distress calls; and the reason is interesting. I do not believe that three distress calls received simultaneously under exactly those conditions would be handled in that fashion to-day. They would be handled individually and simultaneously by the ships nearest the distressed vessels. In those days, tuning-out interference was much more difficult than it is to-day, for three reasons. To-day, the transmitting sets of all ships are much more sharply tuned; a variety of transmitting wavelengths is available; and receiving apparatus is much more selective. If I had not supervised all transmission very rigidly that night, no one could have worked through the jam. We were all working on six hundred meters, and our waves were very broad.

Now, all of this may sound cool and orderly, but permit me to state that there was nothing cool or orderly about the state that my mind was in. The crisis had turned me into an automatic nervous machine. I was so panicky that I had to grip the key firmly with the fingers of my right hand and hold my right elbow steady with my left hand. Nor was the state of my nerves eased by the plunging, the pitching and the corkscrewing of the *Saurian*, the squeaking of the woodwork, or the howl of wind and hiss of spray. My chair was lugged down to the floor, and my legs were wrapped tightly about the chair-legs or I would have been catapulted out of it.

HOW THEORY DIFFERS FROM COLD FACT

AFTER the arrangements had been made for the relief of the oil tanker and the tramp I must have sat for fifteen minutes with both hands clamped over the phones, forcing them down on my ears, trying to collect my wits. I have often imagined other operators I have known—men who are calm and cool and resourceful—going through that ordeal with a steady hand and a steady eye, logging it all up as they went along, crisply reporting each event as it occurred to the officer on watch, as a well-trained operator should do. It would be pleasant to paint a picture of myself as that sort of hero. But I wasn't a hero in any respect; I was a quaking, terrified, blundering kid, forced by circumstance into a position of tremendous responsibility that I would have eagerly shirked. Later on, in my capacity of nine-day wonder, I assumed a lofty, nonchalant pose in static rooms; looked down upon ordinary operators with a great deal of disdain, and admitted under their bombardment of questions that the emergency had found me brave and composed; but the twenty or thirty operators who were listening in within range of the *Saurian* that night knew me for the monumental young liar that I was! I make my confession now without the slightest

embarrassment. But let us get on with the story.

The Blue Funnel reported that the captain had changed her course and was going to the rescue of the oil tanker The Pacific Mail boat reported that she was steaming full speed to the aid of the crippled tramp. And the Nippon Yusan Kaisha reported that the fishing boat no longer responded to his calls.

The rest of the night the Jap and I devoted to trying to raise the fishing boat or any ship within short running distance. The operator of the fishing boat did not reply again. In those days some ships carried only one operator, whose duties were divided between working the radio and some other kind of ship's business. I had hoped that the operator of such a ship might listen in sometime during the night; but no one answered. We were probably still appealing for help long after the fishing boat broke into pieces.



The night was practically gone when my nerves really gave way. KPH called me and I tried to answer, but my hand would not work the key.

DID THE NIGHT SWALLOW GROPING MESSAGES?

EVERY nerve in it seemed dead—or disconnected. The thought of the fishing boat going down—that operator, with whom I had been talking, trying vainly to be of some help, probably a dead man by this time—made me limp and dizzy. I hated the sea as I have never hated it before or since. I made up my mind never to go to sea again. But I did, of course. You always do. And I hated static that night, too, more than I have ever hated it before or since. I have always thought that that man was trying to tell me something that the static would not let me hear. He kept on sending. The Jap, with his poor understanding of English, must have missed the sense of it. Did he send some message that no one received—just before his ship went to pieces? That I might have missed such a message is one reason why I have told this story to very few people. . . .

Day was breaking when I went out on deck for a breath of fresh air. The force of the gale was broken, but mountainous waves were rolling down upon us from out of the misty grayness. Spray stung my face and spattered hissing on the hot funnel. It did not seem possible that a ship as large as the *Saurian* could roll and plunge so and not rip apart. Every moment she staggered and thundered as waves piled completely over the peak.

The second mate came aft, lurching from one permanent object to another. He gave me a glare as he approached. He was a grizzled old timer, a relic of sailing ship days—the kind of ship's officer who thinks that wireless operators are insulting reminders of a mechanical age that is taking more and more of the kingly authority out of the hands of the men who navigate ships. He stopped near me and bawled above the wind:

"Say! What in hell are you doing away from your post? Don't you know you belong in there with those things on your head? How do you know but what ships are in trouble all over the Pacific in weather like this?"

Well, that's the life of a wireless operator. Anyhow, it was in those days. Maybe times have changed.

The fishing boat was the only complete disaster of the night. Parts of her were found floating about the sea, but none of the crew was saved. The Blue Funnel towed the tanker back into Honolulu for repairs; and the Mail boat took the crew off the freighter. She was still floating when they got away, but went down before night.

READERS of this magazine are reminded that our $500 Prize Contest on the best answer to the question "Who is to Pay for Broadcasting—and How?" closes on July 20th. A complete announcement of the terms of the contest appears on page 69 of RADIO BROADCAST *for May.*



A TRADING POST ON THE MACKENZIE RIVER

Probably one of the most northerly parts of the world where a radio receiving set is permanently installed. This place is just two hundred miles south of the Arctic Ocean. The black outcrops in the river are beds of tar sand

A Canadian Broadcasting Station

Interesting Bits About CJCA—a Pioneer Station in a Pioneer Country. How "Great-Spirit-in Box" Goes Along With the Trader's Rifle, Pemmican, and Tea

By H. F. MULLETT

GRAY EAGLE, chief of the Yellow-knife Indians who inhabit the Mackenzie basin district of the Northwest Territories, away up at the top of the map of the American continent, and a thousand and more miles north of Edmonton, the capital city of Alberta, swung his bale of raw furs from his dog-sled in front of the fur trader's post, grunted an order to his squatting dogs, and entered the store.

"How!" he remarked, in answer to the Scots trader's hearty greeting. "Bring furs! How much?"

With rapid appraisal borne of long experience, the trader skimmed through the valuable pile and named his figure.

"No good!" grunted Gray Eagle. "Price better! ask how St. Louis market from Great-Spirit-in-Box!"

And for two days, until the trader, in his lone post a thousand miles from any city, got the latest fur prices by radio from CJCA, the Edmonton *Journal's* broadcasting station at Edmonton, Gray Eagle waited with true native immobility, nor would he part with a fur or a pelt until he knew from "Great-Spirit-in-Box," how the market was running.

That's why it is safe to make the statement, that probably few broadcasting stations on the American continent serve a wider field, and for more diverse uses, than does CJCA. The station call letters daily reported by the *Journal* operator, G. A. R. Rice, whose sonorous announcement that "this is CJCA speaking—CJCA, Edmonton *Journal*, of Edmonton, Alberta, Canada, the sunniest spot in Sunny Alberta," has been picked up away down at Key West, and, in fact, at many other distant places all over the United States.

From the Montana boundary to the Arctic circle, there are but two cities in Alberta where long distance broadcasting is done, and of these two cities, the work done by the Edmonton station is by far the most interesting, by virtue of the scope and diversity of its field. CJCA, of course, isn't a station in the midst of a wilderness, for Edmonton is a city of 70,000 people, growing rapidly toward the 100,000 mark, with half a dozen lines of railway radiating from it, and with every modern convenience such as is enjoyed by dwellers in any large city in America.

PIONEER RADIO SERVICE FOR REAL PIONEERS

BUT because Edmonton is a big and growing city practically on the edge of civilization, its work with radio must necessarily be of a pioneer nature, and much of its service must be to a people still in the pioneer stages, hewing out farm homes from the virgin land, building railways into virgin territory, mapping, surveying, exploring, trading with native tribes, bending mighty rivers to its will, and ever pushing onward and outward even to the shores of the bleak Arctic itself.

The romance of the Edmonton *Journal's* broadcasting lies with that little army of pioneers out almost on the ragged edge of nowhere, to whom CJCA means the only link with civilization—a civilization reached only after months of arduous travel in many cases—a civilization from whence, at long intervals, men with mail bags struggle through to bring news that may be a year old before it reaches its destination.

But even the farm home, in this land of great distances, takes on its own touch of the romantic, for railroads are still all too few, and there are farms to-day, in Northern Alberta, fifty, sixty, a hundred, and more, miles from any railway. What CJCA means to these folks, leading the lonely life of pioneer settlers in a new land, can be realized only by those who have shared the lot of these pioneer people.

Out beyond the last thin steel line of railway that marks the edge of a civilization itself so new as to appear actually to the visitor uncivilized, goes each year that little band of trappers and explorers, government surveyors and missionaries, prospectors and traders, Mounted Police and fire rangers—to join that other little band already there—many of them with years of pioneer work to their credit—many asking nothing better than to live and die in the lone spaces of the Northwest.

And more and more, despite the fact that northern travel calls for limited equipment, the radio is being taken "down north" by these men of the frontier. Canoes may be small and frail—portages long and hard—camps a hard day's journey in between—snow, ice, wind, rain, thaw, fire, and every danger the elements may command, may lie in wait at each turn of river or trail—but the "Great-Spirit-in-the-Box" goes along with the rifle, the pemmican, and the tea.

Down the broad bosom of the mighty Athabasca and Mackenzie rivers, when the spring ice has gone out, and all the land is astir with life of bird, and tree, and beast, go the government men, forever surveying, mapping, reporting—and the black box goes with them. Camp at night means CJCA, with its music program, its world news, and maybe, its personal message for some one of the party.

Its use in the fur trade has already been indicated. Two years ago when world prices in furs dropped heavily and suddenly, traders of the north were actually paying more



THE EDMONTON "JOURNAL"
—Newspaper and radio plant in far-off Alberta



for raw furs from the Indian and Eskimo trapper, than New York, St. Louis, or Montreal was offering. The radio is solving this difficulty, and saving thousands of dollars.

Through thousands of miles of uncharted timber, as the hot sun of the short northern summer bakes the rotting vegetation dry as tinder, goes the fire ranger, pack on back, with his faithful dog as companion. He carries with him a small receiving set and each night after six he strings his wire to a convenient tree, and listens to his chief, away up the river at McMurray, sending out instructions, giving him the news of the country and of the world, and maybe ending up with a tune or two on the gramophone.

Already, the Canadian Government, recognizing the potential value of radio in the northland, has announced its intention of setting up a string of stations between Edmonton and the Arctic Ocean. One such station is already installed, and this year may see a government station even on Herschel Island, the Mounted Police headquarters for the Arctic.

Station CJCA has already done good service for the police, in sending out urgent messages of wanted people, stolen autos, etc. The value of this work may be illustrated in the case of a foreigner, who was wanted for murder. The fugitive was thought to be heading south from Edmonton. CJCA broadcast his description, and in a few minutes a radio fan in Southern Alberta, twenty miles from the railway and the nearest police detachment, had picked up the message and had telephoned it to the police detachment.

GOOD DEEDS

IN Edmonton Hospital the wife of a commercial traveler lay awaiting a serious operation. Her husband was on his rounds, in small places where the ordinary means of finding him were useless. CJCA located the husband in a few hours, and he came into the city on a fast freight, in time to be at his wife's side during her time of trial.

Soon will Arctic loneliness—pioneer loneliness—the loneliness of the remote farm home and the distant trapper's cabin—be a thing of the past. Soon will Amokuk and his Eskimo friends, in their ice igloo on the Arctic shores, sooth and amuse their babies with radio stories

from CJCA's childrens' hour, and Yellowknife, Dogrib, and Cree Indian, perhaps forgetting ancient feuds and barbaric dances, spend happy hours listening-in while CJCA amuses them with music and song, and all the news of the great world of the White Man, that lies beyond the doors of their forest wilderness.

The *Journal* opened its first radio station May 1, 1922, installing a Marconi Wireless Co. YC 3 type radiophone set, the normal input being 500 watts, and on a wavelength of 450 meters, the antenna output was 3 amperes.

JUST A BIT TECHNICAL

THE transmitting gear consisted of transformed 100 volt A. C. to 6000 volts A. C., which was rectified on one side by a rectifying tube, and a series of condensers employed to smooth out the fluctuations, and the resultant supplied the plate of the 500-watt valve. Grid modulation was the method used to modulate the output at voice frequencies.

This set gave successful transmission as far as Tampa, Florida. A new station was installed on April 23, 1923. The set is unique in the fact that none of the usual electrical machinery is used in its operation, the main source of electrical energy being supplied directly from the domestic 110 volt 60 cycle lighting circuit. A transformer supplies on the secondary side, 10,000 volts, having a capacity rating of 3 K. V. A.



MRS. THORNE

Wife of the gallant police sergeant of the Arctic. Her favorite hobby is listening-in whenever she can get near a radio set—which isn't often, since she is usually far up in the Arctic regions, where radio is considerable of a rarity



SERGEANT THORNE

Of the Royal Canadian Mounted Police, who is an enthusiastic radio fan. He hopes to have radio installed this year at the police post at Herschel Island where he now is arranging details for the execution of two Eskimo murderers

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CJCA's schedule, Mountain time, is as follows:

12:30 noon, reports.
7:30 to 8 P. M. Childrens' half-hour.
8:30 to 9:30 P. M. Evening concerts.
11:15 P. M. Thursday nights. Igloo Hut meetings.
Tuesday and Saturday nights at 10 P. M., calls to stations in the North West Territories are given.

(The Igloo Hut is the name of a radio club of clever and enthusiastic musicians, whose programs are always received with delight by the fans.)

Announcing Some Announcers

WDAF WOAW WOS WWJ



© Underwood & Underwood

AT W O A W

Is Gene Rouse, a genial announcer at this popular and well-known station

AT W O S

Is J. M. Witten, announcer and program director of this station in the capitol city of Missouri

AT W D A F

Is Leon J. Fitzpatrick, who is chief announcer of the station, "Happy Lark" of the famous "Nighthawk Frolic", and radio editor of the *Kansas City Star*







AT W W J

Is Edwin L. Tyson, whose measured, calm accents are a pleasant event in the lives of radio listeners throughout the Middle West



A Word from the Enemy

A Ship Operator Talks with and about His Friends the Broadcast Listeners and adds Some Constructive Suggestions

By R. E. SHLUKBIER
Commercial Radio Operator

DURING the two long years the sailor member of the family had been gone, he had completely encircled the globe in the capacity of radio operator on a tramp freighter. It was with some emotion, therefore, that he rushed home and let himself in through the door.

Things seemed strangely quiet inside but an entrancing odor from the kitchen reassured him. Dubiously he moved through the rooms to the kitchen where he stood speechless with wonder. There sat Grandma, all unconscious of his presence, or of anything else for that matter, a pair of phones clamped over her ears, darning socks. She was nodding her head in regular momentum, and—were his eyes deceiving him, or was just the slightest rhythmic motion of her shoulders perceptible? Suddenly she was all attention, her hands moved deftly through a maze of cardboard tubes and a seemingly hopeless mixture of wires, and a half dozen knobs were given a slight adjustment. Then the contents of a pot on the stove was energetically stirred and the socks darned again—double speed.

"Grandma! What in the world——"

After the stormy greeting in which Mother joined from upstairs, came questions about the mysterious contraption. "Oh!" said Grandma, "Clare made it and you know they don't play many gramophone records any more. I was just listening to dance music played by Dan's Orchestra. You remember him don't you?"

Afterwards the wanderer was given a rousing welcome by Dad and quite stampeded by his brother Clare, one of those indescribable American youths possessed of an insatiable curiosity. At dinner the conversation again swung to radio and it developed that the youngster had a mania, not for radio lyric sopranos or

bedtime stories, but for long-distance reception. He completely confounded the family with a volley of technical terms, mildly amusing his brother, Dad, and Mother. Grandma openly worshipped.

Looking askance at Dad whose dial twistings had produced no startling results, he claimed having received Pittsburgh and defiantly boasted that the new set he was going to build (when he got the money) would bring in the stations in the Middle West.

HOW TIMES HAVE CHANGED

SO THIS was the result of giving that young upstart a few crystals and coils of wire two years before to enable him to listen to an amateur who was at intervals broadcasting gramophone records. Slowly all the story was unfolded: A near-by station had started broadcasting music regularly which greatly stimulated his interest. The young rascal stole or borrowed every radio publication obtainable, tried every possible crystal combination, and by hoarding quarters exacted from Dad under various pretexts and the regular half dollar from Mother on Saturday he finally got an audion.

To the credit of his nimble mind be it said that Dad did not discover that filament current was necessary for the operation of the audion nor did he discover its source until an irate neighbor followed two wires from the battery of his Ford through the kitchen window to a table in a corner where Grandma zealously preserved a hiding place for these works of iniquity.

The Ford stood underneath an open lean-to close by and the neighbor seldom used it after he returned from work at night. Whether or not Grandma was entirely ignorant of the circumstances was not determined but that the shadow of suspicion should fall upon her made no especial difference. Anyhow, the kitchen was her undisputed domain after supper and the rest of the family noted the youngster's doings only absently. Dad, now thoroughly alive to the gravity of the situation, let the taxes go by delinquent and purchased a storage battery.

Clare could not have acquired his present knowledge without paying the price in the way of ruined tubes and materials. After a little questioning in private, he diffidently admitted that Grandma had been contributing her egg money.

A few days later, materials for an up-to-date tuner and amplifier were purchased and the two brothers combined their experience in the designing of a receiver. Dad built the cabinet and after the first demonstration retracted entirely his prediction that he would not get any enjoyment out of a loud speaker. He had heard one of the screechy things somewhere down town. The music produced was mellow and well modulated. Radio got a boost and the professional operator was awakened to the fact of its existence for a new purpose.

When Clare's brother again went to sea, he listened for the music and was surprised to find how consistently he could hear the same voice and the same music heard by the folks at home. Even in the far-off Pacific on the way to the Orient he occasionally heard music from home.

IN ONE SHORT YEAR

ON NEARING the American coast on the return voyage, he was astonished to hear many new broadcasting stations. Stations in practically every state were heard. On his arrival home he found that long-distance reception had become the regular thing and that Clare at times was picking up stations a thousand miles away with loud-speaker volume.

However, they complained of code interference. It seemed to be the fashion to blame this on the telegraph amateurs and so Clare berated them with zeal, backing up his charges with various magazine accounts of like interference. It was amusing to read these obviously inaccurate accounts and the occasional replies from the amateurs who countered with insidious remarks about non-selective receivers, if indeed they were not too busy to say anything at all.

Clare tuned-in a station and his brother found that the chief offender was a powerful commercial station a few miles away whose broad spark could not be tuned out at that distance even though the receiver was unusually selective. These interfering signals from this busy station were so continuous that the concerts were practically demoralized and Dad had lost interest altogether. A Navy station also contributed some disturbance but the amateurs who seemed to have sharply tuned transmitting apparatus were seldom heard even though a few rotary spark notes and a few key thumps seeped through. They tried wave traps and directional antennas, with but mediocre success.

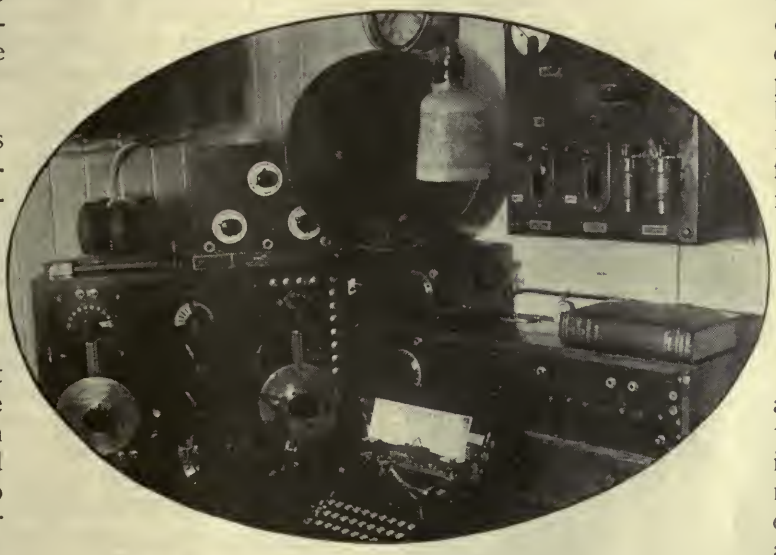
After another interval of a few months the commercial and Navy stations installed tube sets which left the local concerts undisturbed.

On the other hand, broadcasting wavelengths had been changed, the individual receiver's range increased by the addition of radio-frequency amplifiers and code interference was worse than ever when one tried to receive outside stations. It was also noted that the long-suffering amateur was no longer abused and that the wrath of the irate fans was transferred to the unsuspecting commercial operator, whose broad waves overlapped the broadcasting when he used his 450-meter wave. Publications were beginning to say things about ship-to-shore communication and government officials were complaining about not having sufficient funds to cope with the situation.

THE PROBLEM OF CODE INTERFERENCE

SINCE the writer at times probably contributes to this interference he will suggest a few of the conditions confronting the commerical operator at sea.

Many ships have been furnished with continuous wave transmitters working on a wavelength of 2,400 meters with the object of relieving the congestion on 600 meters and incidentally to increase their working range. Changing conditions of the past five years, however, have more than defeated the purpose. The shore transmitters have been tremendously improved and the receivers on board ship are now very sensitive. New commercial shore stations on the east coast can be heard the length and breadth of the Atlantic and they communicate directly with ships as far east as Gibraltar and west for hundreds of miles into the Pacific.



WHERE THE ENEMY LURKS
A corner in radio on a cargo ship

It is not easy to communicate over long distances successfully through this 600-meter confusion, and so wavelengths not so crowded are resorted to. A 706-meter wave was assigned but it is too close to the 600-meter wave and to the 800-meter compass station wave to be entirely practical and so the 450-meter wave which is giving the music listeners all the interference, is used. This wave cannot be used during most of the broadcasting hours of the local stations, but it is doubtful that the signals of a distant ship are very noticeable through the loud signals of a local broadcasting station and so the listener is still annoyed when he tries to get a little thrill out of midnight DX reception.

While a fan is patiently turning his dials in search of China, a host of ship operators are also trying to get DX, and this is not nearly as easy as is generally supposed. It often happens that when a wireless operator tells about communicating directly with his home port several thousand miles away, the listener will not be impressed. In fact, the idea among the uninitiated seems to be that, consistent with the other wonders of the century, one must but press the key to bid dreamy Honolulu a fond good-night or to ascertain via Hamburg, the status of good German sausages.

Desirable as this condition may be, it is not as yet realized and the operator is still apt to be ingloriously balked by a paltry few hundred miles and send his dots and dashes with a persistency born of desperation as an angry captain moves heaven and earth in his insistence to dispatch this message or that.

THE SHIP OPERATOR HAS HIS TROUBLES

OVER a distance of a few hundred miles, communication is very easy, but beyond that, especially on runs through the tropics, static will sometimes demoralize communication altogether even over short distances. Besides there is the ever-present and obnoxious problem of interference. Interference is becoming more and more serious because of the

increased working ranges the ship operators are expected to cover.

Last winter, ships occasionally managed to get their signals through to New York from the Pacific, and this season it is being done nightly. A station will not as a rule respond the first time it is called since any number of ships within several thousand miles may be calling it, and so the air is crowded with a steady repetition of the same signals until the desired



IN THE PANAMA CANAL
Mr. Shlukbier's ship in a quiet moment

station is either raised or daylight overtakes the ship, putting an end to DX work until night falls again.

Since passenger ships are equipped with continuous wave transmitters taking the load of love and kiss messages from the 600-meter wave, and cannot therefore disturb the broadcast listener, someone may wonder why a freighter so far away should wish to get in touch with the home port and whether or not all this interference is necessary. That is exactly what all operators worthy of the name are asking themselves.

À BAS T R REPORTS

IT IS safe to say that over half of the signals are caused by unpaid position messages known as T R reports. Their primary object was to notify a shore station that a certain ship was within range. These reports have degenerated into a general contest for reaching either New York or San Francisco according to the location of the ship. It is true that these reports are printed by newspapers in some sections of the country. These reports should only be sent through the normal ranges of a coast station, or better still, daylight range, and a ban should be put on their transmission at night. This would be more effective in reducing the amount of interference than all the tube sets which could be installed for years to come.

There are also other violations of radio operating regulations which cause needless interference. The government officials rely almost entirely upon the operators themselves to report these. It is quite characteristic of the American operator to assume a tolerant attitude, and actually very few reports are forthcoming. A possible remedy would be to appoint certain ships with reliable operators as traffic ships giving them authority to stop unnecessary signals. They would be supplied with official cards to be sent to offenders warning them that a second offense would be made the subject of an official report.

Reduction of interference would also increase the reliability of radio for the protection of lives at sea which is its ultimate reason for existence. At present a ship in distress forced to use a low-powered emergency set would probably not be heard at all unless by some ship very close by. This situation may explain some of the mysteries of the deep. Moreover it often happens that an operator has an important message and is unable to put it through on account of unimportant traffic which is causing this external interference.

The broadcast listener can be assured that in time all code signals will disappear from the broadcast wavelength, although a certain amount of it will be encountered for some time. Meanwhile this disturbance should be regarded with tolerance.

WHO IS TO PAY FOR BROADCASTING AND HOW?

A Contest Opened by RADIO BROADCAST in which a prize of $500 is offered

What We Want

A workable plan which shall take into account the problems in present radio broadcasting and propose a practical solution. How, for example, are the restrictions now imposed by the music copyright law to be adjusted to the peculiar conditions of broadcasting? How is the complex radio patent situation to be unsnarled so that broadcasting may develop? Should broadcasting stations be allowed to advertise?

These are some of the questions involved and subjects which must receive careful attention in an intelligent answer to the problem which is the title of this contest.

How It Is To Be Done

The plan must not be more than 1500 words long. It must be double-spaced and typewritten, and must be prefaced with a concise summary. The plan must be in the mails not later than July 20, 1924, and must be addressed, RADIO BROADCAST Who Is to Pay Contest, care American Radio Association, 50 Union Square, New York City.

The contest is open absolutely to every one, except employees of RADIO BROADCAST and officials of the American Radio Association. A contestant may submit more than one plan. If the winning plan is received from two different sources, the judges will award the prize to the contestant whose plan was mailed first.

Judges

Will be shortly announced and will be men well-known in radio and public affairs.

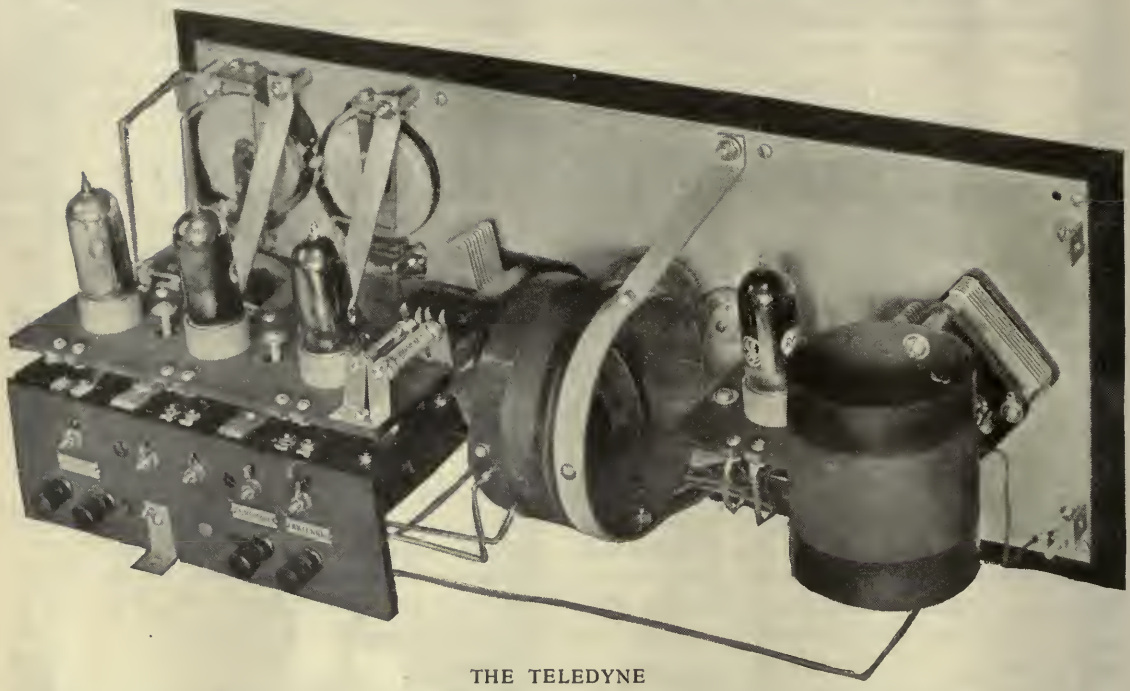
What Information You Need

There are several sources from which the contestant can secure information, in case he does not already know certain of the facts. Among these are the National Association of Broadcasters, 1265 Broadway, New York City; the American Radio Association, 50 Union Square, New York, the Radio Broadcaster's Society of America, care George Schubel, secretary, 154 Nassau Street, New York, the American Society of Composers and Authors, the Westinghouse Electric and Manufacturing Company, the Radio Corporation of America, the General Electric Company, and the various manufacturers, and broadcasting stations.

Prize

The independent committee of judges will award the prize of $500 to the plan which in their judgment is most workable and practical, and which follows the rules given above. No other prizes will be given.

No questions regarding the contest can be answered by RADIO BROADCAST *by mail.*



THE TELEDYNE

Rear view of a completed commercial receiver. The home constructor by using good parts which he may select himself and mount on a panel as suits him best, can easily build this set

How to Build a Teledyne Radio Receiver

By BOWDEN WASHINGTON

Chief Engineer, Cutting & Washington Radio Corp., and designer of the Teledyne

In RADIO BROADCAST for May Mr. Washington in "Regeneration Without the Squeal" described the commercial form of the receiver which he has designed to get volume and distance without unneighborly radiation. This is his how-to-build-it article on that receiver.—THE EDITOR.

THE principle of regeneration is undoubtedly of great value inasmuch as regeneration increases the usefulness of a vacuum tube up to perhaps a hundred times. On the other hand, regeneration as applied to the conventional type of single-circuit broadcast receiver (and to a lesser degree to the two-circuit type), becomes a menace to the whole future of home radio. This, of course, is on account of the possibility of these receivers transmiting, "re-radiating" as it is incorrectly called, though it is not the re-radiation but merely simple radiation which causes most of the trouble. As any one who lives in a town of any size knows, the interference created by these receivers has practically ruined distant reception.

It seems, however, unwise to discard this highly useful and quite economical method of sensitizing a tube, and in a search for a regenerative receiver which would not create interference, the Teledyne was developed.

This receiver consists of a tuned radio-frequency amplifier, which is entirely stable and shows no tendency to oscillate, a fully regenerative detector, and the usual two audio-frequency stages. With four UV-199 tubes, used in conjunction with a hundred-foot, single-wire antenna, it is possible to obtain loud speaker signals on fairly distant stations.

In comparative tests against a five-tube neutrodyne, I have found that this circuit gives considerably more volume. It is also highly selective, and extremely easy to tune. The detector may be set into oscillation and the "carrier wave whistle" picked up without fear of creating any appreciable outside interference.

The radio-frequency amplifier operates in approximately the following manner:

Its grid inductance is also the antenna tuning inductance. Its plate inductance forms a delivery coil and transfers its output energy to the detector grid inductance, which is tuned by the usual parallel variable condenser. The output of a vacuum tube (somewhat like a dry cell) is greatest when the external impedence of the output circuit is equal to the internal impedence of the output side of the tube. By properly proportioning the inductance and coupling of the delivery coil, the impedence of the detector grid circuit may be made to "show through" into the amplifier plate circuit at this correct impedence value when the detector grid circuit is tuned.

THE CONSTRUCTOR HAS PLENTY OF LEEWAY

IN GIVING directions as to the construction of the Teledyne, I have purposely omitted any detailed panel drilling layout, but have shown instead the correct layout of the various parts. My reason for this is that I do not wish to recommend any particular makes of parts; a particular make may not always be available, and the constructor may have at hand certain perfectly appropriate parts of a make other than that specified, which he would be justified in using rather than purchasing new ones. Good parts, of course, should be used. It is important to keep the radio-frequency layout approximately as shown, as it is absolutely essential that no coupling shall exist between the two grid inductances. This means that the radio-frequency grid inductance should be mounted at some little distance from the detector grid inductance and horizontally. The detector grid inductance should be mounted vertically, and in such a position that an extension of the axis of the radio-frequency coil would pass through the middle turn of the detector grid winding, and at the same time intercept the axis of this coil.

The arrangement of the audio amplifier is of course optional with the builder, though some simple shock absorber mount such as that indicated should be devised for the detector and the two audio amplifier tubes. As all four tubes will be used at all times except for local reception, but one rheostat is shown for sim-

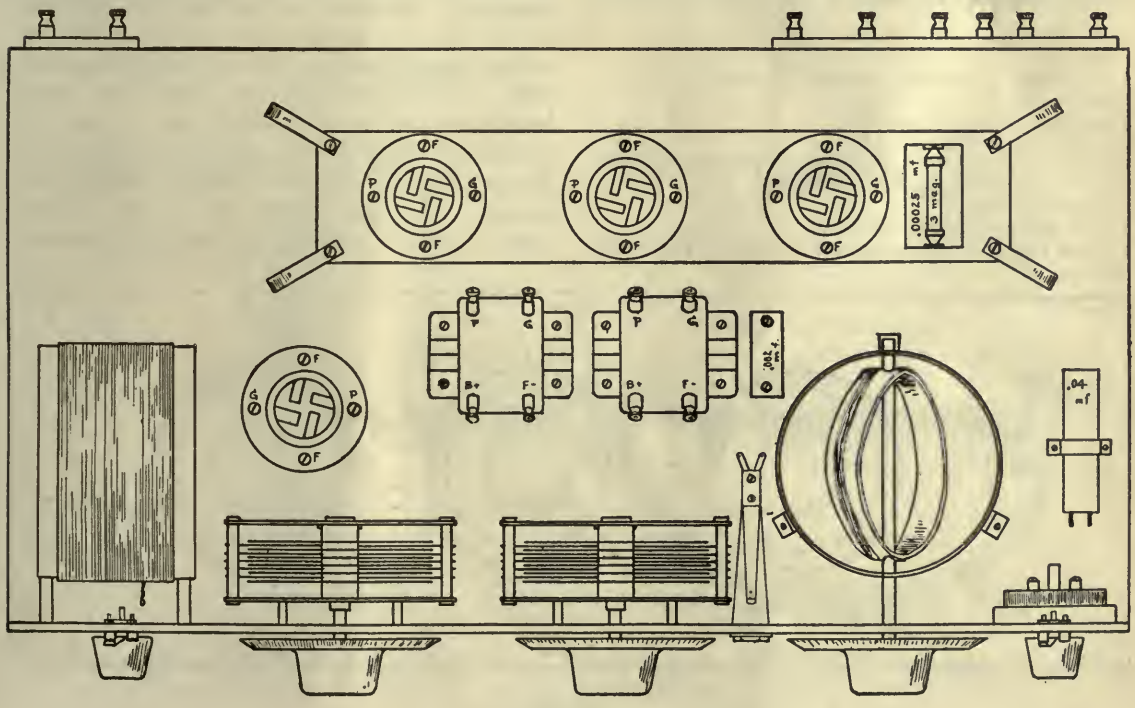


FIG. 1
Plan view

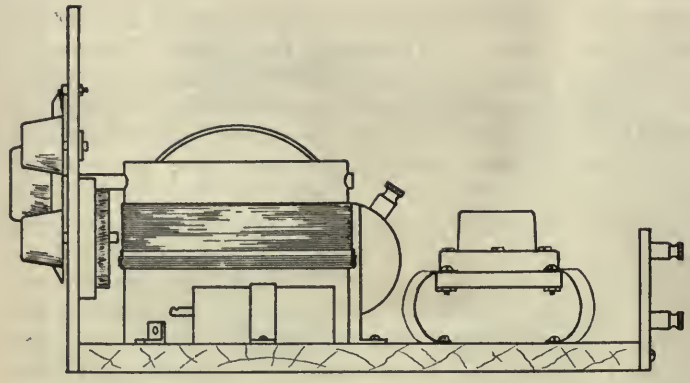


FIG. 2
Right Elevation

plicity, and a two-point switch is provided, so that the loud speaker may be operated on one or two audio stages.

These are the necessary parts of the complete Teledyne as shown:

1 panel 2″ x 1½″ x $\frac{3}{16}$″
1 panel 6″ x 2½″ x $\frac{3}{16}$″
1 panel 19½″ x 6½″ x $\frac{3}{16}$″
1 wooden base board, preferably laminated 19½″ x 10″ x ½″
2 good variable condensers .00025–.0003 micro farads.
3 3½″ dials.
2 Instrument type switches with bushings.
4 switch points.
4 switch stops.
1 pc. tubing 4″ outside diameter, 2¾″ long, $\frac{1}{16}$″ wall
1 pc. tubing 4″ outside diameter, 3¼″ long, $\frac{1}{16}$″ wall.
1 pc. tubing 3¼″ outside diameter, ¾″ long, $\frac{1}{16}$″ wall.
4 good sockets for UV–199 tubes.
2 audio transformers.
1 Seven to 12 ohm rheostat with "off" position and knob.
1 good .00025 mfd. mica grid condenser.
1 3-megohm leak.
1 good .002 mfd. mica condenser.
1 paper telephone condenser of any capacity above .04 mfd. (This condenser is at all times across the B battery, and if leaky will run this battery down. To test for leaks place the condenser across 90 volt B battery, remove it, wait several minutes and discharge the condenser with a piece of metal. A quite noticeable spark will occur if the condenser is faultless).
11 binding posts.
150 ft. No. 26 D. S. C. wire (double silk covered)
10 ft. No. 30 D. S. C. wire (double silk covered)
1 3-point jack.
Miscellaneous wood and machine screws, strip brass, regeneration coil shaft, flexible pigtail material for regeneration coil and tube mount leads, phosphor bronze strip $\frac{5}{16}$″ x 26 gauge for shock absorber spring, etc.

BUILDING THE TELEDYNE

I WOULD rather leave the exact details to the individual constructor for very much the same reason that I do not wish to specify makes of parts. I believe the average person who has arrived at the stage of building his own four tube set usually has a fair accumulation of odds and ends, some of which certainly can be used. A suggested layout is shown in Fig. 1. The radio-frequency grid inductance is shown at the left, supported from the panel by separators which may be cut out of brass tubing with a hack saw, and this coil may also be fastened to the base with two wood screws at its point of tangency. Mounted on the panel in front of it will be seen a two-point switch which includes either 50 or 80 turns in the antenna circuit. This is necessary to cover the entire broadcast wavelength band on all sizes of antennas. Next is the antenna tuning condenser, followed by the detector tuning condenser. The jack shown is of the "three-point" type. Loud speaker binding posts are

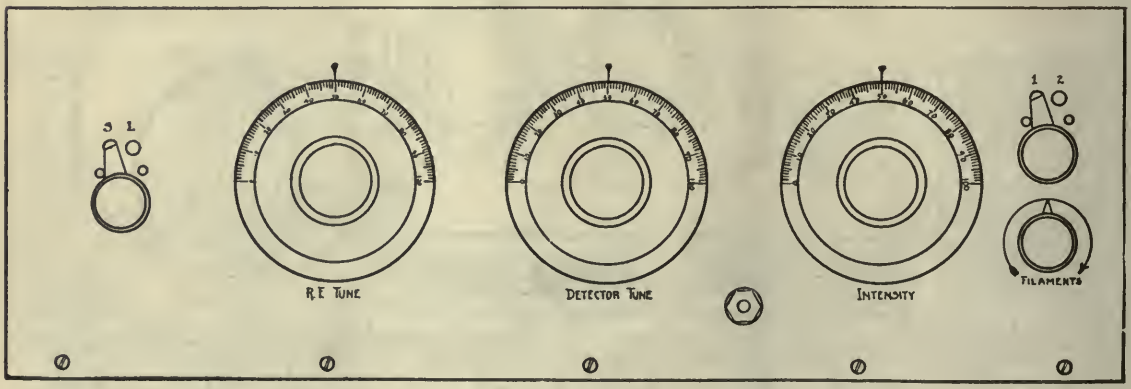


FIG. 3
Front elevation

provided on the rear terminal board, and the jack is so wired that when the telephone plug is removed, the loud speaker is automatically cut in. This is rather a nice arrangement, as it enables the user to "fish" for distance and get the tuning done on his telephones, and then by merely pulling the plug half way out, flood the room with music from a distant station.

Next comes the detector grid inductance mounted vertically with the detector regeneration coil. The rheostat, B battery condenser, and one two-stage switch are at the extreme right.

I have shown the detector and two audio tubes mounted on a strip of bakelite or wood and sprung from the base by four U shaped phosphor bronze strips. It is suggested that a straight wire be run along the filament connections on the sockets and that two of these spring supports be used to carry the filament current. There is no need of a vibration-proof mounting on the radio frequency tube.

It is convenient to use the right hand socket on the strip for the detector tube, the middle socket for first, and the left for second audio frequency stage.

The small terminal board at the left contains the antenna and ground binding posts. The larger board at the right carries plus A,– A,– B, plus $22\frac{1}{2}$, plus 90, plus C,– C and two posts for the loud speaker.

All winding of the coils should be done exactly as shown in Fig. 4. Notice that a strip of well shellacked cardboard $\frac{1}{64}$" thick is laid over the detector grid inductance at the filament end before the four-turn delivery coil is wound in place. Note also that this delivery coil begins over the first turn of the detector winding.

All wiring should be made as short and direct as possible, and all joints soldered with resin cored solder. Do not use either paste or acid.

Fig. 5 shows the connections of a Teledyne.

TUNING THE RECEIVER

THE Teledyne is extremely simple to tune, but of course requires some practice. Real volume on long distance is only usually obtained by a final readjustment all around. A vernier is not necessary, and for that reason I have not shown it, but a vernier on the detector tuning condenser, either mechanical or electrical, is undoubtedly an aid to making the final adjustment.

There are two general methods of tuning the Teledyne, the first is the familiar beat note methods whereby the detector is made to oscillate by increasing the regeneration control. The secondary or grid circuit tuning adjustment is then varied, and the various beat-notes

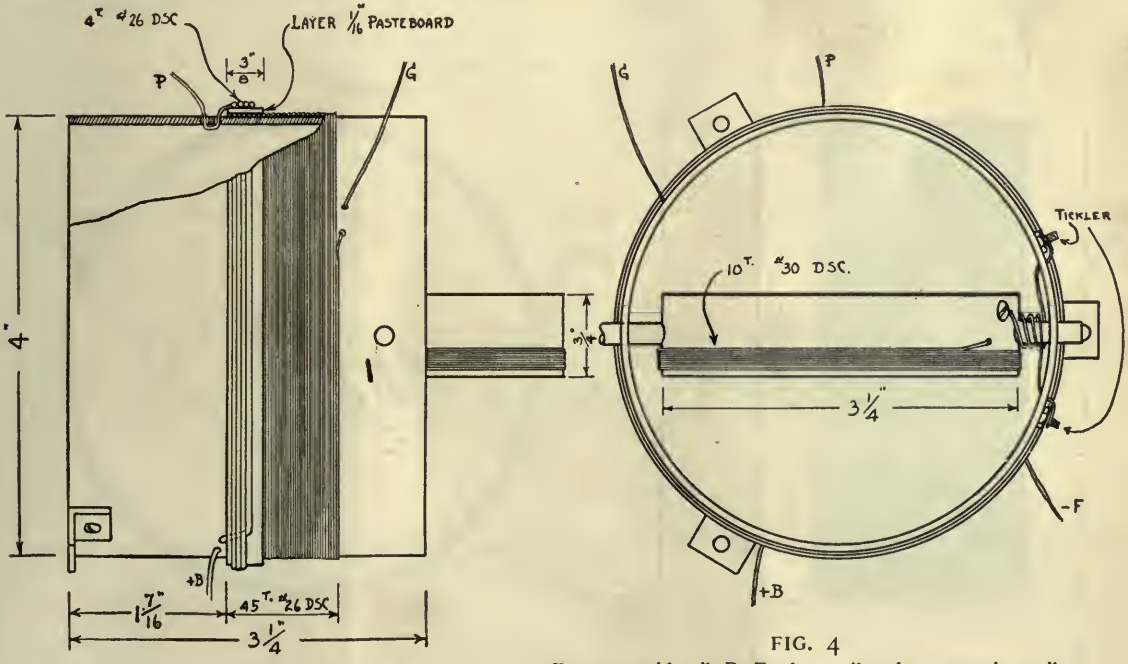


FIG. 4
Detector grid coil, R. F. plate coil and regeneration coil

of the stations broadcasting will be heard. One of these is chosen, and the antenna circuit is then tuned to this wave by varying the antenna series condenser until the beat-note is loudest. The regeneration is then reduced until the beat-note disappears, and the received program is clear.

The second method of tuning is similar to that employed with the neutrodyne type of receiver, with the exception that only two controls are necessary. The regeneration is reduced to a low value, and the antenna and grid circuit tuning adjustments are then simultaneously varied, and held in tune with each other as the entire scale is covered. The process is exactly similar to that of tuning the neutrodyne, except that it is much more rapid.

The tuning adjustments are almost entirely independent of each other, so it is readily possible to record the dial settings of the antenna and grid tuning adjustments for every station heard, and thus keep a permanent record of these stations. By reference to this record the dials may then be set for any particular station, at any time, and that station will be received without the necessity of retuning.

THE ANTENNA

THE antenna used depends largely on the location of the receiver. Like most receivers, it is somewhat more selective on a short antenna. If located within five miles of a large broadcasting station, I would recommend a single wire, with an overall length from the receiver to the far end of 65 ft.; if located at a greater distance from a powerful transmitter, lengths up to 150 ft. may be used. The best available ground should be used, usually a good, clean connection to a cold water pipe. Sandpaper both the inside of the ground clamp and the pipe.

One word of warning—never burn the filaments of UV-199 tubes hotter than is absolutely necessary for good reception. Burning them too hot does not increase their response, but does boil the thorium off the filaments, and this in a short time ruins the tube. This is sometimes rather disconcerting, as the tube, of course, lights and appears normal, but it is either feeble or totally inoperative. There is no need of this happening however, if the above precaution is taken.

The Teledyne can be used quite successfully even on distance, with a ten foot indoor antenna, though the results are naturally not as good as if an outdoor antenna is used.

On a ten foot wire running from the set to the picture molding, the writer has received adequate loud speaker signals in Minneapolis from Omaha, Chicago, St. Louis, Davenport, Cleveland, and Pittsburgh.

It must be remembered that there are oc-

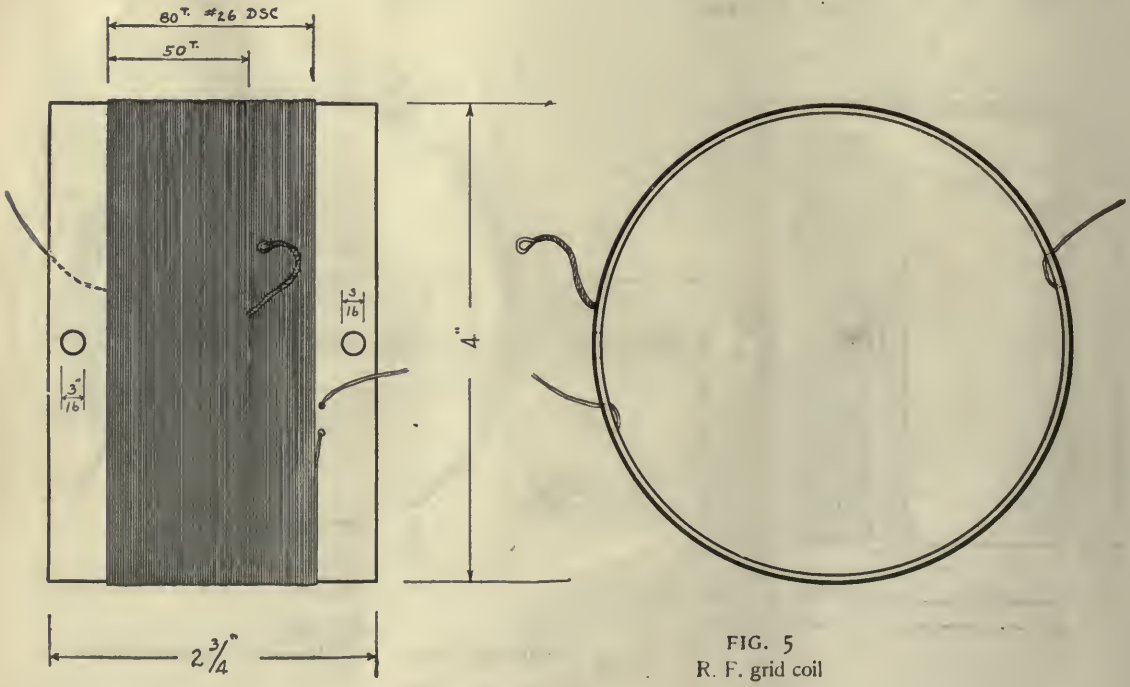


FIG. 5
R. F. grid coil

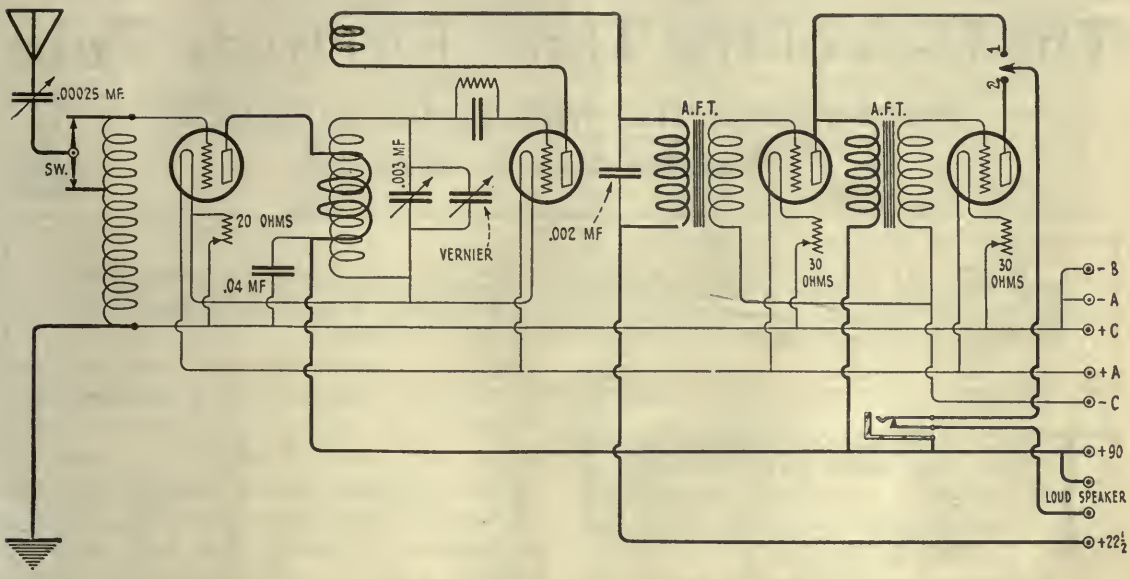


FIG. 6
Complete diagram of connections of the circuit

casional buildings which owing to the large amount of metal used in their construction act as a shield, in which case an indoor antenna is not satisfactory.

In using a short indoor antenna connect as follows:

1. Connect the ground lead in the usual manner.
2. Connect a fixed mica condenser of 125 micro-micro-farads capacity between the antenna and ground binding posts. This size is sometimes difficult to obtain. Two 250 mmfd. Dubilier grid condensers may be used in series.
3. Connect the ten foot antenna directly to the grid of the radio-frequency tube.

WHAT the farmer gets out of broadcasting is the subject of an interesting article by Robert H. Moulton which will appear in RADIO BROADCAST *for July. Mr. Moulton tells how the farmer gets something out of the air besides music and how his radio receiver is paying him dividends.*

The Uses of the Three-Electrode Tube

WHAT MAKES THE WHEELS GO 'ROUND: IV

By WALTER VAN B. ROBERTS

Readers who wish to have available a fund of reliable radio theory more up to date than most textbooks will do well to keep this series of articles by Mr. Roberts. All of these articles, while treating of the general subject of radio theory, are complete in themselves and each installment is comprehensible alone. This is the fourth of the series which began in this magazine for March.—THE EDITOR.

THE three-electrode tube can be used in a great many ways, but its use in connection with radio transmission and reception is confined almost exclusively to the following:

1. Modulation, or the process of varying the amplitude of the transmitted radio waves in accordance with the variations of air pressure that constitute the voice or music.

2. Demodulation (also called rectification and detection) or the process of converting modulated radio-frequency alternating currents into direct current varying in strength in accordance with the original voice or music.

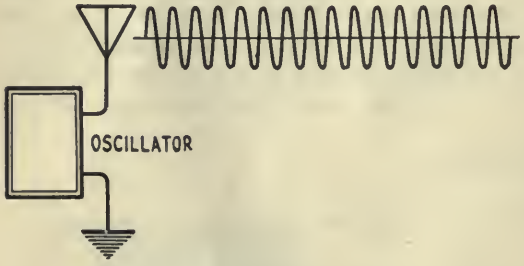


FIG. 14
How an unmodulated continuous radio wave may be diagrammed

3. Regeneration, a process for neutralizing some of the unavoidable resistance in the receiving circuits, resulting in greater currents being produced by the incoming waves.

4. Amplification, or increasing the energy of either radio- or audio- (voice or music) frequency currents, without changing their form.

5. Oscillation, or the production of high frequency alternating currents. At the transmitting stations it is high frequency current flowing in the antenna that radiates energy under the name of wireless or radio waves.

37. MODULATION

THE simplest case of modulation occurs when a pure note of a single frequency, such as produced by a tuning fork, is transmitted. When no sound is supplied to the transmitter or microphone the transmitting station is sending out radio waves of a single frequency and constant amplitude as shown in Fig. 14. But if an air wave or variations of air pressure from a vibrating tuning fork hit the microphone as shown in Fig. 15 then the modulating apparatus causes the amplitude of the radio waves to vary in accordance with the tuning fork wave. If the original radio wave be represented by sin pt and the air wave from the tuning fork by sin qt then the modulated radio wave would be of the form sin pt $(1+m \sin qt)$ where the constant m shows the degree of modulation, that is, how large a percentage change in the amplitude of the original radio wave is caused by the modulation. (if $m=0$ the wave would not be modulated at all. If $m=1$ the amplitude would periodically fall to zero as shown in Fig. 16.)

38. ANALYSIS OF MODULATED WAVES*

NOW the surprising part about the modulated wave is that it can no longer be considered to have a single frequency. For by a simple trigonometric formula we can show that $\sin pt\,(1+m \sin qt) = \sin pt + \frac{m}{2}\sin(p+q)t + \frac{m}{2}\sin(p-q)t$ which shows that the modulated waves must be treated as the sum of three different trains of constant amplitude

*The starred sections may be omitted on the first reading, since these parts are rather more technical than the main part of the series.

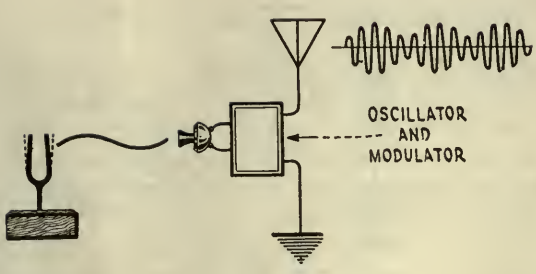


FIG. 15

A continuous radio wave modulated by an audio-frequency impulse from the tuning fork

waves of frequencies respectively: 1, the same as the frequency of the original unmodulated radio wave, which is called the "carrier" frequency; 2, a frequency greater than that of the carrier by the signal frequency; and, 3, a frequency less than the carrier by the same amount. That is, the carrier frequency being $\frac{P}{2\pi}$ and the modulating frequency $\frac{Q}{2\pi}$, then there will be sent out waves of frequencies $\frac{P}{2\pi}$, $\frac{P}{2\pi}+\frac{Q}{2\pi}$, and $\frac{P}{2\pi}-\frac{Q}{2\pi}$.

39. SIDE BANDS*

FOR very high quality music all tones between about 30 and 5000 vibrations per second should be transmitted with equal efficiency. To transmit the former we must, as explained above, transmit a frequency 30 cycles greater than the carrier and another 30 cycles less than the carrier, in addition to the carrier itself. To transmit the 5000 we must use the frequencies 5000 greater and 5000 less than the carrier. And to transmit all the intermediate tones, we must use the two bands of frequencies (called the upper and lower side bands) shown shaded in Fig. 17.

The whole range of frequencies used is called a "channel." In the case just described the width of the channel is 10,000 cycles. The important thing about all this is that broadcasting stations do *not* use only a single frequency or wavelength as might be supposed from the figure given in the newspaper radio programs (that figure is the frequency of their carrier wave in kilocycles per second) but they each require a channel of definite width, and hence only a rather small number can work at once without their channels overlapping, which results, from the listener's point of view, in a continuous whistling sound (of high pitch if the channels overlap only slightly, and of lower pitch if the overlapping is greater).

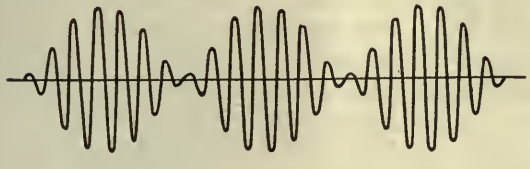


FIG. 16

40. RELATION OF FREQUENCY TO WAVELENGTH

RADIO waves travel with the speed of light, 300,000,000 meters per second. Now in any wave motion the frequency or number of waves passing a given point per second, multiplied by the wavelength, gives the speed with which the waves are traveling. If a train of railroad cars passes a given point at the rate of two cars per second and each car is fifty feet long, the speed of the train is obviously one hundred feet per second. Quite similarly, if the frequency of passing radio

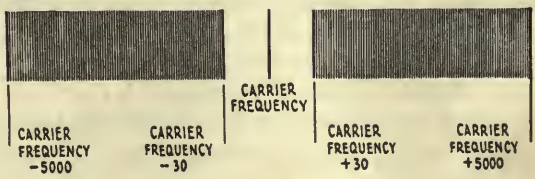


FIG. 17

The complex emitted wave is composed of a carrier frequency and two side bands. The whole is a "channel"

waves is one million per second, then the length of each wave must be 300 meters to make the speed come out the value stated above. For a long time the term wavelength has been used rather than frequency, but at present the kilocycles seem to be displacing the meters. The reason for this is that if the frequencies of several transmitting stations are given, we need only make sure that no two are within about ten kilocycles of each other in order to be sure that they will not interfere. (Non-interference when waves are only ten kilocycles apart will of course only be true if a very highly selective receiving set is used, one that can pick up all the frequencies lying in one channel and none lying outside of it). On the other hand, if we work with wavelengths, we must calculate anew the width of channel expressed in meters for every different wavelength. Thus a 10-kilocycle channel at three hundred meters wavelength is only a three meter channel, while at three thousand meters wavelength, it is a three hundred meter

channel. There are about nine times as many ten kilocycle channels available between the wavelengths 30 and 300 meters as there are between 300 meters and 30,000.

41. MATHEMATICS OF A MODULATING AMPLIFIER TUBE*

FIG. 18 shows how a vacuum tube can be made to modulate. The grid is supplied by means of transformers with the carrier frequency and the modulating frequency. We now make use of the equation given previously for plate current, putting in the two alternating potentials along with the C battery potential.

$i_p = K\,(B + \mu \times \text{grid potential})^2 = K\,(B + \mu[C + a \sin qt + b \sin pt])^2$

$= K\,[(B + \mu C) + \mu\,(a \sin qt + b \sin pt)]^2$

$= K\,(B + \mu C)^2$ which is direct current

$+ 2K\,(B + \mu C)\,(a \sin qt + b \sin pt)\,\mu$ which are currents of frequencies $Q/2\pi$ and $P/2\pi$

$+ K\,\mu^2 a^2 \sin^2 qt$ which reduces to direct current and current of frequency $2\,Q/2\pi$

$+ K\,\mu^2\,b^2 \sin^2 pt$ which reduces to direct current and current of frequency $2\,P/2\pi$

$+ 2K\mu^2\,ab \sin qt \sin pt$ which can be resolved into currents of frequencies $\frac{P-Q}{2\pi}$ and $\frac{P+Q}{2\pi}$.

Now of all three currents, only those of frequencies $P/2\pi$, $\frac{P+Q}{2\pi}$, and $\frac{P-Q}{2\pi}$ are near enough "in tune" with the antenna circuit to produce appreciable currents in it. Hence the antenna current and the radio waves caused by it, have the carrier frequency and the two side frequencies, and hence correspond to the modulated waves analysed in a previous paragraph.

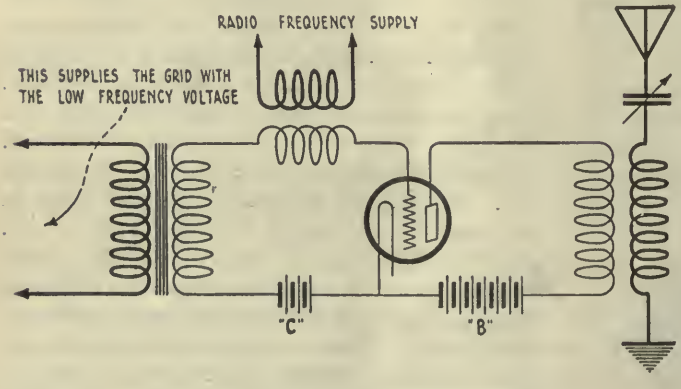


FIG. 18
A simple method of modulating a vacuum tube

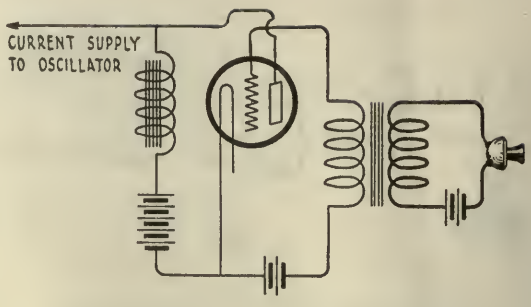


FIG. 19
A commoner method of vacuum tube modulation

42. THE HEISING SYSTEM OF MODULATION*

THE modulating circuit of Fig. 18 is not one commonly used: it was chosen because the mathematics of its operation is easily worked out from the equation for plate current. The circuit most commonly used is shown in Fig. 19. Two tubes are used. The one not shown in the diagram is the oscillator that supplies the antenna with radio-frequency current. The current supply for the plates of both tubes comes through the iron core inductance or "choke" coil which tends to keep the total current supplied to both tubes constant. But the voice hitting the microphone causes voice-frequency variations of current in the primary of the transformer which in turn produce voice-frequency variations of the grid potential of the tube shown in the diagram. These variations of grid potential cause the tube to draw a varying amount of plate current. But since the total current supply is kept constant, the oscillator tube must receive more whenever the other tube receives less and vice-versa. The more current the oscillator tube receives the more strongly it oscillates, while if it receives less current than normal, its oscillations are weakened. Thus, corresponding to the voice, we have variations in the radio wave amplitude, in other words the radiated wave is modulated by the voice. It might seem inefficient to use two tubes this way instead of one, but it is not so bad as it seems, for the oscillator by this method is part of the time being forced well above its allowable safe continuous output. This is the Heising system of modulation, and it is used in many of the most successful broadcasting stations.

43. SUPPRESSED "CARRIER" TRANSMISSION

THE carrier wave has no part in conveying intelligence. It is required only for the purpose of demodulation at the receiving end. It can be left out entirely provided that a local oscillator tube is used at the receiving end to supply current of the same frequency to take its place. The "balanced modulator" used to get rid of the carrier is shown in Fig. 20. Analysis of this circuit (which is merely two tubes, each acting in the manner previously taken up) shows that the two side bands generated by each tube act additively in producing current in the antenna, but the carrier frequency current in the plate circuit of one tube just cancels the effect of the carrier current in the other tube as far as producing current in the antenna is concerned. Much power is wasted transmitting the carrier, but for most purposes it is best to do so because it is difficult to make the local oscillator at the receiving station supply just exactly the same frequency. Another advantage in suppressing the carrier is that the locally generated carrier frequency at the receiving end is not subject to variations in strength and hence there is a reduction in the amount of "fading" of the received signals.

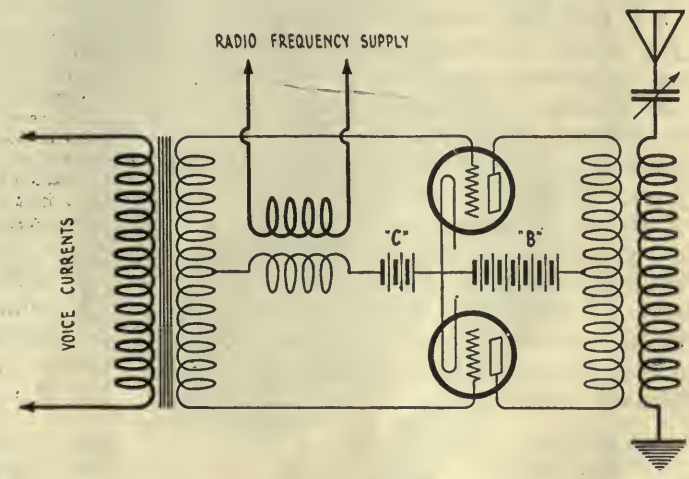


FIG. 20
A "balanced modulator" system which eliminates the carrier wave

44. SINGLE SIDE BAND TRANSMISSION

FURTHERMORE, only one of the side bands is required to convey the speech or music, as will be evident from the complete analysis of demodulation given later on. If only one is used, the channel required will only be one half as wide, which is an important feature if the ether is "crowded" with transmitting stations. Also, the receiving set can be made to receive only one half as wide a band of frequencies and hence offers only one half as much chance for static and other interference to get in. If both the carrier and one side band are suppressed, the local oscillator at the receiving end can be as much as fifty cycles different in frequency from the original carrier without serious interference with intelligibility of speech. However, the harmonic ratios in music would suffer. For the reasons mentioned above the American Telephone and Telegraph Co. are using single side band transmission in their transatlantic telephony tests. This system is not now practicable for short wave work as it is too hard to "filter out" the side band that is not wanted, when the width of these bands is only a small fraction of the carrier frequency.



THE SUPER-HETERODYNE

MAJOR EDWIN H. ARMSTRONG is writing his own story of his new super-heterodyne,—exactly as he described it before a recent meeting of the Radio Club of America,—exclusively for RADIO BROADCAST. The article will appear in July.

The super-heterodyne, one of the few new circuits brought out in recent years, was developed by Major Armstrong in France under war-time pressure and now is becoming constantly more popular.



What Our Readers Write Us



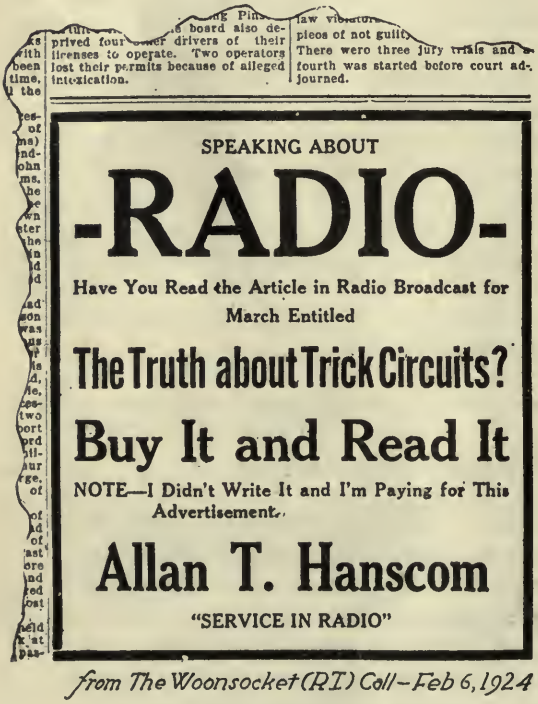
Contra—Women Announcers

AT THE risk of opening an argument which might become somewhat unchivalrous, we are printing the letter which follows. It was written by a producer and distributor of phonograph records who has every qualification to know whereof he speaks. And, as a matter of fact, there is apparently no danger of the broadcast announcing profession suddenly, or, indeed, even gradually being monopolized by women, for at present there are probably not more than ten women announcers throughout the country. (This for those who may grow disturbed over the prospect—not an editorial opinion).

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.
DEAR SIR:

The phonograph industry has learned much from radio of late. But broadcasting stations can learn some fundamentals from our experience with the sales of phonograph records.

When the speaker is not seen in person, and if that speaker be a woman, her voice is very undesirable, and to many, both men and women, displeasing. I submit this not as an argument, but as a fact. We have found that a record of a woman's talking voice will not sell, and it has cost several manufacturers several thousands of dollars to learn that despite the greatness of the artist, people will not pay good money to listen to the talking record of a woman's voice. Consequently, I believe that a vote of radio fans would show great disapproval of women announcers and speakers.



from The Woonsocket (RI) Call—Feb 6, 1924

WHAT OUR READERS WRITE FOR US

This two-column advertisement was inserted and paid for by an enthusiastic reader in Rhode Island

THIS letter is one of a considerable number of similar ones which have arrived since we published A. F. Van Dyck's two articles on "Man-Made Static" in the April and May numbers.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.
DEAR SIR:

Perhaps it might interest you to know that your article in April on "Man-Made Static" describing the trouble caused by an electric heating pad enabled me to discover the cause of a disturbance which had been causing me hours of profanity for over a year. Exactly the same situation as Mr. Van Dyck described had been happening in my house and I had been blaming everything and every one in the vicinity except the offending pad.

Fifteen minutes after reading the article in RADIO BROADCAST, I had found the trouble. Of all the excruciating noises which bother the radio fan, this one caused by heating pads is the worst; it fairly sets one's teeth on edge. Compared with it, static of the worst kind and regenerative noises sound like the sweetest music. That was certainly a most profitable investment of twenty-five cents.

ERNEST F. DOW

LETTERS are still coming in, inspired by Carl Dreher's two recent articles on "Is the Broadcast Listener at Fault?" and "Is the Amateur at Fault?" There is, of course, much to be said on both sides, and only by the honest saying of it can the situation be clarified.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.
DEAR SIR:

Carl Dreher's recent article on "Is the Broadcast Listener at Fault?" interested me, but I should like to make a few additional observations.

The case of 9 RR, who is the gentleman referred to by Mr. Dreher as expressing sweet sympathy with the midnight broadcasters can best be understood by remembering that he lives in the same city as the "Kansas City Nighthawks." When 9 RR keeps quiet from 8 until 10:30 P. M. in compliance with the law, and then is kept off for another

Announcing:—



★

A New Magnavox M4

requiring no battery

THE supreme achievement of Magnavox engineers represented in a Reproducer of truly *exquisite* tone quality.

The superb tone quality of M4 results from the perfection of the Magnavox semi-dynamic operating principle incorporating; *first*, a new magnetically balanced armature; *second*, an improved type of diaphragm supported by hollow rubber gaskets; and *third*, an extremely high resistance winding which makes M4 unusually sensitive.

Price $25.00

Beautifully finished in dark enamel with gold high lighting.

Equipped with flexible cord and Weston plug ready to connect as simply as a head set.

Magnavox M4 and other Magnavox Radio Products can be had of good dealers everywhere

THE MAGNAVOX CO., OAKLAND, CALIF.
New York Office: 350 West 31st Street
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MAGNAVOX
The Reproducer Supreme

6R

Public Lib
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★ Tested and approved by RADIO BROADCAST ★

four hours because nothing will tune-out WDAF's harmonics while they have their alleged frolic, it can be expected that he will be in a different position to most other amateurs, so his feeling should not be taken as a general one.

It has often been remarked that the enforced quiet hours have reduced interference from amateur stations. This is a point which I should like to hear more correctly stated. It is true that when this regulation was made, some owners of single circuit receivers got less interference, but the general interference was not altered at all. Too many amateurs are going around confessing that their sets create interference, whereas, quite probably they do not. The spark is the only type of transmitter which I know does create interference serious enough to be noticed. I think that even an ICW set is harmless.

While in New York last year, I was listening to 2RK on a single-circuit receiver, at a point about a mile distant from him, and I found the tuning quite sharp. From experiments which I have made from time to time in the last five years, I am inclined to believe that if interference is encountered from a CW station, the fault is with the receiver. One should never lose sight of this point. As a matter of fact, the improvement in design of receiving sets is so rapid that I think the present compulsory silent period will be lifted in a year or so.

H. S. Gowan,
Kitchener, Ont.



NOT ALL "APPLAUSE"

Goes to broadcasters. This card, done in full colors, hove in the office not long ago

"To Begin With, Radio Saved My Life."

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

You asked some time ago for letters telling "What Radio Has Done for Me." Well, to begin with, radio saved my life. This I did not fully realize until after my doctors had explained it all to me, but now I know it to be true.

Some two years ago, I found I had serious lung trouble. I tried to fight it "standing up" for a while, but soon my doctors sent me to Asheville, N. C., where I remained in a sanatorium and made no progress. Considering myself a gone goose, and preferring to die among my own family rather than passing out at Asheville, I came home, down and out. I practically gave up, and lost all interest in everything. The combined pleadings of my family and doctors to buck up, did not make any impression on me whatever.

One day a strange chap came into my bedroom and began to fool around with some wires and a box on a small table near me. He did not have much to say, and I was in such a state that I thought he had something to do with my funeral. I rather thought that this stranger's presence was only another indication of the complete care my family was taking of me and that this was the real beginning of the end.

Then the chap said: "Say old man, try these on your head and see if they fit." I wondered whether people were now having their heads measured for burial. Anyhow he placed the contrivance over my head, and I don't think I have been before or since so near heaven as I was then. I heard a voice and music and actually believed I was leaving this earth.

Making a long story short, I became as interested as a six-year-old. The set was installed on Friday and on Monday, my doctors said to me, "You have made as much improvement in the last three days as we could have expected in a month. From then on, I lived in bed with the phones on. But I did not stay there very long. . . .

Not long ago I was out riding with my doctor, who remarked to me that I owed my complete recovery not to his good work especially, but to the beneficial effect of the radio set at the psychological time.

T. B. S.,
Atlanta, Ga.

A British Amateur Reports

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

If you have space for the following, I would like to report reception of the following American radio amateurs. I used two valve, detector and one low-frequency valve. If any of them are interested and can verify same, I would be glad of a card.

Received on 25 November, 1923, about 10:30 P. M. E. S. T. 2CXL, 8MZ, 8TR, 8UF, 8AGO, 8CPD, 8CPO, 8XAW, 9CR, 9AMK, 2EL (working 5HL) 8AMM (working 9WC).

Received 10 February, 1924, about 8 P. M. E. S. T. 1ALJ, 1AOL, 1APY, 2OMF, 5AIR, 9ZL, 2CEI (working 5AIC), 8COI .

These dates and times are calculated in Eastern Standard throughout.

Yours truly,
A. C. Simono,
Wellington Road,
Mablethorpe, Lincolnshire,
England.

"Joy Unconfined"—about the Roberts Set.

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

The sole fault I have to find with your famous one-tube knock-out reflex receiver is that users frequently run into a faulty fixed or variable crystal and as a result grow dissatisfied.

This is borne out by my own experience, for I have had wonderful results, when the crystal "was feeling well" on three different occasions with all conditions other than the crystal the same. So far I have tried several crystals. With one semi-fixed crystal I seemed to get the most satisfactory results—when that was adjusted right and fastened, I could get three to four houis of perfect reception. Then I had all Chicago stations, Detroit, Springfield (Mass), Philadelphia, Fort Worth, Dallas, Northfield, Atlanta, and once, Oakland, Cal., but apparently after that favored spot lost its sensitivity, the set would



"THE STANDARD OF COMPARISON"

ULTRADYNE ★

The Improved

SUPER-HETERODYNE

The Ultradyne employs the "Modulation System," a basic development by R. E. Lacault, A. M. I. R. E., radio engineer of this company, and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

The "Modulation System" places the Ultradyne years ahead of all present methods of radio reception. This new principle increases the sensitiveness over that of any known receiver. Weakest signals are made to operate the loud speaker.

Results secured by Ultradyne owners are amazing and exceed even those obtained with any other receiver under the same conditions. For range, signal audibility and faithful performance, the Ultradyne commands your first consideration.

Write for descriptive Circular

PHENIX RADIO CORP.

5-7 Beekman St. New York



Send for 32-page illustrated book giving latest authentic instructions on drilling, wiring, assembling and tuning 6 and 8 tube Ultradyne receivers.

50 Cents

Edited by:

R. E. Lacault



ULTRAFORMERS
Types "A" and "B"

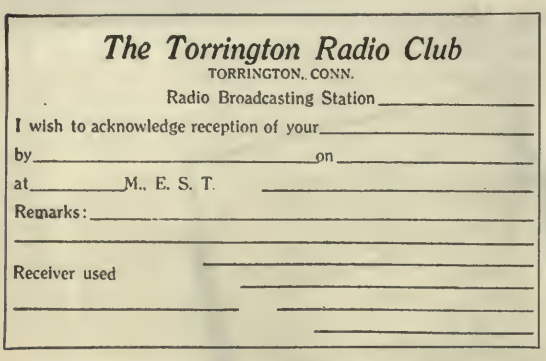
New improved long wave radio frequency transformers. Type "B" may be successfully employed in any circuit where long wave radio frequency transformers are essential.

$5.00

Designed by:

R. E. Lacault

★ Tested and approved by RADIO BROADCAST ★



PRINTED THANKS FROM THE RADIO CLUB

Members of the Torrington, Conn., Radio Club send these cards out to broadcasters

get only local stations. These locals would come in better with the detector contact off.

Regarding the Roberts knock-out two-tube set, I must say I have had excellent success with it. The hardest stunt I have asked of it yet was to bring in Louisville on 400 meters through WJAX on 390. It did its best—angels could do no more. I heard Louisville right through WJAX which isn't bad since there is only ten meters difference between the two stations, and Louisville has a power of ½ k.w., 400 miles away, while WJAX has 1 k.w. and is about four miles away from me.

I did several things which Roberts did not specify. I brought the taps on the A coil out to switch points on the panel, which helped selectivity and volume and then I put the whole coil on a lever, with a control knob on the panel so that the coupling with the primary S coil could be varied—which is an advantage. The T coil is on a lever at the end of a horizontal shaft which can be rotated. The coupling can be varied in a vertical plane (fanwise) which makes for compactness. With this set last night I heard (on the loud speaker) WFI, KFKX, WFAA, WGY, WHAS, WOR, WCAL, WBZ, WDAP, KDKA, WGN, WOC, and WBAP.

J. E. Roberts,
Cleveland, Ohio

Radio and Shorthand

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

When I first became a radio fan, I merely listened-in as a pastime. Now I have found another use for my radio.

One can usually tune-in some lecture or talk on general topics of the day, and I have found that my shorthand has been greatly improved since I started the practise of spending about a half hour each evening, copying down what I hear.

I used to think that I got enough practise during the day doing my regular work, but in taking dictation, I find usually I am more concerned in getting every word than in neatness of the result. And when I am copying what I hear over the radio, it does not matter if I miss a few words, and I can pay more attention to the size and shape of the shorthand characters, and so get splendid practise that I cannot get during working hours.

Salmer Peterson,
Arlington, S. Dak.

Not So Fast, Announcers

Editor, Radio Broadcast
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

The writer, a radio fan, in the name of all the radio fans in the Island of Cuba, respectfully addresses to you this letter in order through your magazine to call the attention of all the broadcasting stations in the United States to the fact that it is next to impossible to understand the name or initial of the transmitting station because the announcers in general speak extremely fast and this, added to the static, keeps us from knowing who is transmitting.

During the past few months, I have been experimenting in order to ascertain the distance I could reach with my receiving set and regularly every night hear Los Angeles, Fort Worth, Alabama, Davenport, Pittsburgh, and others. I received the concerts well, but was not able to identify the stations until the second or the third number, due to the extreme speed of the announcers when giving the initials.

Undoubtedly you are aware that there are in the neighborhood of 25,000 radio amateurs in Cuba and they are very much interested in hearing the States.

If you will be so kind as to write an article in your magazine with regard to the above, I can assure you the favor will be appreciated by all the radio fans in Cuba.

Yours very respectfully,
Oscar H. Sta. Cruz
Habana, Cuba.

SIX MEN IN A DIRIGIBLE

BATTLING fog and wind, pushing bravely toward the North Pole. . . How the first wireless apparatus ever put aboard an airship dramatically saved six lives. .—Told by Jack Irwin, the Marconi wireless operator aboard Walter Wellman's dirigible America *on its fateful Atlantic voyage in October, 1910. The story will appear in an early number.*

For the Fullest Measure



of Undistorted Volume

To obtain the fullest measure of undistorted volume, your receiver must deliver to the diaphragm of your loudspeaker or ear phones audio frequencies which will produce the maximum volume and purest qualities of tone.

This depends directly upon the efficiency of your audio amplifying transformers.

The GENERAL RADIO CO. type 231-A is distinctly a quality transformer—of high electrical and mechanical efficiency.

Features contributing to its superior performance are:

Low loss steel used in its core construction

Layer Winding properly insulated and impregnated

Air gaps in core to avoid distortion

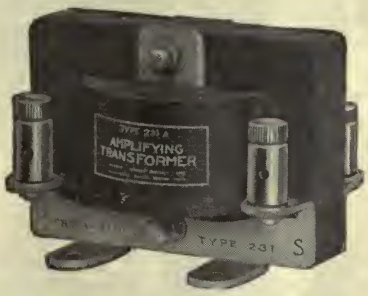
Unbreakable feet with convenient mounting holes

Heavy leads with soldered connections

High and flat amplification curve
Which indicates that amplification is nearly uniform throughout its entire audio range, making it **best for all stages.**

Turns ratio 3.7 to 1 **Impedance ratio 10 to 1**

Instructive Folder on "Quality Amplification" sent free on request



Type 231-A
AMPLIFYING TRANSFORMER
"Best For All Stages"
PRICE $5.00

Sold by Good Radio Dealers
EVERYWHERE

★

"Products of Proven Merit"

GENERAL RADIO COMPANY
Manufacturers of
Radio and Electrical Laboratory Apparatus
Massachusetts Ave. and Windsor St.
CAMBRIDGE MASSACHUSETTS

GENERAL RADIO Co

★ Tested and approved by RADIO BROADCAST ★



QUESTIONS AND ANSWERS

In writing to The Grid for constructional data, correspondents are requested to send a stamped self-addressed envelope with their letter of inquiry and also to furnish the editor with all possible information concerning the use to which the apparatus is to be put. This should include, when pertinent, type of tube, wavelength, voltage, current, sizes, the experience of the correspondent and a description of available material. This will greatly add to the facility with which our advice may be carried out, and to the general usefulness of this department.

QUERIES ANSWERED

Describe the Construction of a Loop for the Super-Heterodyne	*A. S.*, Farmington, Me.
What are the Dimensions, Number of Turns, etc. of the Oscillator-Coupler for the Haynes Super-heterodyne	*A. C. S.*, Hazen, Ark.
How Can I Decrease the Radiation of My Single Circuit "Blooper?" . . .	*O. M. W.*, Key West, Fla.
What is the Purpose of the Grid Leak and Condenser? What is its Action in a Receiver	*J. C. B.*, Brooklyn, N. Y.
Is a Tuned Radio-frequency Amplifier More to be Desired than the Untuned Transformer-coupled Type?	*G. E. C.*, Seattle, Wash.
How Can I Eliminate Interference from Local High-powered Broadcasting Stations	*W. J. S.*, Chicago, Ill.
What Kind of a Receiver Shall I Buy? Would you Advise Trying to Build My Own?	*A. D. C.*, Philadelphia, Pa.

LOOPS

THE most desirable size of loop for broadcast reception is a compromise between the more efficient larger sizes and the convenience and mobility of a small frame. We recommend a square loop, three feet on a side, the various dimensions of which are indicated on the working drawing of Fig. 2.

The loop is of the solenoid type, i.e., wound in "box" form rather than as a spiral. There are nine turns of wire, separated one-half inch, wound in grooves, sawed in the end pieces. Any convenient wire may be used. Green double silk covered, No. 18 is perhaps the most easily manipulated, and when wound on a stained frame, the finished loop presents a very creditable appearance.

The frame is constructed of 1″ by 1½″ lumber. The upright may be drilled at the lower support on which the wires are strung to pass the middle wire. The other wires of course pass on either side of the upright. The construction of the base is clearly shown, the holes through the top and into the bottom being one inch in diameter, and the lower eight inches of the upright rounded to fit with sufficient looseness to permit turning of the coils.

Fig. 1 shows the approximate wavelength range of this loop when shunted by the average .0005 mfd. plate condenser.

This loop is especially adapted for use with the Haynes super-heterodyne receiver, and multi-stage radio-frequency amplifiers. It may also be used with a proper receiver as a direction finder.

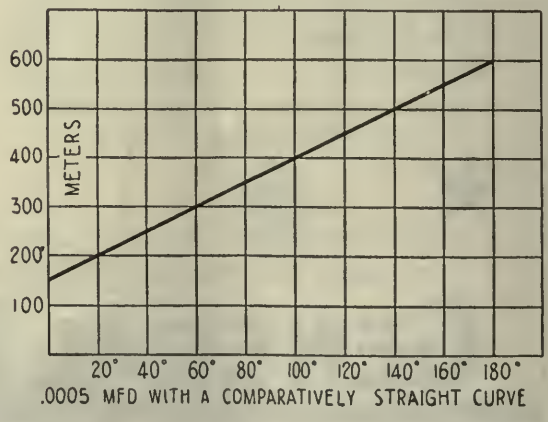
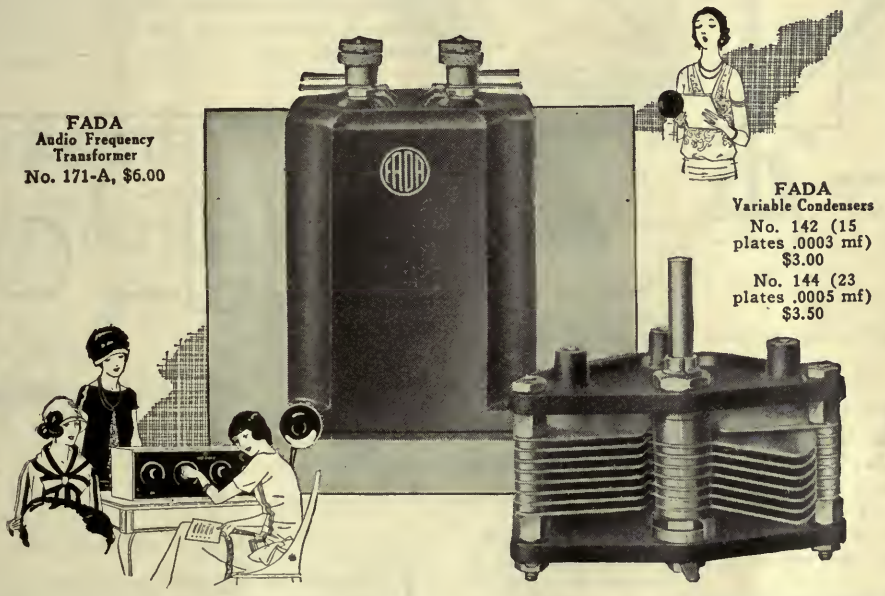


FIG. 1

FADA

★

Announces a New Audio Frequency Transformer and New Variable Condensers



FADA
Audio Frequency Transformer
No. 171-A, $6.00

FADA
Variable Condensers
No. 142 (15 plates .0003 mf) $3.00
No. 144 (23 plates .0005 mf) $3.50

IN KEEPING with its established policy of producing only the finest of radio apparatus, F. A. D. Andrea, Inc., announces a new Audio Frequency Transformer suitable for all circuits, and particularly adapted to Neutrodyne receivers.

A high average amplification over all audio frequencies is the outstanding accomplishment of this new FADA transformer. Encased in bakelite with nickeled binding posts, it looks twice its worth. Try FADA Audio Transformers in your receiver and know what uniform and distortionless amplification really means.

The name FADA on a condenser means just one thing—condenser satisfaction. The new FADA condenser is made in two capacities—15-plate, capacity .0003 micro-farads, and 23-plate, .0005 micro-farads; and each the exact capacity at which it is rated. Radio frequency losses are reduced to a minimum by special rotor wiping contact brushes. A true "low-loss" condenser with an efficiency exceeding that of condensers selling at much higher prices.

Dealers are now ready to supply FADA transformers and condensers.

F. A. D. ANDREA, INC., 1581 Jerome Avenue, New York

F. A. D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC
NEUTRODYNE
UNDER MARCHAL PATENT NO 163,000 DATED MARCH 27 1923 AND OTHER PATENTS PENDING
TRADE MARK REG. U.S. PAT. OFF.

★ Tested and approved by RADIO BROADCAST ★

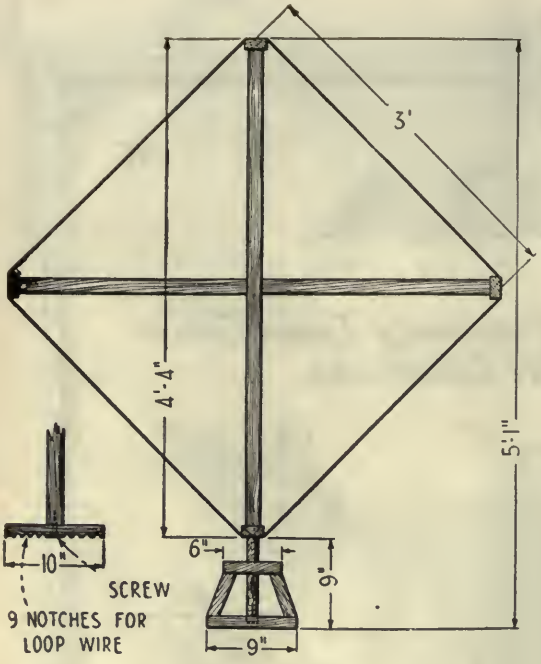


FIG. 2

AN OSCILLATOR COUPLER FOR THE HAYNES SUPER-HETERODYNE

DIMENSIONS for a suitable coupler are as follows: The stator is of formica or bakelite tubing, $3\frac{5}{8}$" in diameter and $2\frac{1}{4}$" long. It has two coils wound on it, each of 18 turns of No. 22 D.C.C. wire. The coils are separated by a $\frac{1}{4}$" space.

The rotor is of the same material and is 3" in diameter and $1\frac{1}{4}$" long. One coil of 15 turns of the same wire is wound on it.

Mechanical details of the mounting support and rotor shaft have been omitted as these differ in various types of standard couplers. The stator coil is set at a 45° angle to the base. This reply gives only the dimensions of the coil forms and number of turns for each winding. See Fig. 3.

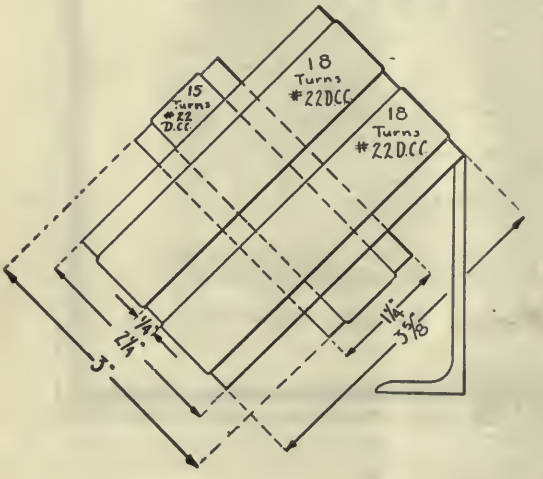


FIG. 3

SINGLE CIRCUITS AND "BLOOPING"

AN EASY, quick method of changing over your single-circuit "blooper" into a double-circuit receiver with the chances for radiation materially reduced, is shown in Fig. 4. The dotted lines show how the circuit looked as a single-circuit radiator. Coils S and T are the stator and rotor respectively of a standard coupler. C1 is changed from the series antenna connection to a shunt connection across the stator which then becomes the secondary. The primary consists of about ten turns of D.C.C. wire (sizes 24 to 18 will do) wound directly over the secondary. This serves as an untuned primary.

When the wave trap, shown elsewhere in these columns is used with this modified circuit, an additional absorption circuit is provided which also tends to diminish the radiation of the type of receiver to a negligible quantity.

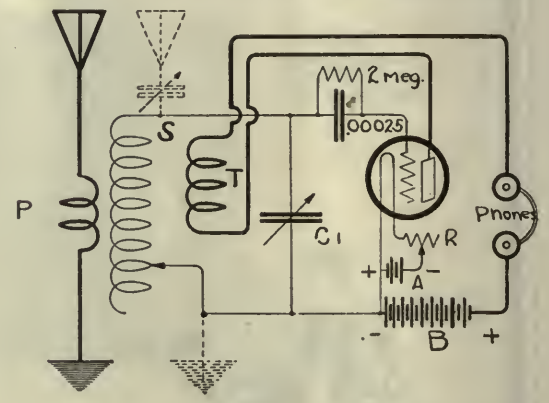


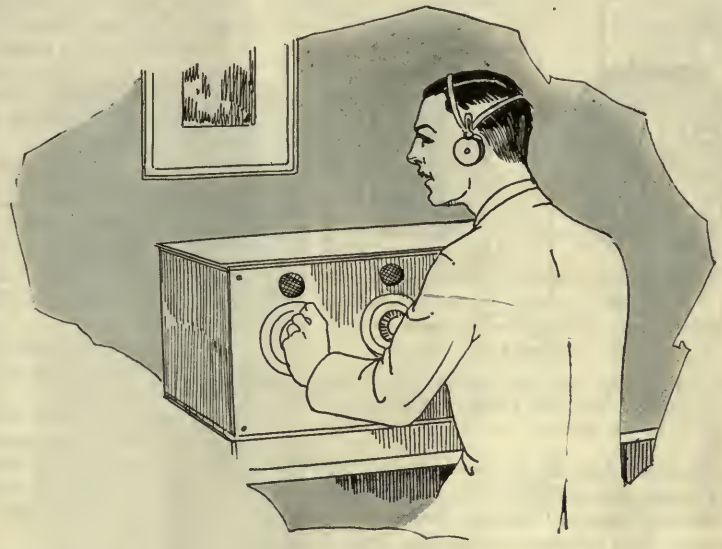
FIG. 4

THE GRID LEAK AND CONDENSER

THE grid leak and condenser supplies the grid of the tube with rapid surges of electron changes.

The theory of its action is as follows:

Suppose electrons surge from the tuner windings into one side of the grid condenser. The electrons which were on the grid side of this condenser will then rush out on to the grid of the tube, and cut down the plate current. But this will be so quick as to produce no effect in the telephones. On the back surge, however, something else will happen. The electrons will then rush out of the tuner side of the grid condenser to such an extent as to pull some electrons away from the grid of the tube, and thereby make it positive. This will mean that some of the free electrons in the tube will be drawn to the grid of the tube and out on to the wire connecting the grid to the condenser. On the next return surge of electrons on the tuner side of the condenser from the tuner, these extra electrons which came from the tube are no longer free, but are trapped between the condenser and the grid of the tube. They cannot get out of the grid back into the vacuum of the tube because the grid is not heated as the filament is. The result is that the grid is more negative than it was before because of the excess of the electrons it now has. The plate current in the tube will therefore go to a lower value than it did before. This trapping of electrons will continue on each positive swing of the grid so that the grid will soon reach an average negative value below where it started, by



hours spent to solder connections carefully
. . . wires shortened
. . . circuits altered . . .

and still energy leaks away

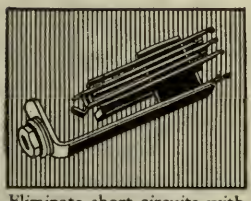
WHAT a tiny fraction of broadcasted energy actually gets to your set! How vital it is to prevent a particle of that energy from leaking away!

Yet in the most carefully constructed set, there are scores of places where stations you particularly want can literally leak away!

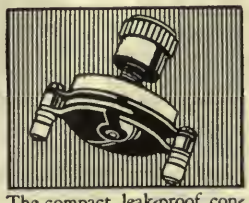
For *every small part* must convey current before energy *gets* to your phones or speaker. It's mighty important to you to know that every one of them is doing its full duty to prevent energy leaks.

MAR-CO small parts are made with precision, by the makers of scientific instruments — *designed* to stop leaks and conserve precious energy!

The compactness, the sure contacts hundreds of thousands have found in MAR-CO instruments, would be *worth* high prices. Actually, they save you money when you buy . . just as they save stations that might otherwise leak away—when you use them!



Eliminate short circuits with MAR-CO SHUR-GRIP jacks--. Formica insulation, sterling silver contacts, hooked terminals for quick, leak-proof connections—60 cents to $1.00 and well worth it.



The compact, leak-proof construction, and the amazingly smooth, easy operation, of MAR-CO neutralizing condensers works wonders in R.F. circuits. Perfect neutralizing of tube capacity for $1.25.

★ **MAR-CO**

PLUGS · JACKS · RHEOSTATS · SOCKETS · SWITCHES · NEUTRALIZING CONDENSERS

RADIO PRODUCTS

★ Tested and approved by RADIO BROADCAST ★

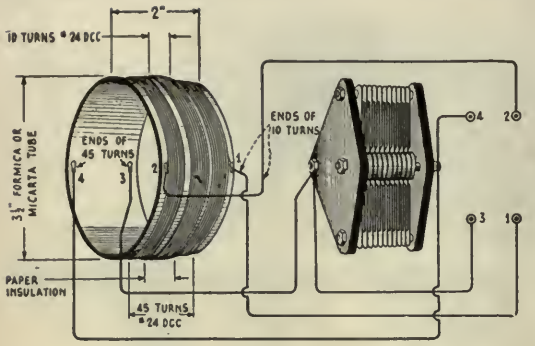


FIG. 5

The four binding posts allow use of this circuit in various ways. For general use, post 1 goes to the antenna, and post 2 to the antenna post on the receiver

the number of electrons which are trapped. This means that the average plate current will be correspondingly decreased, the telephones will be affected by this decrease in plate current. It is therefore necessary to bring the grid back to its original condition if the oscillations in the antenna have stopped.

The grid leak which is shunted across the grid condenser permits the trapped electrons to "leak" out into the set. For further details see the interesting and helpful book, *The Radio Pathfinder*, by R. H. Ranger.

TUNED R. F. AMPLIFIERS VERSUS UNTUNED R. F. AMPLIFIERS

THERE is something to be said in favor of both of the methods of radio frequency amplification mentioned. The transformer system needs no adjusting, per stage. Excepting for the ordinary tuning of the input coupler controlling the received wave, there is no further adjustment of the tuner.

In the tuned R. F. amplifier each stage must be tuned separately to resonance with the incoming wave. This operation is complicated and not always easy. But, when each stage has been properly adjusted, the reception is exceptionally good. One drawback of a set having tuned radio-frequency amplification is that the self-oscillations of the tubes make it a difficult set to control. This has been partly overcome by incorporating in the set, neutralizing capacities, resulting in a circuit similar to the standard neutrodyne set. The disadvantage in using untuned transformers is that they will not work with the same efficiency on all wavelengths. The wavelength at which best results are obtained is called the "peak."

INTERFERENCE AND THE WAVE-TRAP

IN A recent article by Mr. A. J. Haynes (November, 1923) this question of e iminating local interference was answered in detail. However, Fig. 5 shows the circuit diagram for a wave trap which will accomplish this elimination.

The inside winding is a coil consisting of 45 turns of No. 24 D.C.C. wire wound on a 3½" diameter tube, 2" long. The outside coil is wound directly over the first coil, being separated by a piece of linen or cambric cloth. It consists of 10 turns of No. 24 D.C.C. wire. Figs. 5 and 6 show the circuit, and method of coupling to a receiver.

CHOOSING A RECEIVER

THERE are several limitations that must be taken into consideration when choosing a receiver. Those of first importance are: amount to be spent; location, i.e., use of loop or outdoor aerial; purpose of its use, i.e., general broadcast reception for entertainment or experimentation.

A one-tube reflex set is comparatively cheap, efficient in operation, and has the advantage of working a loud speaker for local reception.

A three-tube reflex will permit the reception of distant stations on a loud speaker, is selective in tuning and is generally conceded to be a standard type of home receiver. A three-tube regenerative set is also excellent although the novice experiences some difficulty at first in effectively operating it.

A five-tube neutrodyne is an exceptional distance-getter, but on account of the multiplicity of controls is rather unwieldy to handle for one who knows nothing at all about radio.

The super-heterodyne is the "high-powered" par excellence receiver of radio. Simple in operation and effective for long distance reception, this set can surely be called the highest type of radio receiver yet developed. Most super-heterodynes are designed for loop reception.

The sets described will fit all sizes of pocketbooks and all have been described in past issues of Radio Broadcast.

There is an advantage to building your own since the experience gained enables one to understand the workings of the set. If one is especially handy with tools, the building of a set is heartily recommended.

In the May issue of the Grid a list of receivers that do not radiate, was given. We advise prospective purchasers of radio receivers to consult this list.

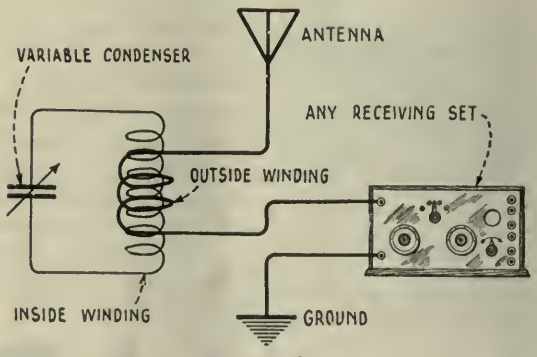


FIG. 6

HOW to build a broadcasting station using two five-watt tubes, is the subject of an unusually complete how-to-make-it article which will appear in this magazine for July. It is written by Ashley C. Dixon of Stevensville, Montana, owner of station KFJR and author of "What Radio Means at a Rocky Mountain Ranch" in Radio Broadcast *for January.*

"GOLDEN-LEUTZ"

SUPER-PLIODYNE 9

GOLDEN-LEUTZ SUPER PLIODYNE-9 TRADE MARK REG. ★

THE PERFECT BROADCAST RECEIVER



SIZE 40″ x 8″ x 8″ WEIGHT 65 LBS.

MANUFACTURED UNDER FARRAND LICENSE

A New Broadcast Receiver having 5 stages of Tuned Neutralized Radio Frequency Amplification, Detector and 3 stages of Audio Frequency Amplification

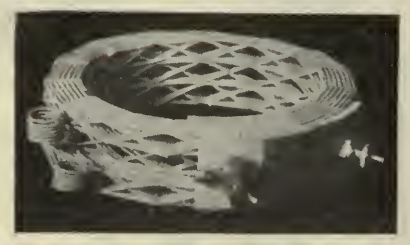
Built for People Who Want the Best

Complete Illustrated Catalogue and Instruction Book Mailed Upon Receipt of 25c

GOLDEN-LEUTZ INCORPORATED, 476 Broadway, New York City

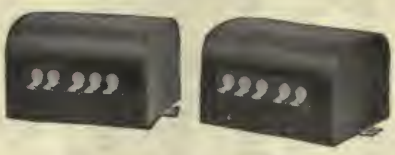
★ Tested and approved by RADIO BROADCAST ★

New Equipment



SICKLES DIAMOND WEAVE COIL

A coil of substantial construction which largely eliminates bulky insulating materials. It is readily mounted and does not require a great amount of space. The distributed capacity is material reduced and at final analysis it is quite efficient electrically. These inductances have been made to supply the demand for the coils T1 and T2 in the RADIO BROADCAST Knock-out sets. Made by the F. W. Sickles Company, Springfield, Mass.



COMO TRANSFORMERS

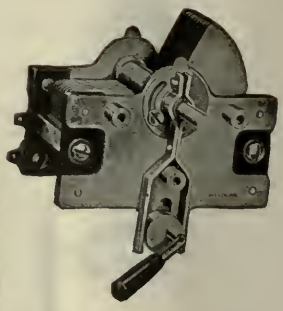
A sturdy pair of push-pull transformers, one input and one output. Using these, the radio fan can build a very satisfactory push-pull amplifier. Made by The Como Apparatus Company, 446 Tremont St., Boston, Mass. Price $12.50 per pair

ACCURATUNE MICROMETER DIAL

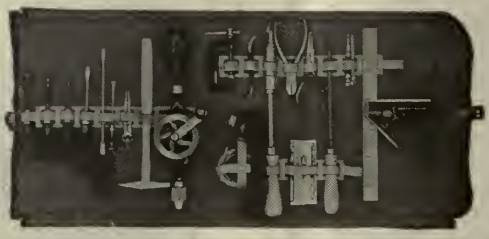
This is a control which not only adds to the appearance of your set but also makes for fine tuning. The micrometer adjustment is very effective on the most critical receivers. Made by The Mydar Radio Company, Newark, N. J. Price $3.50



HAMMARLUND MODEL "B" CONDENSER

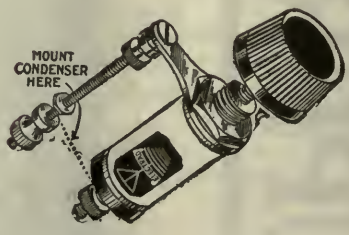


A well built piece of apparatus which reduces electrical losses to a minimum. The plates of hard brass are pressed into slotted brass posts and soldered, thus eliminating the possibility of material dielectric losses. Body capacity effect is prevented by grounding the aluminum end plates making it unnecessary to use shielding. The vernier control used makes extremely fine tuning possible as well as accurate logging. Made by Hammarlund Mfg. Co., Inc., 144–146 West 18th St., New York City



"GNOME BRAND" RADIO TOOL KIT NO. 1

A kit which is worthy the attention of radio fans generally. It contains all the tools which would ordinarily be needed by the home builder of receiving sets and the quality is first class. Hammacher, Schlemmer & Co., Inc., New York City. Price $20.00



ELECTRAD VARIOHM

A variable resistance rated by the manufacturers between five thousand and one hundred thousand ohms. Designed for panel mounting with adjusting knob. It may be used as the coupling resistance in resistance-coupled amplifiers. Made by The Electrad Corporation, New York City



Licensed under Armstrong U. S. Patent No. 1,113,149

MacMillan Listens to Honolulu and New Zealand "Tunes In" California

using

ZENITH
TRADE MARK
Long-Distance Radio

From a little ice-bound schooner—eleven degrees from the North Pole—comes this message:

"Am very thankful that Arctic Exploring Ship Bowdoin is equipped with complete Zenith radio apparatus. Here at top of world, in darkness of great Arctic night, we have already listened to stations practically all over the United States, from Europe, and even from far away Honolulu. Zenith has united the ends of the earth.—MacMillan."

Again, from far-off New Zealand comes a report of radio reception even more startling:

"It may interest you to know that the writer last evening landed KGO, Oakland, California, between 6:45 and 7:30 P.M. Heard his call four or five times distinctly, and jazz music. As San Francisco is ***6,300 miles from New Plymouth,*** and only one tube was used, we think this is a very fair performance."

—(signed) H. Charles Collier.

The sets used by Captain MacMillan and Mr. Collier are earlier models—since improved by the addition of ***a third stage of audio frequency.*** These new models represent an achievement not duplicated in any other set on the market. Write to-day for full particulars and name of nearest dealer.

Zenith Radio Corporation
McCORMICK BUILDING, CHICAGO, ILLINOIS

Model 3R The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the new and different Zenith three-circuit regenerative tuner.

Fine vernier adjustments—in connection with the unique zenith aperiodic or non-resonant "selector" primary circuit—make possible extreme selectivity.

2,000 to 3,000 Miles With Any Loud-Speaker

With the new Zenith 3R satisfactory reception over distances of 2,000 to 3,000 miles, and over, is often accomplished in full volume, using ***any ordinary loud-speaker.*** The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet - - - - - $160

Model 4R The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the new Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be satisfactorily accomplished over distances of more than 2,000 miles $85

ZENITH RADIO CORPORATION,
Dept. 1-G 328 South Michigan Avenue, Chicago, Ill.

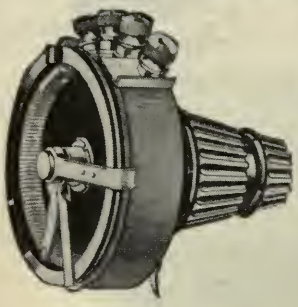
Gentlemen:
Please send me illustrated literature on Zenith Radio.

Name.....

Address.....

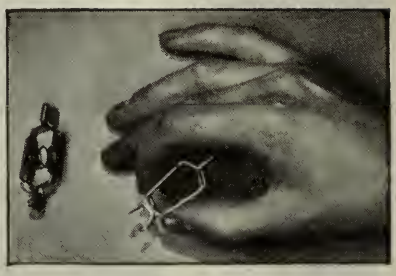
★ Tested and approved by RADIO BROADCAST ★

New Equipment—*Continued*



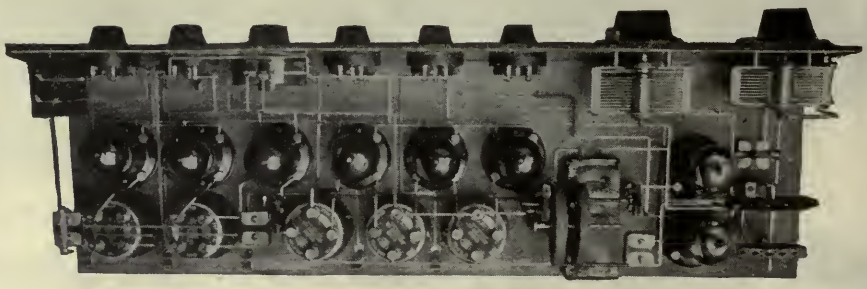
RADIO TUBE CONTROL UNIT

A compact device combining rheostat, vernier and potentiometer mounted as one unit, with two knob control. It is made of moulded bakelite. One knob controls the rheostat and the vernier, the other knob controls the potentiometer lever. Made by Herbert H. Frost, Inc., Chicago, Illinois. Price $1.75



PONS RADIO AND BATTERY CLIP

An inexpensive clip with a spring in the center and jaws on either end which makes this device valuable wherever there are radio sundries. The clip may join two batteries, or place telephone leads in series—among other uses. Made by Eugene Pons, 838 Lincoln Ave., Schenectady, N. Y.



A SUPER-HETERODYNE

The photo shows what has been done with parts manufactured by the Radio Receptor Company, New York City

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM MARCH 21 TO APRIL 18 INCLUSIVE

CALL LETTERS	LOCATION	(KILOCYCLES)	WAVE LENGTH	POWER (WATTS
KFFP	Moberly, Mo.	1130	266	50
KFPH	Salt Lake City, Utah	1240	242	50
KFPL	Dublin, Texas	1240	242	20
KFPM	Greenville, Texas	1240	242	10
KFPN	Jefferson City, Mo.	1240	242	10
KFPP	Olympia, Washington	1270	236	20
KFPQ	Denison, Texas	1300	231	10
KFPR	Los Angeles, Calif.	1300	231	500
KFPS	Casper, Wyoming	1240	242	10
KFPV	San Francisco, Calif.	1270	236	50
KFPW	Carterville, Mo.	1120	268	20
WABB	Harrisburg, Pa.	1130	266	10
WCBO	Memphis, Tenn.	1200	250	20
WCBQ	Nashville, Tenn.	1270	236	100
WCBR	Providence, R. I.	1220	246	5
WCBT	Worcester, Mass.	1260	238	250
WCBU	Arnold, Pa.	1180	254	50
WCBV	Tullahoma, Tenn.	1190	252	10
WDBF	Youngstown, Ohio	1220	246	50
WEAR	Baltimore, Md.	1150	261	50
WHO	Des Moines, Iowa	570	526	500
WIAY	Washington, D. C.	1100	273	100
WLS	Chicago, Ill.	870	345	500

TOTALS

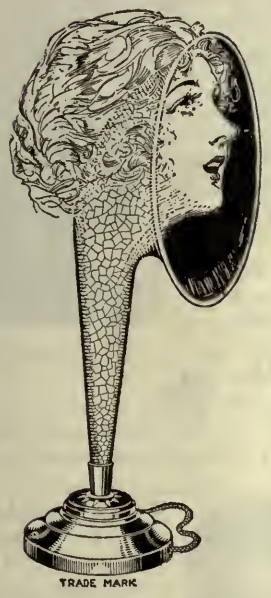
Number of U. S. broadcasting stations	598
Number of Canadian broadcasting stations	44
Number of Cuban broadcasting stations	34

Atlas

TRADE MARK

RADIO-REPRODUCTION LOUD SPEAKER

"The Musician of the Air"



Complete $25



Atlas Unit with phonograph coupling $13.50

Presidential Conventions!

The Republican Convention, Cleveland, June 10.

The Democratic Convention, New York, June 24.

A Message to the Public!

THE very next best thing to being actually present at these two events, of national and international importance, is to hear their ATLAS RE-PRODUCTION. Bring these momentous proceedings and orations right into your home in all their original naturalness for the entertainment and instruction of your family and friends. Get *all* of these speeches, every word clearly inflected, in the full, undistorted tones of the speaker. Just as realistic as though you were actually there. Buy your *ATLAS* NOW!

Booklet "A" upon request

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Makers of Mono—TIME- LAG FUSES—Multiple

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District Offices in

Boston, Mass. Philadelphia, Pa. Baltimore, Md. Pittsburgh, Pa. Detroit, Mich.
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Sole Canadian Distributors:
Marconi Wireless Telegraph Co. of Canada Ltd., Montreal, Canada.

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

THE artist who is responsible for our cover this month is Remington Schuyler. In Wyoming, he is known to the Indians as Ta-tan-ka-luta, which, being translated means Red Buffalo. Mr. Schuyler is regarded as a highly authoritative painter of Indians, even by the Indians themselves. At his home in New Rochelle, N. Y., Mr. Schuyler has done much for the Boy Scouts, who, naturally enough, are not unenthusiastic about close associations with a real Westerner.

JULIAN KAY is a radio man who was toying with spark coils and unwilling crystal detectors back in the days when an antenna atop a house was a matter for uncomfortable neighborly astonishment and disapproving shaking of heads. He and the editor were discussing the present Greek confusion of radio names one day, whereupon Mr. Kay waxed so enthusiastic that his present excellent article is the result. There are several others to follow.

ZEH BOUCK is a busy contributor to our magazine. Of late, he has associated himself with the William P. Mullaly Company, advertising agents, and has organized a radio department for them. When we talked with him recently, he was momentarily three centuries away from radio, deep in the absorbing pages of Burton's *Anatomy of Melancholy*.



CARL DREHER

WITH designing malice, we think, Carl Dreher took this snapshot himself atop Æolian Hall, which houses the apparatus of WJZ and WJY, with the purpose of showing that he is quite above radio, but we know better, though he writes: "In my spare time I am a practitioner of the art of writing fiction. Engineers all say I am a good writer, and writers praise me as an engineer. As a result of this striking unanimity of opinion, I don't know *what* the devil I am." Mr. Dreher does not always put himself on a pedestal.

THERE are few men who have been radio operators who have had a jollier time at it than George F. Worts whose thrilling, straightforward tale of one eventful night on the miscalled Pacific appears in this number. Mr. Worts has been in most of the ports on both sides of the Pacific in most of the many types of ships one finds there. Now he is living in the center of that interesting colony of artists and writers at Westport, Connecticut, where he writes the magazine stories which many of us enjoy.

H F. MULLETT is on the staff of the *Edmonton Journal* and confides that he is English by birth, but really can't help that. "I came to Canada on the night boat twelve years ago," he writes, "successfully evading the line-up of creditors at the docks. For five years I worked for the Alberta government, but reformed and went into journalism."



H. F. MULLETT



R. E. SHLUKBIER

R E. SHLUKBIER is a native of Michigan —Saginaw, to be exact. During the war, he went through the Harvard Radio School, later became a Naval operator with the fleet, and since his demobilization has been a commercial operator in the merchant marine. "A Word from the Enemy" is the result of opinions thought out during quiet tricks at the key.

BOWDEN WASHINGTON sends his article "How to Build a Teledyne Radio Receiver," from Minneapolis where he is now located as chief engineer of The Cutting & Washington Radio Corporation. In 1916 he joined with Dr. Fulton Cutting, forming the firm with which he is now connected. "In 1917," Mr. Washington writes, "I developed the first new marine transmitter since 1907, of which more than $750,000 worth were made and sold."

Watch the radio columns of your newspaper for the big convention broadcast schedules.



Cheer *with the* Galleries *When the Delegates March In!*

No "influence" needed this year for a gallery seat at the big political conventions! Get it all, with a Radiola Super-Heterodyne.

When the delegates march in—their banners streaming; when the bands play and the galleries cheer—be there with the "Super-Het." Hear the pros and cons as they fight their way to a "platform" for you. Hear the speeches for the "favorite sons." The sudden stillness when the voice of a great speaker rings out. The stamp and whistle and shrill of competitive cheering. Hear the actual nomination of a president.

It used to be all for the delegates' wives and the "big" folks of politics. Now it's for everybody. Listen in. Get it all! With the *newest* Radiola.

Radiola Super-Heterodyne

It needs NO ANTENNA—no ground—no connections of any kind. Has a handle to lift it by. Tunes in with just two knobs that you turn to marked spots on the dials. Tunes out powerful near stations to get the far ones. A wonderful new achievement in the perfection of its tone—its sensitivity—and its supreme selectivity!

Complete with six Radiotrons UV-199 and Radiola Loudspeaker; everything except batteries . . $286

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External, rotating loop, easily assembled, larger than self contained loop in Radiola Super-Heterodyne, for extreme reception range. Loop AG 814 . . . . . $12.00

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There are many Radiolas at many prices. Send for the free booklet that describes them all.

RADIO CORPORATION OF AMERICA
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Gentlemen: Please send me your free Radio Booklet.

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433 California Street, San Francisco, Cal.

Radiola

REG. U.S PAT OFF

★ Tested and approved by RADIO BROADCAST ★



WALTER VAN BRAAM ROBERTS

One of the most highly regarded of the present radio technicians. He is designer of the Roberts Knock-Out Two-Tube set (RADIO BROADCAST for April and May), and author of "A Practical Super-Heterodyne using 199's" (August, 1923), and the technical serial "What Makes the Wheels Go 'Round." He is a graduate of Princeton University and is now doing research work there at the Palmer Physical Laboratories

RADIO BROADCAST

Vol. 5, No. 3 July, 1924

England's Venture into Broadcasting

The British Listener-In and Amateur—What the "Broadcatcher" Gives and What He Receives—Nine Hearts That Often Beat as One—Problems of Radiation and Other Interference—The Cost and Quality of British Apparatus—Some General Observations

By WILLIAM H. CARY, Jr.

LONDON.

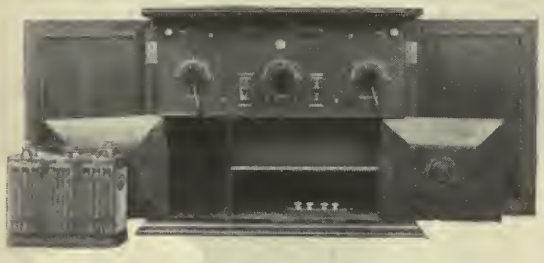
ON THE whole, the radio bearings are well oiled, here in England. This, at least, is the impression one is likely to receive after talking with B. C. L.'s, amateurs, radio editors, engineers, and others, and after listening, from various points in and near London, to the signals that pass in the night. And why not? Considering the caution with which Great Britain entered the broadcasting game—her profiting by the example of the "Yanks", her establishment of a British Broadcasting Company to control the nine stations (only nine, not five hundred and seventy-five), and her foresight in technical and administrative matters—good results are naturally to be expected. The advantage of having all transmission under a single control was brought home to me the first night I listened-in. 2LO was on, and it was a few minutes before an opera was due to fill the air.

"You will find on page——of your *Radio Times* for January——," came the announcer's voice, "a summary of the opera and some comments on the music and its composer." This happened to be an "S. B. (Simultaneous Broadcast) to all stations," so that from Aberdeen to Bournemouth, from Cardiff to London, subscribers to this official weekly of the B.B.C., and those who had planked down their tuppence for a copy at a newsstand could post themselves on the forthcoming music.

According to Post Office figures, about 600,000 broadcast listeners have so far taken out licenses. In November alone, between 40,000 and 50,000 new licenses were issued. There undoubtedly exist some low wretches who make their own sets and listen-in for nothing, leaving the financing of the programs to honest folk. But the general opinion seems to be that evaders are few, and that the 10 or 15 shilling charge* (depending upon the kind of license wanted) does little to prevent people from buying or making receivers. One experimenter—one, by the way, who had heard America during the Transatlantic Broadcasting Tests in November—thought that people who paid out their shillings for a receiving license might very likely invest rather heavily in a set or in parts, so as to be sure and get their money's worth during the twelvemonth. This recalls the old absurdity of the Irishman who stuffed a five-dollar bill down a crack in a boardwalk, in order to make it worth while to rip up the walk and recover a nickel that he had lost there.

*Equivalent to about $2.20 and $3.30.

At any rate, in England there is a lively interest in broadcasting. Across the street from a fifteenth-century church in a quiet little village in Hertfordshire (and sandwiched in between a shop displaying tripe and flounder and one exhibiting Scotch whiskey, brandies, etc.), I came upon a store devoted exclusively to the sale of the latest receiving apparatus. In backyards visible from trains passing



A COMPACT SET

The cabinet contains everything necessary except a loud-speaker The closed cabinet is shown on the next page

through the outskirts of London, the number of antennas is reminiscent of the view from a N. Y., N. H. & H. train up beyond 125th Street, New York. Or even worse. I counted ten parallel antennas in ten adjoining back-yards. In town, on every hand there are radio stores, and electrical shops selling radio as a sideline. Enthusiasts who are not inside ardently "talking shop" gaze silently with covetous eyes at the window displays as we do at home. Magazine stands are full of radio periodicals and the periodicals are full of both good and not-so-good stuff, with a fairly healthy proportion of "ads."

Some of the non-technical schools are teaching radio theory and construction to the younger boys; notably the London County Council Schools. I am told that red-cheeked twelve-year-olders are making one shilling do the work of two by strategic shopping around for grid leaks, coils, and whatnot.

WHAT THE PROGRAMS ARE LIKE

THE quality of the B.B.C.'s transmissions seems to be excellent. If there is any kick coming—and of course there is: 600,000 listeners cannot be expected always to chant the same refrain—it is due to the fact that some thousands of the audience may want jazz while other thousands may prefer news or opera. And, unlike the listener-in in America, who can often choose any one of twenty programs, the Englishman must, during the frequent periods of "S.B. to all stations," take what's offered—unless he can tune-in something made in France. As a matter of fact, the S.B.'s are generally well worth listening to—the dance orchestra from the Savoy Hotel, for instance.

One of the most popular programs staged by the British Broadcasting Company is music from "The Old Vic," a sort of secondary national opera house. It is situated about a mile from Marconi House—where are the transmitting plant and antenna—on the south side of the Thames. A land line was used at first to bridge the gap, but it was both inconvenient and noisy. Finally, Captain A. G. D. West, Assistant Chief Engineer of the B. B. C., installed apparatus in The Old Vic for transmitting on low power and low wavelength; these transmissions were picked up by 2LO and put on the air on 365 meters.

Since the November transatlantic tests, by the way, new wavelengths have been assigned to most of the original eight* British stations. As follows:

Station	Location	Wavelength During Tests	Wavelength at Present
2LO	London	363	365
2BD	Aberdeen	495	495
5IT	Birmingham	423	475
6BM	Bournemouth	385	385
5WA	Cardiff	353	350
5SC	Glasgow	415	420
2ZY	Manchester	370	400
5NO	Newcastle	400	435

Here is a complete program from station 2LO, chosen at random:

Monday, Jan. 7, 1924

3.30-4.30.—Concert: The Wireless Trio and Frank Poulton (Bass-Baritone).
5.00.—WOMEN'S HOUR: Ariel's Society Gossip. A Newspaper Story from "Whirligigs," by O. Henry.
5.30.—CHILDREN'S STORIES: Songs by Uncle Rex. "Jack Hardy," Chap. 16, Part I., by Herbert Strang.
6.15.—Boys' Brigade News.
6.25-7.00.—Interval.
7.00.—TIME SIGNAL AND 1ST GENERAL NEWS BULLETIN. *S. B. to all stations.*
JOHN STRACHEY (the B.B.C. Literary Critic): "Weekly Book Talk." *S.B. to all stations.*
Talk by the Radio Association. *S.B. to all Stations.*
Local News and Weather Forecast.
7.35.—THE LONDON 8 CONCERT PARTY.
S.B. to all Stations
Introducing each other.
Quartette, "Come to the Fair" (*Easthope Martin*) . . . .
COLTON, TARRI, VIRGO, COPELAND

*To these should be added a ninth station, Sheffield, which now not only transmits "S. B.'s" from London, but offers programs originating in its own studio. Its wavelength at present is 300 meters. It has not yet been assigned a call

Instrumental Trio, "Extase" (*Louis Ganne*)
JOAN DUFF, DOROTHY ALWYNNE, WALTER NUNN
Song, Devon Dialect Song
STANLEY HAYSMAN
Bag-pipes Song and Story
TOM COPELAND
Violin Solo, "Gypsy Airs" (*Sarasate*)
DOROTHY ALWYNNE
Humorous Trio, "Willie Brewed a Peck o' Malt" (*Burns*)
. . . . VIRGO, HAYSMAN, COPELAND.
Humorous Imitations on "Coal Black Mammy" (*Suzette Tarri*) . . . . SUZETTE TARRI
Song. "On With the Motley" (*Leoncavallo*)
WILFRID VIRGO
'Cello Solo . . . . . WALTER NUNN
Anglo-Scottish Interlude TOM COPELAND AND SUZETTE TARRI
Song, "Love's a Merchant" . . . EVA COLTON
Piano Solo, Waltz Chromatic (*Godard*) JOAN DUFF
Final Medley, Old Songs (*arr. Suzette Tarri*) THE 8
9.15.—MR. H. GERMAN (President of the National Farmers' Union) on "The Farmers' Position To-day." *S.B. to all Stations.*
9.30.—TIME SIGNAL AND 2ND GENERAL NEWS BULLETIN. *S.B. to all Stations.*
Local News and Weather Forecast.
9.45.—"THE MEISTERSINGERS," Act III. (*Wagner*), relayed from The Opera House, Covent Garden. *S.B. to all Stations.*
11.15.—Close down.
Announcer: R. F. Palmer.

It is evident that the engineers and executives of the B. B. C. are doing their very best, and their best is pretty good. One listener recently wrote to the editor of the *Radio Times*.

DEAR SIR:
Will you please have one rotten program at least once a week, so that I may have an opportunity of having a night out occasionally without regrets?
Yours faithfully,
J. F., London, W.

The *Wireless Review*, a weekly, commenting on a discussion that had been stirred up in one of the daily papers on the subject of the programs, says, "It was noted that most of the contributors to the discussion were in favor of programs being at least as serious as at present. There were some who wanted all jazz, but they were comparatively few. . . . It is gratifying to know that as far as the correspondence went, it was a distinct endorsement of the present policy of the B. B. C."

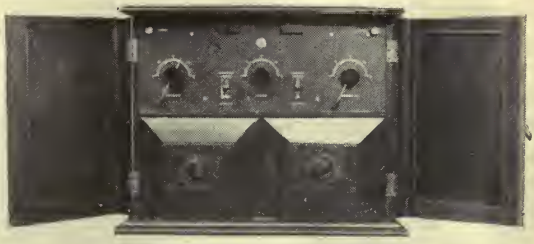
ADVERTISING NOT ALLOWED—ALOUD

AS WITH our stations in America, it is all well enough to broadcast "Yes, We Have No Bananas," but *not* to add that so-and-so's store, at such-and-such an address, expects a consignment of the yellow fruit next week and will sell it at so-much a bunch. In fact, an attempt is made to drown all direct advertising before its eyes are open. Manuscripts are always censored before they are allowed to be read into immortality. I am told that when a talk on modern novels, for instance, is given, the publisher's name is not mentioned; and that when phonograph records are used (as in tests or for certain children's programs), the name of the piece is given, but not the make of the record.

English people seem inclined to think that direct advertising by radio in America is more flagrant than is really the case. Some of them have also the impression that the air with us resembles a delirious person's dream about bee-hives. I have assured them that only on exceptionally clear evenings and on exceptional receivers do all 575 of our stations bombard that receiver at one time.

TROUBLE FROM RECEIVERS THAT RADIATE

THE situation regarding interference from oscillation is a peculiar one in Great Britain. When the British Broadcasting Company first started in, under the supervision of the Post Office, there was considerable fear that tube sets would cause trouble. Officials thought of the storm of whistles and squeaks in America, and turned up their mental coat-collars. Accordingly, the Post Office then undertook to test all sets which were to bear the official stamp of the B. B. C., to make sure



A POPULAR RECEIVER
With the British listener-in. He is just as avid as his American cousin, reports Mr. Cary

that they would not radiate sufficiently to cause interference; and it was made illegal to sell for broadcast reception any complete set not bearing the official stamp. Later on, however, many people who had little technical knowledge wanted to build their own apparatus.

A special license was provided, allowing them to do so, and knowledge of the proper operation of receivers was spread as widely as possible.

But one good squeak deserved another, so it seemed, and recently there has been a marked increase in the amount of interference from bloopers. B. B. C. officials were—and still are—alarmed; listeners-in were likewise personally affected. The blame was placed principally upon those holding Experimental Licenses and those holding the more recently established Constructor's Licenses. But the Post Office no longer tests receivers for oscillation, but only for wavelength range. Mr. Hugh S. Pocock, Editor of the *Wireless World*, says in a recent number of his magazine:

> Exactly what circumstances have brought about such a complete reversion of policy on the part of the Post Office is difficult to follow. Probably it is out of consideration for the manufacturers who were naturally very seriously handicapped in the design of receivers when they had to make them pass the test of non-radiation. In fact, it is exceedingly difficult to design a truly efficient receiver which will pass such a test.
>
> Is it surprising that interference from oscillation should be so much on the increase, remembering that these sets go usually to complete novices who hold broadcasting licenses? If it has been found that official broadcast receivers cannot be satisfactorily designed for non-radiation, then surely publicity should be given to the fact, in order that those using them shall be aware of the interference they may cause and learn how to operate their sets in order to avoid interference.

The law is laid down for holders of the Experimenter's License in these words:

"The apparatus shall not be used in such a manner as to cause interference with the working of other stations. In particular, reaction (regeneration) must not be used to such an extent as to energize any neighboring aerial."

Thus the man who "lives like a star and dwells apart" may obtain the advantages which a regenerative receiver will give, yet without disturbing any one; but the town-dweller must "watch his step"—(or as many "steps" as he is using).

The fact is, the single-circuit regenerative hook-up, not unknown on the west side of the Atlantic, is extensively used on this Island, although vocal and printed expression regarding it parallels what we have become used to at home. To avoid interference from oscillation, various other circuits have been brought forward. Reflex sets have been much in vogue, and neutrodyne receivers are beginning to find considerable favor in the eyes of many enthusiasts. Super-heterodynes have been used by advanced amateurs for some time, but not generally; they are expensive, and, for the reception of any British broadcasting, unnecessary.

Interference from other sources does not seem to be particularly serious. Set-owners who live along the coast have occasion to think horrid things of the naval and commercial stations now and then; and sometimes amateurs invade forbidden wavelengths. The latter, working on 440 meters (the length allowable for C. W. and telephony only) have been requested to "pipe down" during what are known as the Main Broadcasting Hours—5 to 11 P. M. daily and at certain other hours on Sundays.

LICENSES AND WHAT THEY INVOLVE

AT PRESENT there are three classes of receiving licenses. The Broadcast License, which costs 10 shillings a year, allows the holder to listen-in to whatever he may be able to hear. He agrees that his "receiving set, and any valve, amplifier, head-telephone, or loud speaker used therewith, will bear the official trade-mark of the British Broadcasting Company."

The holder of a Constructor's License pays 15 shillings a year, and certifies as follows: "My receiving set will be made or put together by myself; and in its construction I will not knowingly use parts manufactured elsewhere than in Great Britain or Northern Ireland."

The third class is known as the Experimenter's License. It costs 10 shillings a year and permits the holder to use any kind of apparatus in his set, but "Applicants must satisfy the Postmaster General that they have in view some object of scientific value or general public utility and that they are competent to carry out experiments in wireless reception." On the application blank appears also this:

> Strike out (A) or (B):
>
> (A) I declare that the proposed installation will not be used for the reception of broadcast programs except for experimental purposes.
>
> (B) I desire also to use the proposed installation for the reception of broadcast programs for the purpose of entertainment and I agree on that account to pay a license fee of 15s. (instead of 10s.) per annum.

The holder of the first two classes of license

needs only to fill out a blank at his local Post Office, and pay over the stipulated ten or fifteen bob. The would-be experimenter, however, "shall produce evidence of British nationality and two written references as to character. A certificate of birth should be furnished if possible; but this will not be insisted on if the referees testify of their own knowledge that the applicant is of British nationality." His license is obtained through the General Post Office in London.

The regulations governing the British amateur transmitting license may be interesting to American "hams." The requirements regarding evidence of British nationality, references as to character, and birth certificate are the same as for the Experimenter's License just mentioned. Among other things, applicants must also "satisfy the Postmaster General that they have in view some definite object of scientific value or general public utility. If scientific research is intended, they should be certified as competent investigators by a Government Department or some recognized scientific body." By examination or otherwise the applicant must satisfy the Postmaster General that he has attained:

(a) A sufficient knowledge of the adjustment and operation of the apparatus which he wishes to work.

(b) An operating speed of at least 12 words (Morse)* a minute, sending and receiving. This qualification is necessary even when wireless telephony only is used, in order that the person in charge of the station may be in a position to act upon instructions in the Morse code issued by Government and commercial stations.

A fee of 5s. will be charged for the examination referred to above, when necessary.

The person in charge of a sending station must also make himself acquainted with the regulations of the International Convention in so far as they relate to the prevention of interference and impose certain duties on all wireless operators.

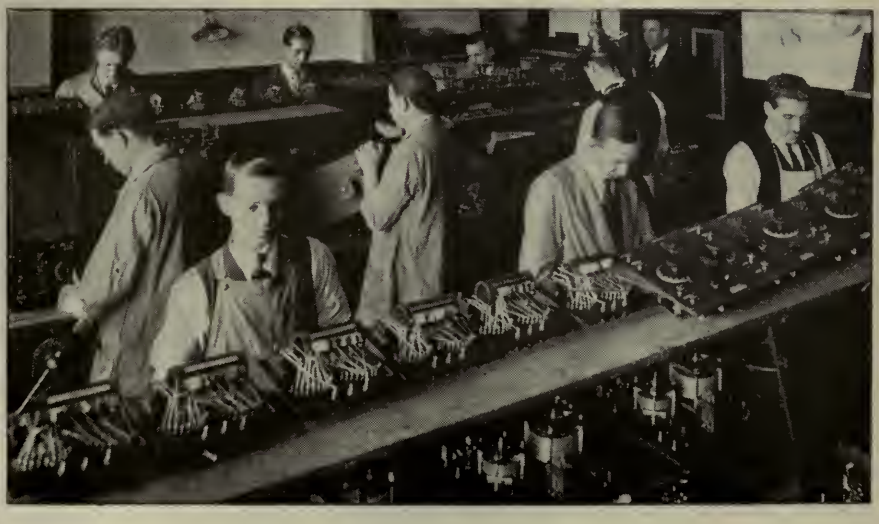
Also:

"For each station authorized to use power up to 10 watts, the charges, which will cover the use of receiving as well as sending apparatus will comprise an initial licensing fee of 10s. plus an annual fee of £1, payable in advance. . . . Higher fees will be charged for more powerful stations.

The combined height and length of the antenna must not exceed 100 feet. For spark, I. C. W., C. W., and telephony, the wavelength band from 150–200 meters is reserved for the British amateur. He may operate within this range during broadcasting hours (although not on the 440-meter wave, as mentioned above). In any case, the amateur may not transmit for periods amounting to more than two hours a day.

THE COST AND QUALITY OF RECEIVING APPARATUS

SEVERAL companies are clothing their broadcast receivers in extremely handsome cabinets, advertised for sale at approximately the same prices as equivalent American "furniture." Most of the less pretentious store sets, and also the separate parts, appear to be carefully and substantially made. Stores are full of apparatus for apparently every conceivable purpose, and, as at home, there are plenty of different kinds of instruments designed for the *same* purpose. The receiving apparatus of British amateurs, before the advent of broadcasting, was generally mounted



A CORNER IN AN ENGLISH RADIO FACTORY

*This of course, is not what we call "Morse"—our land-line code—but the "Continental" or "General Service" or "International Morse" code.



A SIX TUBE RECEIVER

Three radio, carborundum detector, and three stages of audio made by Metropolitan-Vickers Company, of Manchester. It retails in England for £91

on horizontal panels; this style still prevails in many cases, but slanting panels and vertical ones, similar to most of ours at home, have become much more popular during the last year. One or two manufacturers put out complete units in small square boxes, all the same size and each containing a condenser, or vario-coupler, or tube unit, or some other part. This arrangement is intended to appeal both to the person who wants to build up his set gradually, as his means allow, and to the novice-experimenter, and the restless and ubiquitous "circuit-hound" whose chief pleasure is the pursuit of new and more efficient hook-ups. The square blocks thus serve their purpose. One objection may be that a mess of external wiring results from connecting up six or eight of these units.

The cost of parts averages about the same as in the States, in spite of a considerable variation in many items. Of course, the British listener is admittedly paying for his broadcasting; and those who buy store sets pay also a certain tax for the B. B. C. stamp required on all manufactured receivers. This tax varies from about 1 to 4 per cent. of the selling price of the apparatus. In some cases, due to the incorporation of certain patented apparatus in the sets, there is in addition a Marconi tax to pay. Often, therefore, a B. C. L. pays his broadcasting license fee, the price of the set, the B. B. C. tax, *and* the Marconi tax, before turning his attention to such trifles as tubes, phones, and batteries.

Many manufacturers include the B. B. C. tax in their advertised selling price, and some prices are inclusive of everything but tubes—or everything but tubes and batteries, for instance. It will be seen that, as with us, it is with few exceptions impossible to buy a receiving set which may really be called complete—from A battery to antenna wire. British enthusiasts have been known to exercise their voices in well-modulated complaint of this latter condition.

Various makes of dry-cell tubes are now becoming popular. One type draws .06 of an ampere at 2.5 volts. These low filament consumption tubes are known as "dull emitters."

THE RADIO ENTHUSIAST—HABITAT: EVERYWHERE

I AM sure that there is no fundamental difference between members of the radio fraternity in America and in this, or any other



AN EIGHT TUBE OUTFIT

An excellent example of excellent English taste and workmanship in cabinet building. This set has five stages of tuned radio-frequency amplification, and two of audio



A GOOD ENGLISH AMATEUR RADIO INSTALLATION
Is this station 5CC at Bath

country. One meets here the same enthusiasm the same exaggerations, the same patter of station calls, apparatus, and circuits; the same praise, the same "kicks," the same "wise cracks." It is only the words which expresses all this that differ. And the vocabulary of the British listener (not to mention the old-time amateur) must at first seem very foreign to any one trained in the American idiom. "Dull emitter valves," "frames," "accumulators," "note magnifiers," and other "components" are discussed on all sides.

WHITHER?

WHERE is it all going to lead?" is, of course, the question frequently asked. What will broadcasting be like in England five years from now—or even two years?" Nobody can do more than guess at the answer; but the outlook is promising—and mighty interesting.

People here are interested in what the "Yanks" are planting and reaping in the radio field, but they are far from dropping their tools to gawk at us; they have far too much to do tilling their own wavelengths. A number of British amateurs, engineers, and the "general public" are expressing their hope, even their conviction, that reliable rebroadcasting of international programs is the next big thing we have to look forward to.

And we can only express the same hope, and say to them (with double meaning): "More power to you!"

More power to all of us!

The Story of the Super-Heterodyne

Its Origin, Development and Some Recent Improvements—A Radio Club of America Paper

By EDWIN H. ARMSTRONG

Marcellus Hartley Research Laboratory, Columbia University, New York

THE purpose of this paper is to describe the development of the super-heterodyne receiver from a war-time invention, primarily intended for the exceedingly important radio telegraphic direction finding service in the Signal Corps of the American Expeditionary Force, into a type of household broadcasting receiver, which, with our present vision, appears likely to become standard.

The invention of the super-heterodyne dates back to the early part of 1918. The full technical details of this system were made public in the fall of 1919. Since that time it has been widely used in experimental work and is responsible for many of the recent accomplishments in long-distance reception from broadcasting stations. While the superiority of its performance over all other forms of receivers was unquestioned, very many difficulties rendered it unsuitable for use by the general public and confined it to the hands of engineers and skilled amateurs. Years of concentrated effort from many different sources have produced improvements in vacuum tubes, in transformer construction, and in the circuits of the super-heterodyne itself, with the result that early in the month of April there has been made available for the general public, a super-heterodyne receiver which meets the requirements of household use.

It is a peculiar circumstance that this invention was a direct outgrowth of the failure of the vacuum tubes constructed in the United States to meet a very important problem confronting the American Expeditionary Force. This problem was the reception of extremely weak spark signals of frequencies varying from about 500,000 cycles to 3,000,000 cycles, with an absolute minimum of adjustments to enable rapid change of wavelength. The technical difficulties of this problem are now so well known that it is not necessary to consider them. H. J. Round in England, and Latour in France, by some of the most brilliant technical radio work carried out during the war, had produced substantially aperiodic radio-frequency amplifiers covering the band from 500,000 to 1,200,000 cycles and though covering a much more limited band, amplifiers operating on 2,000,000 cycles had been constructed. These results had been accomplished by the use of vacuum tubes and transformers of a minimum capacity. As this apparatus was used in the highly important intelligence services, all information was carefully guarded. When the United States entered the war, the fact that it was necessary to produce extremely sensitive receivers for short wavelengths and that tube capacity would prove the bar to a straightforward solution of the problem was not known in this country. As a result, no attention was paid to the capacity in the type of vacuum tube which was adopted and while the tube met the

Truth and Poetry—Plus Romance

No reader who makes a practice of neatly avoiding the "technical articles" should miss any of these fascinating lines of Edwin Armstrong's straightforward story of the development of the super-heterodyne, which is quite decidedly romantic in spite of the simple and direct way in which it is told.

This article tells how the second harmonic super-heterodyne was developed after the pressure of war-time necessity had caused the practical invention of the receiver. Mr. Armstrong has some pertinent remarks to make on radiation, reradiation, and the future of broadcast reception in general.

Here is an article that no one genuinely interested in radio should fail to read. It is an article we are proud to publish.—THE EDITOR.



EDWIN H. ARMSTRONG

And an early model of the six tube regenoflex second harmonic super-heterodyne—one of the greatest achievements ever made in broadcast receivers. This young inventor at one time studied under Professor J. H. Morecroft at Columbia University, New York City. Much of his present radio experimental work is being done at the Marcellus Hartley Laboratory at Columbia

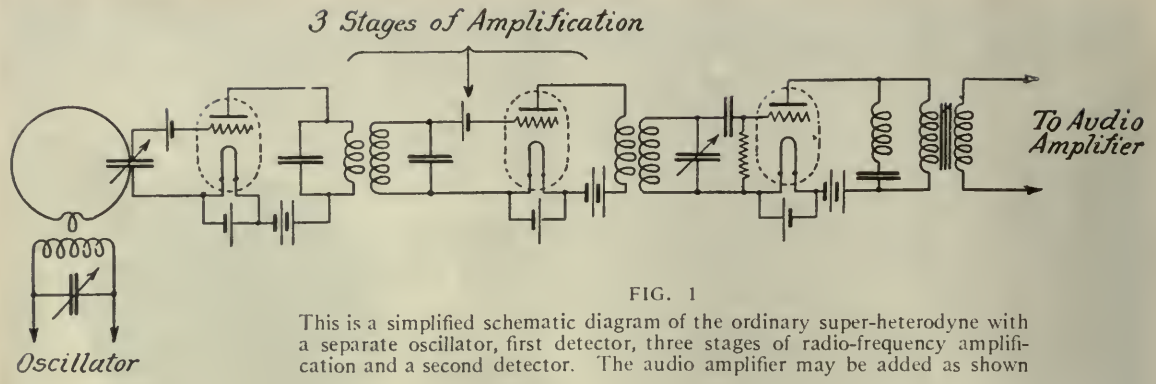


FIG. 1

This is a simplified schematic diagram of the ordinary super-heterodyne with a separate oscillator, first detector, three stages of radio-frequency amplification and a second detector. The audio amplifier may be added as shown

requirements of the lower frequencies admirably, it was impossible to use it effectively for the frequencies of importance in the direction finding service.

HOW THE SUPER-HETERODYNE ORIGINATED

DURING the early part of 1918, through the courtesy and energy of General Ferrié and his staff, the American Expeditionary Force was supplied with apparatus of French manufacture. It was quite apparent, however, that this source of supply could not be a permanent one and a solution of the problem became essential. During the early part of 1917, I had made a careful study of the heterodyne phenomena and their effect on the efficiency of rectification. With these experiments freshly in mind, the idea occurred to me to solve the problem by selecting some frequency which could be handled by the tubes available, building an effective amplifier for that frequency, and then transforming the incoming high frequency to this readily amplifiable value by some converting means which had no low limit; preferably the heterodyne and rectification. The principles and advantages of this method were explained in a paper presented before this Institute and are now so well known that no further explanation is required here.

After much experimental work, an eight-tube set was constructed consisting of a rectifier tube, a separate heterodyne oscillator, three intermediate-frequency amplifiers, a second rectifier or detector, and two audio-frequency stages. The intermediate-frequency stages were coupled by tuned air-core transformers set for a frequency of about 100,000 cycles, with an adjustment for controlling the regeneration. The amplification of voltage measured at the input of the second detector with the amplifier just below the oscillating point, was about equivalent to a radio-frequency amplification of 500.[1] The arrangement of its circuits in Fig. 1 gave satisfactory results except that the inclusion of a regenerative control on the intermediate-frequency amplifier made skilled handling necessary, as the adjustment of the frequency of the oscillator changed the plate current of the detector tube and this, in turn, varied the resistance which that tube introduced into the amplifier system and upset the regenerative adjustment.

The Armistice ended development at this point, but in the fall of 1919, for the purpose of determining the results which could be obtained by pushing the super-heterodyne method of reception to the limit, a resistance-coupled intermediate-frequency amplifier consisting of five high mu tubes was constructed. The voltage amplification of these five stages was probably between 5,000 and 10,000 fold. While greater amplification could have been obtained, the sensitiveness of a set composed of a two-tube frequency converter, a five-tube intermediate-frequency amplifier, a detector, and one-stage of audio, was such that on a three-foot (one-meter) loop, the sole criterion of reception was simply whether the signal was stronger than the atmospheric disturbances.

PAUL GODLEY USED A SUPER-HETERODYNE TO COPY AMERICAN AMATEURS IN SCOTLAND

THE sensitiveness of the super-heterodyne was demonstrated during the winter of 1919–1920 when the spark signals from amateur stations on the West coast and telephone signals from destroyers in Southern waters

[1] This amplification is based on the ratio of the voltage applied to the second detector to the voltage at the loop terminals. The intermediate frequency amplification is unknown.

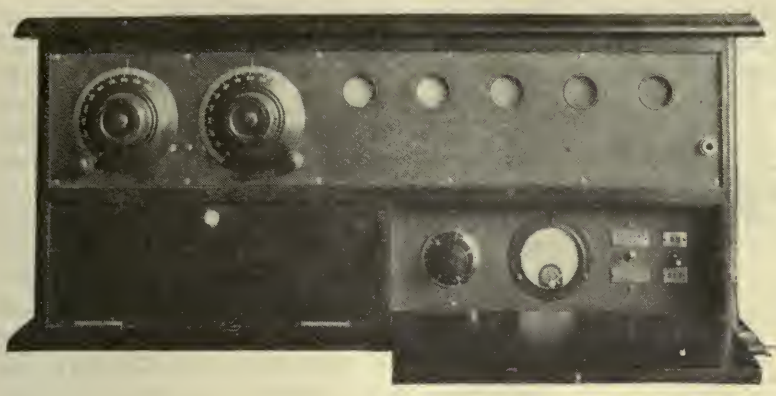


FIG. 2

This super-heterodyne is transformer-coupled and has been used by Major Armstrong in many demonstrations given under the auspices of the Radio Club of America

were received in the vicinity of New York on a three-foot (one-meter) loop. Probably the most striking demonstration of the capabilities of the method occurred in December, 1920, when Paul F. Godley, at Ardrossan, Scotland, received the signals of a large number of amateur stations located in the United States, many of them being spark stations. The super-heterodyne used by Godley consisted of a regenerative tube for the first rectifier, a separate oscillator, four stages of resistance-coupled intermediate-frequency amplification, a second rectifier, and two stages of audio. While it is difficult to state definitely the actual voltage amplification obtained, it appears to have been between 3,000 and 5,000 fold.[1]

With the coming of broadcasting and with the great increase in the number of stations and the consequent interference, the super-heterodyne began to take on a new importance—an importance which was based not on its superior sensitiveness nor on its selectivity, but on the great promise which the method offered in simplicity of operation. It was, and still is, the standard practice to furnish the public with receivers equipped with a variety of tuning adjustments for the purpose of amplifying the desired band of radio frequencies and excluding all others. As a matter of fact, many more adjustments are on receivers than should be used—more than could be placed in the hands of the average user. It would obviously be of the greatest importance if in some way these tuning adjustments could all be made in the laboratory by skilled engineers and sealed, leaving some relatively simple adjustment for the hands of the operator. The super-heterodyne offered the ideal solution. This solution lay in the construction of an intermediate-frequency amplifier which would amplify a given frequency and a band 5,000 cycles above and below it and which would cut off sharply on either side of this desired band. The adjustments necessary to accomplish this could all be made by skilled men, and the only operations left for the user would be the two adjustments necessary to change the incoming frequencies down to the band of the amplifier—adjustments which are not dependent on each other, which are of extreme simplicity, and which can be made equally well by the novice or the engineer. To determine just what could be accomplished along these lines, the writer, working in conjunction with Mr. Harry Houck constructed during the spring of 1922, a set designed for the maximum usable sensitiveness and selectivity.

THE FIRST MODEL

THE set-up consisted of one radio-frequency stage (non-tuned transformer) a rectifier tube, an oscillator tube (used as a separate heterodyne), a three-stage iron-core transform-

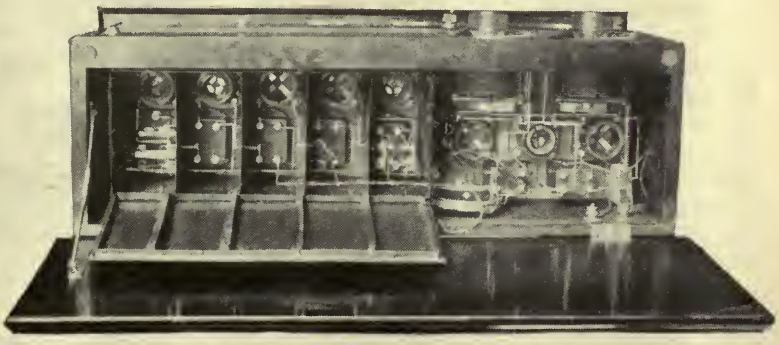


FIG. 3

This is the interior of the receiver pictured above

[1] Based on the standard previously described. This is without the second heterodyne which was used in receiving continuous waves.)

er-coupled intermediate-frequency amplifier designed to cover a band of 20,000 to 30,000 cycles, a second detector tube, and two stages of audio-frequency amplification. UV-201-A tubes

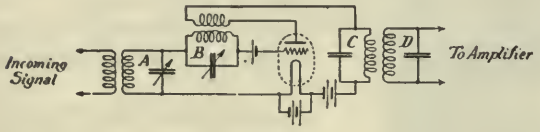


FIG. 5

The fundamental circuit of the second harmonic method of producing the oscillator frequency

were used. The set without the audio-frequency amplifiers is illustrated in Fig. 2 and Fig. 3. To prevent the intermediate-frequency amplifier from oscillating, each stage was shielded separately. The use of a radio-frequency stage ahead of the first detector possesses a number of advantages but the chief one is in eliminating the reaction between the loop circuit and the oscillator circuit. Experience with the original type had shown that when an oscillator of ordinary power was used, it was necessary to couple it rather

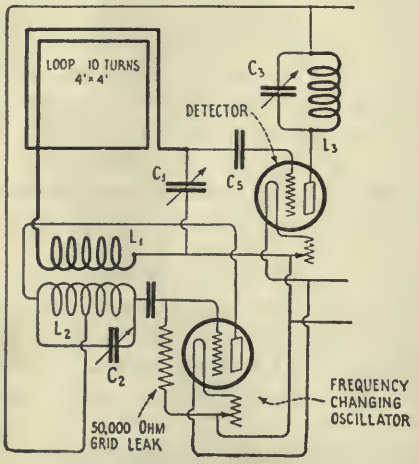


FIG. 4

The ordinary type of wave-changer for the super-heterodyne requires two tubes as shown here—the new method is shown in Fig. 5

closely with the loop circuit in order to insure a sufficiently strong heterodyning current. This close coupling affected the tuning of both circuits, an adjustment of one changing the setting of the other. To avoid this trouble and to produce a system wherein a station could always be tuned-in on exactly the same settings, a single stage of radio-frequency amplification (using a non-tuned transformer) was used, and the oscillator was coupled into this transformer. This arrangement eliminated the reaction, reduced the radiation to a minimum, and, in addition, removed the damping of the first rectifier from the loop circuit and improved its selectivity.

The results obtained with this set were about as expected. On a three-foot (one-meter) loop, the factor determining the reception of a station was solely whether the signal strength was above the level of the atmospherics. The selectivity was such that stations which had never been heard before on account of blanketing by local stations, were received without a trace of interference. While the performance of the set was much superior to any other receiver, it was apparent that the cost of construction and maintenance was prohibitive. The single item of a ten-ampere filament current will give some idea of the size of the storage battery and auxiliary apparatus required.

With the coming of the low filament consumption, or dry battery type of tube, the possibilities of producing a super-heterodyne for household use were tremendously improved. The set of Fig. 3 was remodelled for the WD-11 tube and its sensitiveness was brought to about the same value as obtained with the storage battery tubes. This was a long step forward but still its cost was prohibitive.

WHY THE SECOND HARMONIC PRINCIPLE WAS DEVELOPED

IT HAD been apparent ever since the question of the application of the super-heterodyne to broadcasting had been considered, that there were too many tubes performing a single function which were quite capable of perform-

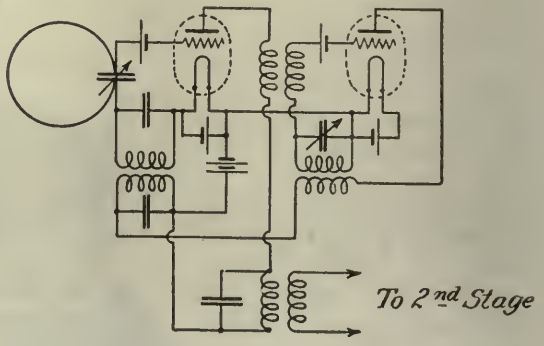


FIG. 6

This circuit makes it possible to reflex some of the intermediate amplifier tubes, using them for audio amplification as well. The result is more economical operation

ing a double one. The most outstanding case is that of the separate heterodyne oscillator. In view of our knowledge of the self-heterodyne, it appears quite obvious to perform the first rectification by means of a self-heterodyne oscillator and thereby save a tube. As a matter of fact, this was one of the very first things tried in France, but, except for very short wavelengths, it was never very successful when a high intermediate frequency was necessary. The reason was this. If a single tuned oscillating circuit was used, the detuning to produce the proper beat caused a loss of signal strength which offset the gain of a tube. If two tuned circuits were used on the oscillator, one tuned to the signaling frequency and the other arranged to oscillate at the heterodyning frequency, then on account of the relatively small percentage difference in frequency a change in the tuning of one circuit changed the tuning of the other. The solution of this problem was made by Houck, who proposed an arrangement so simple and so effective that it completely solved the problem. Houck proposed to connect two tuned circuits to the

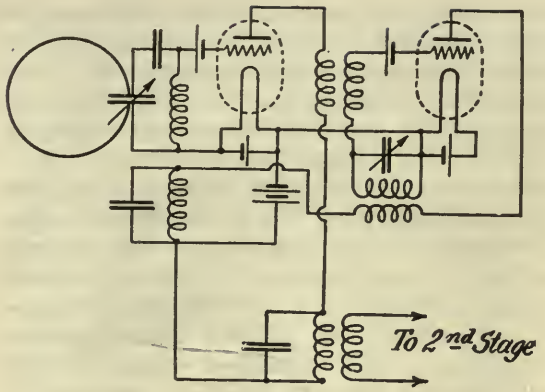
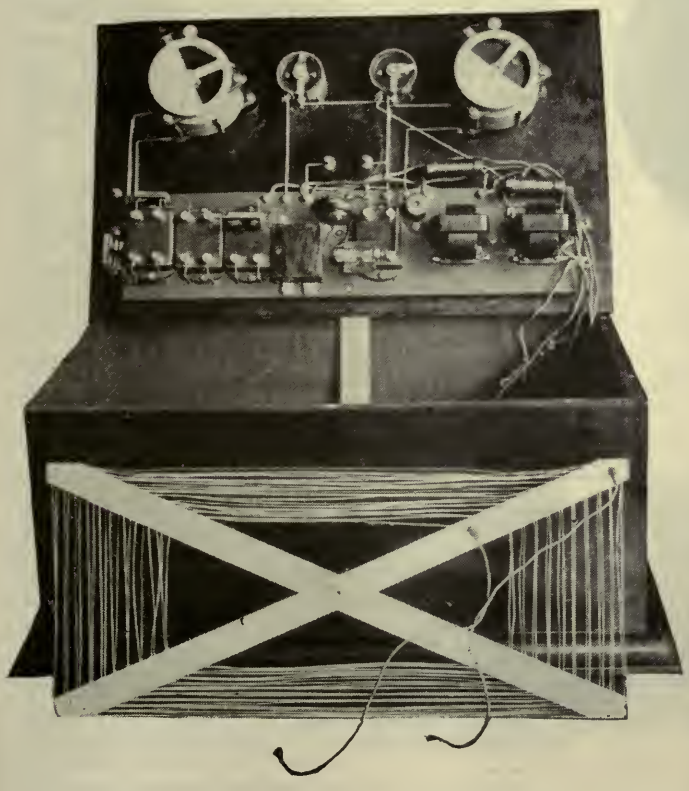


FIG. 7
A similar arrangement to that shown in Fig. 5 and explained in the text

oscillator, a simple circuit tuned to the frequency of the incoming signal and a regenerative circuit adjusted to oscillate at such a frequency that the second harmonic of this frequency beating with the incoming frequency produced the desired intermediate frequency. The general arrangement is illustrated by Fig. 5.

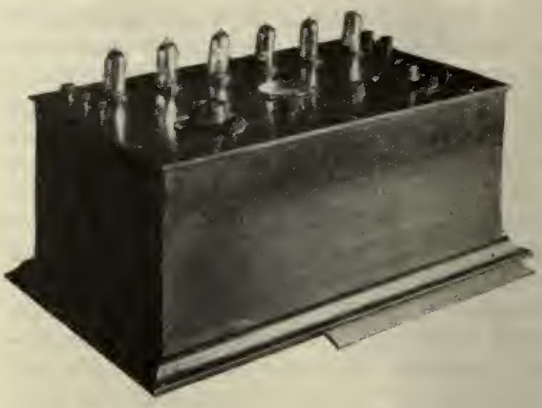
In this circuit A is tuned to the incoming signal, circuit B is tuned to one-half the incoming frequency plus or minus one-half the intermediate frequency, and the circuits C and D are both tuned to the intermediate frequency. The operation of the system is in line with ordinary self-heterodyne action. By reason of the asymetrical action of the tube, there are created in the circuits a variety of harmonics. The second harmonic combines to produce beats with the incoming signals of the desired intermediate frequency, the tube rectifies them to produce the desired intermediate frequency and, through C and D, the new frequency is supplied to the amplifier. On account of the fact that circuits A and B are tuned to frequencies differing by approximately 100 per cent., a change in the tuning of one has no appreciable effect on the tuning of the other. This arrangement solved the oscillator problem and, in addition, practically eliminated radiation.



This is the interior of the original receiver built on the second harmonic principle

The next step in the reduction of the number of tubes, was to make the radio-frequency amplifier perform the function of amplifying

intermediate-frequency as well. This can be done with none of the difficulties inherent in audio-frequency amplification, as the very small amplitudes of voltage handled by the first tube precludes the possibility of the grid becoming positive with respect to the filament. The general arrangement of circuits for carrying this out is illustrated by Fig. 6. In this arrangement the signals received by the loop are amplified at radio-frequency by the first tube and applied to the grid of a second harmonic oscillator by means of an untuned radio-frequency transformer. The combined signaling and heterodyning currents are then rectified by the second tube producing a current of the intermediate-frequency which is applied to the grid of the first tube, amplified therein and passed on to the second stage of the intermediate-frequency amplifier. A more practical method of carrying out this idea is illustrated in Fig. 7. In this arrangement, a secondary



One of the early models of the six-tube receiver. The receivers now sold employ a similar circuit

of the first intermediate-frequency transformer is connected to the grid of the first tube and in parallel with the loop circuit. Otherwise, the arrangements of Figs. 6 and 7 are identical. The parallel type of circuit arrangement eliminates a variety of reactions which would give rise to oscillations of various frequencies and in addition, prevents the reception of long-wave signals by the intermediate-frequency amplifier. When this development had been completed, improvements in the design of the intermediate-frequency transformers made it possible to obtain with two stages all the amplification which could be used.

On account of the high amplification, signals from local stations overload the second rectifier and introduce distortion. Control of the amount of intermediate-frequency amplification is essential. While there are numerous methods equally effective, the simplest one appears to be the control by means of the filament temperature of the second intermediate-frequency amplifier.[1]

The features just described were all incorporated in the receiver which is illustrated in Figs. 8 and 9. The set measured 16″ x 10″ x 10″ and was completely self-contained—the batteries, loop antenna, and speaker mechanism being enclosed in the box. The results were highly satisfactory and loud speaker signals (at night) in the vicinity of New York were obtained from stations in Chicago and Atlanta. It demonstrated that not only could a household receiver of the super-heterodyne



Fig. 8

In this five tube layout a loud speaker has been incorporated

[1]Although some form of potentiometer type of control of the voltage applied to the grid of one of the amplifier tubes would obviously be better, the simplicity of the filament control has many advantages in manufacture.

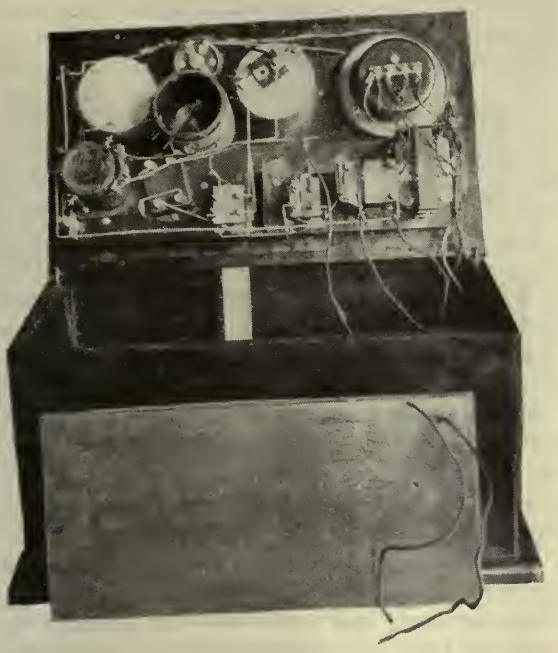


FIG. 9

Interior of the super-heterodyne portable with which an inexperienced woman heard 2LO during the tests run by RADIO BROADCAST and the *Wireless World* (London) last November

type be built, but that the first practical solution of the portable set was at hand.

FROM THE LABORATORY MODEL TO THE COMMERCIAL PRODUCT

IN THIS form, the capabilities of the set were brought to the attention of the Westinghouse Electric and Manufacturing Company and the Radio Corporation of America a little over a year ago. Its possibilities were instantly visualized by Mr. David Sarnoff, who immediately took steps to concentrate the resources of the research laboratories of the Radio Corporation of America, the Westinghouse Electric and Manufacturing Company and the General Electric Company on this new development. From that point on it passed into a new phase—that of placing an invention in a commercial form. In the limited time available, this was a most extraordinarily difficult proposition, and credit for its accomplishment is due to the untiring efforts on the part of the engineers of the above organizations. Many improvements and some radically new ideas of design have been introduced, but it is the privilege of those responsible for them to present these. In the final development of this receiver, an additional stage of audio-frequency amplification was added in order to insure operation within steel buildings, particularly those within the city limits where signals are relatively very weak compared to suburban locations. This makes a six-tube set but six tubes can be readily operated on dry batteries and the increase in sensitiveness is well worth the extra tube.

Some idea of the sensitiveness and the ease of operation of the set illustrated in Fig 9, may be gathered from an incident during the RADIO BROADCAST—*Wireless World* transatlantic broadcasting tests of November and December, 1923. On December 1st, two women, neither having any technical radio knowledge, received loud speaker signals from station 2LO, London, England. This was accomplished at Merrimac, Massachusetts, with the set and loop illustrated in Fig. 9 and perhaps constitutes a record for the first radiophone reception from Europe with a portable receiver. With the same set and a three-foot (one-meter) loop, loud speaker signals from broadcast stations on the Pacific Coast were received in the vicinity of New York on an average of three or four times a week. The sole criterion of reception was whether the signal strength was above the level of the atmospheric disturbances.

The type of super-heterodyne described herein is now available to the public in the two forms illustrated in Figs. 10 and 11. Each of



FIG. 10

The semi-portable six tube super-heterodyne now coming into great popularity. It is luxurious in appearance, simple to operate and produces excellent volume with marked clearness of tone



FIG. 11

The loud-speaker has been made a part of the receiver and a rotatable loop is provided in the case below. This receiver is one of the most luxurious ever placed on the market

these sets incorporate the arrangements herein described. Their sensitiveness is such that, with a two-foot loop and an unshielded location, the atmospheric disturbances are the criterion of reception. Here we reach a milestone in the development of broadcast receivers for no increase in the distance of reception can now be obtained by increase in the sensitiveness of the receiver. Unless the power of transmitting stations is increased we are about at the limit of the distance which can be covered. Future improvement of this receiver will lie along the line of increasing its selectivity and simplifying its construction. Aside from the development of the super-heterodyne but few recent radio receivers have improved in other than their mechanical arrangement and cabinet work.

APPENDIX

Some notes on the interaction between receiving sets.—Radiation—Coupling between antennas—Have broadcast stations enough power to go around?

PROBABLY the greatest outstanding problem in radio is the interaction between receiving sets. This interaction is due to several causes. The three main types may be classed under the heading "Radiation, Reradiation, and Coupling between Antennas."

At the present moment, much attention is focused upon the problem of radiating receivers. Much is being written about it under the misnomer "Reradiating receivers." Little has been written on the subject of reradiating receivers and still less about the problem resulting from the coupling between antennas. Doubtless this is due to the fact that the last two problems are at present masked by the first one. In my opinion, they are equally important, will cause increasing trouble and if radio proceeds along its present lines of development, will as seriously affect long distance reception as radiating receivers are affecting it at the present time.

To explain the above three types of interference, I will define each of them:—

RADIATION

THIS interference is produced by sets which, of their own volition, generate electrical oscillations of a frequency which is determined by the constants of their own circuits. The effect on neighboring receivers is the production of a beat note or whistle on wavelengths close to the frequency radiated by the oscillating receiver. This type of interference is commonly and improperly called "Reradiation." A radiating set may also produce interference by reradiation but this is a secondary matter and the primary cause of interference is radiation. The radiation is in the form of a continuous unmodulated wave.

RERADIATION

THIS type of interference results from an antenna picking up energy from an incoming wave and as the name implies, reradiating that energy into space. The reradiated

energy is not a continuous unmodulated wave as in the previous case but a wave which is modulated substantially in accordance with the modulations of the received signals and which exists only as long as the received wave exists. This type of interference is most pronounced in the case of regenerative receivers which are set just below the point of oscillation. It causes trouble in near-by receivers in two ways. One is that the energy reradiated is not in the form in which it was originally transmitted from the sending station but has some of the characteristics of the receiving set superimposed upon it. The other is that the reradiated energy, particularly in the case of a large antenna with regeneration, boosts the signals in adjacent antennae, producing a fictitious signal strength in the other receivers which disappears when the large antenna is tuned to another station.

At present, receivers which regenerate in the antenna are responsible for most of the trouble. Elimination of regeneration in the antenna would aid the situation greatly. It would not, however, be a permanent solution of the problem. The elimination of regeneration in the antenna would merely reduce the area over which the effect of reradiation would be felt. If the number of antennae increase at the present rate, it will not be long before practically every antenna in a city will be within the reradiating range of a dozen others, each of which will make its influence felt. If regeneration is eliminated from all the antennae, then the question of whether the signal will be strengthened or weakened in any individual antenna on account of the proximity of the others, will depend largely upon their relative size, resistance and position. In general, a small antenna in the proximity of a large one will have its signals strengthened when the large antenna is tuned to the same wave, although this rule is not invariable.

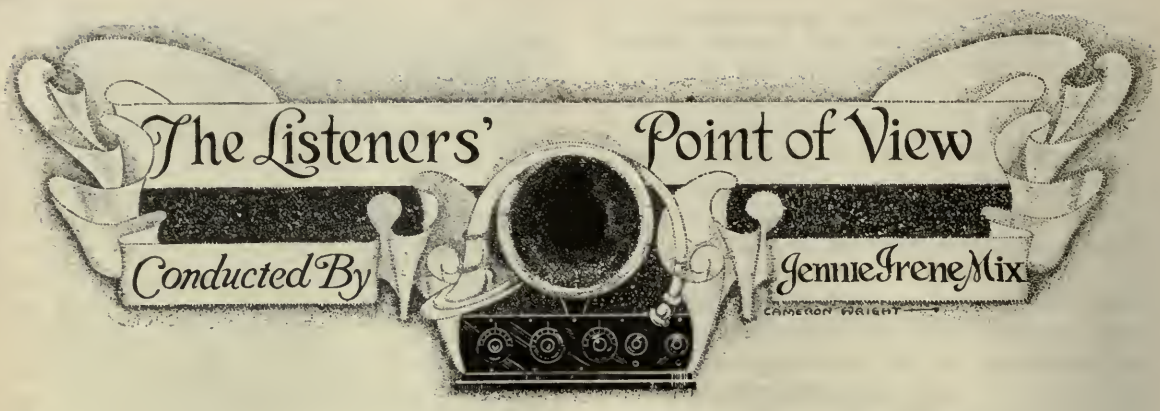
COUPLING BETWEEN ANTENNAE

THIS type of interference is perhaps the most annoying of all. It occurs where two or more antennae are located so close together that each affects the tuning of the other. Where several antennae are associated together and produce this effect (for example, when they are all on the same roof) the difficulties of the operator in keeping his set in tune with a particular station can well be imagined.

At the present time in congested localities, all three of these types of interference occur and the solution of the radiation problem, while it is technically and economically possible of solution, will but serve to concentrate attention upon two other problems which are not technically capable of solution. In addition to these specific problems, we have in cities the much broader one of whether there is going to be enough energy to go around. It is perfectly apparent at the present time that the tuning of a large number of receivers in a congested area to the same signal results in a weakened signal for practically everybody. If every housetop were fitted with several antennae, the question arises as to how much energy the man in the center of the city would find left if everyone ahead of him had absorbed as much from the wave as possible by using as high and efficient an antenna as he could erect. The sole solution to this and all the other troubles is the use of an antenna of the loop type whose effect on near by receiving stations is negligible.

Of course, this necessitates more sensitive receivers with an increase in amplifying power commensurate with the relative receptive powers of an antenna versus a loop. At first sight, it might appear that the cost of this change would be prohibitive but with our present rate of development, I believe that it is going to be possible to build loop sets as sensitive as our present type antenna sets with but relatively little increase in cost. At the same time, the situation can be improved from another angle. The power of transmitting sets will gradually increase both because of the fact that there is no way to eliminate the effects of atmospheric disturbances, elevator induction, X-ray machines and all the other types of interference which exist in a large city except to ride over them with high power and because of the fact that from the program standpoint, it is economically better to concentrate talent at one point.

All these factors point to the elimination of the present type of antenna which will disappear in the same manner as the overhead telegraph, telephone, electric light and trolley wires have disappeared in the last twenty years.



Radio Talent Is Not Localized

AMONG the many advantages made possible through radio, an outstanding feature is the opportunity it affords each section of the country to gain an understanding of the local musical talent in all the other sections. Even to those of us who, through much travel to various music centers while carrying on our professional activities, have felt that we were well in touch with the musical life of the country, the radio brings constant revelation, as surprising as it is agreeable.

Before the days of broadcasting we would one and all have said that the best local musical talent would be found in those localities where music, as a profession, had the greatest following. But that uncanny medium of communication, the microphone, is apt to prove this conclusion more often wrong than right. Some of the best singing and piano playing the present writer has heard over the radio goes to the credit of such stations as WOC at Davenport, and WHAA, Iowa City, Iowa; KFKX, at Hastings and WOAW at Omaha, Nebraska; WMAB, Oklahoma; WCAL, Northfield, Minnesota, to name but a few. This does not mean that you will always get satisfactory musical programs through these stations; but if you tune them in often enough you will at one time or another hear some of the most gratifying performances the radio has to offer.

Why is this? Perhaps some of our readers can enlighten us. It is a case where many opinions are worth more than one. As for a single opinion, the answer to the question seems two-fold, First, that in such towns as these, and many others as well, good health pervades the musical life. Good health in that the bitterness of unrelenting competition has not eaten to the heart of that life and made it a struggle for existence against almost superhuman odds. And another reason may be that many women who once expected to pursue music as a profession and studied under noted teachers to this end, gave up the fight, married, settled in these communities and are now using their music as a by-product instead of making it the main interest of their lives. Also among the men may be some who might have become professional singers, but who at the crucial moment decided to make their lives financially sure by becoming established in business and who now use their vocal accomplishments as church singers and through concert appearances in near-by localities.

The colleges scattered through these sections also contribute their share toward the musicians who are heard on these programs, and an occasional station may be found that is directly associated with a college. But even in such cases the programs are not confined to the students or the faculty.

Long before such a thing as broadcasting was dreamed of, many of these towns now sending out at times such excellent radio programs were known among musical managers as lucrative fields for concert artists. But patronizing a dozen concerts or so during a season has little effect on the musical culture of a community as compared with the residence in that community of well trained musicians.



BETTY COMPTON

—In "Vogues." What has become of the inventor who said he would make it possible to see a broadcast performance as well as hear it? Doesn't this picture prove that his invention was badly needed when WJZ broadcast the musical revue, "Vogues," from start to finish direct from the Schubert Theatre?

The fact that many such musicians live in the localities distant from the so-called music centers can be proved time and again by one who uses a receiving set.

And just as this was being written came a letter from a friend who was long a resident of New York City where she continually heard the best that that city had to offer in music, and who is now in a South Dakota town so small you cannot find it on the map. She writes:

"I have heard some really good music here. It is interesting to find real gifts and talent tucked away in such secluded places as this."

Doesn't this comment prove that if this little town had a broadcasting station some music worth the hearing could be programmed?

While the towns previously mentioned are by no means secluded places, but on the contrary are known far and wide, it has taken the radio to bring their musicians into public knowledge. If the announcers at these stations would be somewhat more particular in giving the names of the various persons heard quite a list of those who have been enjoyed could be set down here. One does not, for instance, want to write Pauley for Crosby, in case the name of the woman pianist who recently played so well in Hastings, Nebraska, should be Crosby although it sounded like Pauley. . . . So let the list remain unwritten.

After all, every disadvantage has its companion advantage. We have all considered it a disadvantage that money was not available for the payment of radio music so that the regular concert artists might be heard by every listener, and this must in time come to pass. But had such a custom prevailed from the beginning of broadcasting, we should never have known what fine local talent is to be found in many towns.



RUTH EDWARDS

—Pianist. Miss Edwards has been heard a number of times over the radio as pianist of the Cleveland Institute of Music Trio. These players, also the String Quartet from the same school, have provided one of the most artistic features associated with station WTAM

Talented Youth Is Broadcasting

THE monthly concert given by the Rensselaer Polytechnic Institute Students Symphony Orchestra at Troy, N. Y., Station WHAZ, always has something good to offer, and, apart from this, is interesting in that it is a means of making known what good work some of our young people are doing along musical lines.

One would expect these students to play popular music well, as it is an expression of youth's spirit. But for them to give a good performance of such a work as a Ballet Suite by Delibes is a test of genuine musical understanding; for it takes something more than mere love of music to bring out with any degree of satisfaction the fascinating grace and polish of this French composer. They generally include a movement from some classic symphony in their programs, on one occasion giving the first movement from Haydn's "Military Symphony." And they will even play for you a Strauss waltz in a way that would do credit to a more pretentious organization. The conductor, A. Olin Niles, must be a man of ideals as well as ability. May he long keep up his good work!

Another student organization, quite famous in its own locality, the Lincoln High School orchestra of Jersey City, was recently heard through Station WEAF under the baton of C. W. Barget. These players, forty-one boys—and four girls, range in age from ten to fifteen years. Probably the reason there are so few girls in the personnel is because ninety-nine girls out of a hundred who study music study the piano.

This High School orchestra is an organization of which Jersey City may well be proud, both because of the talent of the players and the

way that talent has been drilled by Mr.Barget. But it is open to the criticism that applies to all of our public school orchestras, a preponderance of strings and the lack of certain instruments imperative to the right performance of orchestral music. If fewer boys would study the violin and more would study wood wind instruments, or the French horn, the tuba, the double bass, our school orchestras would be improved, and the boys themselves would be benefited because they would stand a better chance of using their musical education for financial returns if they so desired. For you can find hundreds of good violin players these days to one man who can play, let us say, the bassoon, the oboe, the French or English horn.

And while on the subject of young people, those boys from the North East Y. M. C. A. Minstrel Troupe who took part in a program broadcast from station WTAM, Cleveland, gave their listeners a jolly good time with their lively choruses and solos. Whoever drilled them did his work well. A program of this kind is a relief from the monotony of jazz when something popular is the object of the program maker. Jazz is all right—some of it—but there are other forms of popular entertainment the public enjoys as much if not more.

As for jazz, it comes in fifty-nine varieties via radio. If you have in times past tuned-in WEAF Thursday or Saturday evenings at eleven o'clock and heard Vincent Lopez and his orchestra playing in the Hotel Pennsylvania Grill, unless you had the soul of a sluggard you did not tune out until the last note of the hour's program was sounded. And this is said by one to whom ordinary jazz is an abomination. Fundamentally, jazz is an interesting musical medium, but, like all musical mediums, it must be handled with intelligence and finesse. Vincent Lopez brings both of these factors to the direction of his orchestra. Their playing showed that their guiding spirit was an artist.

Yes, Mr. Lopez, we say this even though you do drop into the commonplace sometimes. Why jazz portions of the ballet and the grand march from "Aïda"? We heard those travesties hundreds of miles distant from New York the other night.

EDWARD GERMAN'S "Three Dances from the Music to Henry VIII," heard from nine different stations in one evening, shows that good music can be popular music.

The St. Louis Symphony Afield

WHEN listening to the program of a public concert that is broadcast, the reaction of the audience is about as interesting a feature of the entertainment as is the performance itself. When the St. Louis Symphony orchestra, conducted by Rudolph Ganz, gave a concert in Jefferson City, Missouri, during a recent tour, it was broadcast through WOS. The response of the audience to every number showed that orchestral music does not go unappreciated in that rather small city. There was something like pandemonium after the "Tannhäuser" overture, and another Wagner number, "Dich Theure Halle," given by the soloist, came in for the same sort of reception. When the announcer gave out the information that Mr. Ganz would play a request number at the close of the program there was some curiosity on the part of one listener as to just what sort of music would be requested. It proved to be "The Blue Danube." Not a bad choice, by any means.

The management of the St. Louis orchestra evidently has no fear of a broadcast perfor-



HENRY HADLEY

—Composer, Conductor. Some of the lighter orchestral works of this foremost among American composers are heard now and then over the radio from broadcast orchestras that make it a point to present programs of genuine musical value. While giving the major portion of his time to composing, Mr. Hadley is also well known as an orchestra director, having for some years been assistant conductor of the New York Philharmonc

mance injuring the patronage of the organization. On this tour the orchestra played in many Missouri towns that could listen in to that Jefferson City concert. They no doubt did listen, and then, early the next morning, bought seats for the coming concert in their town. That is what radio is going to do for the patronage of music, all over the country, just as soon as some of the musical managers get over their scare about it.

Handel and Mendelssohn Are Still Popular

AFTER the Madrigal Choir from the Oratorio Society of New York had sung choruses from "The Messiah" and "Elijah" through station WEAF, the announcer asked those who had been listening to send in word if the program was enjoyed so that it might be known whether or not such programs would be acceptable in the future.

He could have found the answer to his question in any musical dictionary. Handel, who wrote "The Messiah," died in 1759. Mendelssohn, who wrote "Elijah," died in 1847. Why have their works survived so long after their death? Because of the public's interest in them.



CAPTAIN HERMANN WEBEL, U. S. A.
Bandmaster. The 17th U. S. Infantry. His band has been heard from WOAW, and is very highly regarded



VICTOR KOLAR
—Assistant Conductor of The Detroit Symphony Orchestra. Mr. Kolar conducted the series of concerts for children given in Orchestra Hall, Detroit, during the past music season and broadcast from station WWJ. Thousands of children and grown-ups as well, far distant from Detroit, listened in to these concerts. Mr. Kolar in addition to being a conductor of conspicuous merit, is a composer whose works have attracted wide attention

And so, Mr. Announcer at WEAF, the surety goes without asking, that many listeners were grateful to your station for giving them an opportunity to hear excerpts from these works.

Flying Fists and the Microphone

HAVING commented a number of times in this department on the programs of old-time American songs which are so deservedly popular with radio audiences, WBZ was tuned-in a while ago for the express purpose of hearing such a program which had been previously advertised. Immediately the dials were adjusted came a deafening roar of shouts accompanied by the stamping of feet. Then a voice:

"If this broadcast is a flop you may know it's because I'm new to the job and there are seventeen people hanging on my back."

The astonished listener-in examined the dials carefully. Surely there was a mistake. This could not be the Springfield station, always so correct and courteous. Then came

another voice, the cultured sort that is ever in evidence from WBZ.

"This is station WBZ broadcasting from Boston the fight at the Boston arena for the heavyweight championship of New England."

The microphone was then turned over to the first voice, and from that moment until the end of the fight in the seventh round when Jack Shawkey knocked out Eddy Somebody (the listener was too excited to get his full name), radio music was forgotten by the one whose business it is to listen to it, for she has always had a secret longing to attend a prize fight. Round by round that fight was followed with many a chuckle over the drawling witticisms of the man at the microphone. If a galaxy of the greatest musical artists in the world had been broadcasting a program while that fight was in progress the dials would still have been kept at WBZ. Woman-like, the listener was rooting for Eddy Somebody from the moment it became evident that he was getting the worst of it. And there was exultation that it took seven rounds for the challenged champion to retain his title.

When it was all over and the two combatants, according to the man at the microphone, were "going home to mother," the WBZ cultured voice conveyed the information:

"We will now resume our musical program from the Hotel Brunswick Studio, Boston."

But, not being in a musical mood, with one's mind still bearing that graphic picture of the prize fight, it was not until some evenings later that a connection was made with the Hotel Brunswick Studio, Boston, where a program by the Tschaikowsky String Quartet of the Weltman Conservatory of Music, Malden, Mass., was the attraction. The advance notice of this program had spoken of the quartet as being comprised of four men "who have heard, studied and played the greatest music under the greatest conductors and with the greatest players, and who follow music as an art and not as a trade."

This seemed, like many press notices, too good to be true. But the work of the quartet that evening did much toward justifying the preliminary praise. Even in the most brilliant numbers there was the poise that comes only after one has so thoroughly mastered the classics that something of their equable spirit will tincture the performance of the most modern works, just as it is the technical foundation of these works. Mr. Leon Weltman, with Edward Garmant at the piano, played a group of violin solos in a manner in keeping with the general high standard of the program which was one that did credit to station WBZ. All who heard this program must have elt grateful for the opportunity to enjoy such music so well presented. The entire program came through the air to the present writer's studio in Toledo as clearly as if it were heard in Boston.

And—it is frankly acknowledged—we are glad that the prize fight came through just as clearly, but the thrill of hearing such an event involves considerable mental strain.



MARY ELLIS

—Soprano. After being a member of the Metropolitan Opera Company for a number of seasons, Miss Ellis has joined the ranks of operetta. Station WJZ has presented this young singer in a series of recitals of songs by Rudolph Friml with the composer as accompanist

Among Other Things

Some of the other events that deserve being remembered, and one or two that should be forgotten are——

MRS. H. H. A. BEACH, America's foremost woman composer, in a short piano recital, Station WRC, Washington, D. C. An attractive group of numbers very charmingly played.

MR. MORRIS A. SCOTT singing a group of songs, station WTAM, Cleveland, along about 1.40, A. M. He deserves special mention because he kept the tempo of every song up to the mark, and also because his phrasing was intelligent, his tone unforced, and his interpretations as a whole in good taste.

THE 17th U. S. Infantry Band, stationed at Fort Creek, Nebraska, and frequently heard through station WOAW at Omaha. One of the finest bands in the country, judging from these radio performances. The playing of the men shows the broad musical education of the bandmaster, Hermann Webel, graduate of the Paris Conservatory, and later a student in musical history, theory, and composition, under leading New York teachers including W. S. Pratt and Henry E. Krehbiel.

THE program of old hymns—the good ones—sung Sunday evenings at station WHAA. Enjoyed perhaps by more people than the directors of this station realize. A custom that should be indefinitely continued.

THE orchestra of the Hotel Statler, Cleveland, in a dinner hour program each evening, broadcast by station WTAM. One of the finest hotel orchestras so far heard over the radio. The director gives his audience credit for enough good taste to enjoy something other than jazz. His orchestra plays the lighter classics beautifully



VINCENT LOPEZ

And his well-known and well-liked orchestra playing at the Hotel Pennsylvania, New York, have been heard from WEAF



RADIO—FARTHEST SOUTH IN THE UNITED STATES

Lazy Gulf of Mexico clouds and the tall towers of the Navy's high power radio station, NAR, at Key West, Florida

THE MARCH OF RADIO

J. H. Morecroft

President, Institute of Radio Engineers

Names—And Still More Names

WAS there ever an art which called forth as many unpronounceable and unintelligible names as has radio? This failing for coining names, sometimes simple and sometimes complex, for tubes and circuits originated at a certain laboratory in Schenectady about twelve years ago according to our recollection. These Graeco-Schenectady names, as Doctor DeForest aptly characterized them at the time, were not as bad as they first sounded because they were at least coined by men who knew some philology. The names of sets and circuits which descend to-day on a startled world, surpass one's powers of pronunciation and analysis alike. One firm kindly condescends to translate its names into ordinary English for us, so we at least know what the names are intended to convey but many others remain outside our vocabulary and in despair we have decided not to attempt to keep up longer with the word coiners.

That prefix "super" has suffered rare punishment since radio came into its stride—overworked so much that nowadays unless a set is super something or other no one pays any attention to it. And the situation has its serious side, as well as comic; many times lately we have been asked by enthusiastic newcomers in the radio field about the relative merits of the super-diddle-daddle and the super-daddle-diddle and have had to confess that we didn't even know what they were. Wherewith our reputation has straightway fallen to less than nothing! "He knows the theory," say our in-



CAPTAIN O. P. JACKSON, U. S. N.

New director of Naval Communications. "I consider," says Captain Jackson, "that the greatest progress in the efficiency in our battle fleet will come about through the development of radio communication"

quirers, "but he doesn't know how it is applied." Won't the word coiners take a few days off?

Pot Shots at the Goose, Golden Egg, *et al.*

WHY can't some dealers see past the end of their noses? Several times in these columns we have noted the disagreeable effect produced by a raucous blast of what passes for music bellowed forth from a poor loud speaker, being pushed much past its working limit by excessive amplification. On our way to the ferry almost every evening we have to witness this misdirected effort of small dealers to get customers. A hole cut through the transom permits the loud speaker to pour forth its strident tones on the stream of commuters on their way home. The dealer evidently expects to attract customers by this display of the wonders of radio. Killing the goose that lays the golden egg is a sound economic policy compared to this disagreeable form of advertising because at least the goose might be despatched noiselessly without bothering the neighbors.

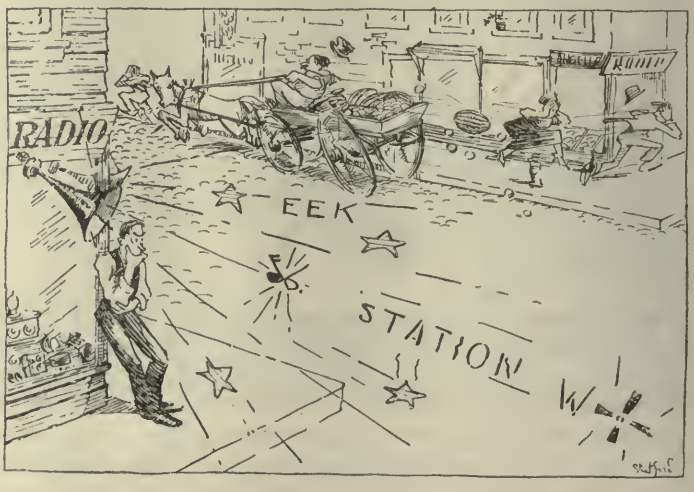
The average loud speaker is none too good even when treated gently, but when it is forced to compete with honking automobiles, and horse-drawn trucks on cobble-stone pavements, the effect is painful indeed. When will these dealers come to their senses and try to get good reproduction inside their stores, instead of making themselves a public nuisance and killing their trade at the same time?

Something the Senate Can't Investigate

RECENTLY the Senate considered a bill having to do with the conditions under which a broadcasting license could be held. This bill contains the declaration that "The ether and the use thereof within the territorial jurisdiction of the United States is hereby re-affirmed to be the inalienable possession of the people of the United States and their Government."

Some of the Senators actually became curious as to the meaning of the bill they were acting upon and called upon the framer of the bill, Senator Howell of Nebraska, for a definition and explanation of the "ether." To this very pertiment inquiry (for surely our Senators wouldn't legislate on matters they didn't understand) Senator Howell confessed—"We don't know much about the ether. We haven't been able to investigate it."

Senator Bruce expressed the opinion that it was not seemly to assert ownership of something which could not be defined or caught hold of, but the Senate disagreed with him and accepted the dictum of the bill that the people of the United States own the ether, inalienably.



THE DEALER: "WHY IS BUSINESS SO POOR?"

It is perhaps a good thing that Mr. Doheny can't extract oil from the ether or the people probably wouldn't own it very long, in spite of the Senate's declaration to the contrary.

An "R. E." is a Prophet Without Honor

LATELY we have received several letters from men in the radio business on stationery burdened with such a name and title as John Smith, R. E., the R. E. evidently standing for Radio Engineer. As such a designation undoubtedly gives prestige among people not acquainted with college degrees and their significance, it seems worth while to point out the status of such a degree.

To the best of our knowledge none of the good technical schools in this country confer such a degree, and it does not seem likely that it will be officially recognized by any such school. The really technical phases of radio are electrical. Perhaps we had better not say simple because the theory of radio is as advanced as any other branch of electrical science. What we mean is that any one who wants to become a radio engineer must be first an electrical engineer, and a good one.

The degree E. E.—standing for electrical engineer—is given by many engineering schools. None of them, however, have thought it wise to give such degrees as P. E. (Power Engineer) or T. E. (Telephone Engineer) both of which branches of the electrical art absorb many more men and have much greater invested capital than radio. Such degrees would be of no service at all to the men using them because those with whom they associate would know enough immediately to appraise the standing of the user. The man using the title R. E. however, generally moves among people who may be unduly impressed with its importance. The title R. E. has no standing, and it is not difficult to make the same assumption for those who affect it.

There Are No "Inaudible" Radio Waves

NEW ideas and developments in radio are coming to the front in such profusion that many times a writer finds himself without suitable language to express his thoughts. There are, of course, innumerable new words coined in the name of radio to designate new sets and circuits, or catch-words originated by enthusiastic advertisers to get the purchaser's attention, but to these we do not refer.

In a recent interview dealing with the remarkable scheme of radio repeating which the Westinghouse engineers are developing, one of them referred to their high frequency wave as "inaudible." "Pittsburgh," said he, "sends out the ordinary wave to which KDKA's listeners are accustomed and another inaudible wave which is used for repeating to Hastings and London." Several inquiries came to us regarding this inaudible wave—how did it differ from the ordinary one?

The use of "inaudible" in this sense is rather unfortunate because it expresses more and less than it should. It seems to say that the longer



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WALLACE IRWIN

—The creator of Hashimura Togo, who makes that delightfully ingenuous, yet observing character say (in *More Letters of a Japanese Schoolboy*):

"On Table befront of him sat one black suitcase all covered with nickel plated science. It cantained a window with electric bulbs doing so inside. It cantained silver pushers, pullers, arrows and Kodak supplies. It cantained so many Wires that I was sure it was connected with Edison somewhere. It had a Horn with its mouth wide open as if to speak. It had one of these switchboards which enable Hon. Telephone Operatress to get your number wrong 13 times out of 11. Taken altogether, this was a Radio."



MISS AGNES MILLER

Of New York, who wrote the play "A Million Casks of Pronto" which won the $500 prize offered by station WGY, Schenectady, in its recent contest

wave is audible whereas the short one is not. Now what was meant was simply this—using an ordinary receiving set the high-frequency wave to Pittsburgh is of so high a frequency that it is generally impossible to tune-in on it. This is because the distributed capacity of the coils, tubes, and connections, is sufficiently great that the 94-meter wave cannot be tuned-in and in this sense it is inaudible.

If about two-thirds of the turns are taken off the various coils used then this inaudible wave may become audible, provided it is rectified and amplified just as the regular wave is. No engineer or person in authority who uses a new word, or uses an old one in a new sense, can escape the responsibility of making his meaning perfectly clear.

Distance Records During the Past Winter

RECORD transmissions were recorded for several stations during the past winter season, some of which are probably freak transmissions but long-distance records will become more and more common with every improvement in receiving and transmitting sets. WOR reports reaching Japan, over 9,000 miles; WJAZ sent to Samoa, 7,000 miles; WLAG got through Soviet Russia to Batum, 6,680 miles, and WGY and WEAF both have been heard several times in South Africa, a distance of 7,880 miles. The real record is apparently held by WHAZ of Troy which on four successive mornings was heard in Invercargill, New Zealand, a distance of 9,577 miles from Troy.

There Are None Too Proud to Study

THERE are few who will deny that radio has done more to interest the general public in experiment and study than any other development in any age. The automobile caused many a man to wonder about the evaporation of gasoline when his carburetor did not work, and the elementary laws of the electric circuit came for their share of his interest when his ignition or lights failed. But the study excited by the automobile's misbehaviour is nothing compared to that in which the general BCL is indulging to-day.

In the subway we see staid business men devouring a serious article on radio and it is surely true that many a youth who previously spent his evenings in a corner pool room is now engaged in trying to beat his pal in establishing long-distance receiving records. A well known scientist expressed the idea not long ago that "radio is becoming vulgarized," but it seems that such a thought deserves but little sympathy. Possibly it would be more satisfying to one's vanity to feel that the branch of science in which he spent his investigations was far beyond the ken of the average human mind, but wouldn't it be more satisfying to know that his branch of knowledge was of such importance to the human race that everyone was striving to gain its portals—that any contribution he might make would be an immediate and universal good?

It probably had been a source of some embarrassment to the scientist we have in mind that some of his friends bitten by the radio bug had become so inoculated that their thirst for knowledge had prompted the questions which outreached his grasp of the subject. For it is perfectly easy to pose as an authority in a branch of knowledge which interests no one else, but it takes an able man indeed to hold a reputation for knowledge in such a subject as radio into which nearly every intelligent man seems to be delving so earnestly.

A well known radio worker, when asked why he put wax in his sets and why he refused to make public the constants of the circuits said something to the effect that it wouldn't do any good anyway. He had to build twenty

sets before he could make one work, so therefore it was a foregone conclusion that the general public would find it impossible to build one successfully even if the constants were published.

Well, from our acquaintance with the radio amateurs of to-day, we wouldn't put much money on his opinion. Many of the "radio proletariat" are evolving a rather fair grasp of the technique of radio and their knowledge is growing every day. The subject has ensnared men from all walks of life. In the colleges, students from every branch of engineering feel that they must know radio at least whatever else they learn. Graduates of all kinds are striving to master its secrets. The publishers of the more theoretical books on radio can vouch for this fact.

We happen to know the president of a large electrical company who is "taking time off" to study radio seriously. He spends long hours in study and performs all kinds of laboratory experiments to expand his grasp of the subject. A successful bank executive is working assiduously with a college instructor for tutor, to gain such technique and knowledge of the theoretical side of radio that he "can help his friends" to understand their sets. A professor of chemistry is spending his evening hours, not in evolving more elaborate chemical formulae to puzzle his students (as perhaps he should) but in studying the action of loud speakers.

Radio Antennae Are Safe

AN ABANDONED antenna wire had been carelessly strung over some 2,400-volt power wires in Montclair, N. J. and when some firemen were fighting a grass fire they came in contact with the dangling antenna which connected them to the high-voltage wire and gave two of them a fatal shock. This antenna was strung in a careless and dangerous manner but the accident, while lamentable, does not mean that danger lurks in antennae and that country-wide investigations should be started. No one but a fool would think of putting up a wire across high voltage lines even if for no other reason than the possibility of being shocked while putting it up. It is not at all impossible that the wire was one thrown over the power wires by some mischievous lad, and was not an antenna at all.

More Electrodes in New Radio Tubes

THE ubiquitous triode, with its filament to boil off electrons, its plate to pull them across the vacuum, and the grid to control their flow, performs such wonderful feats that it seems as though more than three electrodes in a tube would be superfluous. Such is not the case however; years ago a four-electrode tube from Schenectady, christened the plio-dynatron, was described and now we have the five-electrode tube making its appearance. This will undoubtedly perform modula-



STATION WJAX

Of the Union Trust Company, Cleveland, Ohio, which has just been moved to this location atop their new building at the corner of Euclid avenue and East Ninth street—Cleveland's Forty-Second and Broadway

tion, oscillation, rectification, amplification, and a few other functions. Powerful an instrument as the triode is, it will probably soon be supplanted by the quadrode or other tube even more liberally endowed with electrodes and what these multi-electrode tubes will do is quite beyond conception. It is probably a conservative statement to make that a present five-tube set may be equalled in the future by only one of the newer tubes.

Don't Do It by Radio Unless Other Methods Fail

IN OUR last number there was described a new radio beacon, consisting of two large transmitting coils placed at about 135 degrees to each other; it had been designed for the Air Service, to make the navigation of planes easier and more reliable.

This same type of beacon is to be installed at San Francisco, we learn, to guide the ferry boats across the bay in case of fog; it seems that even in the land of "sun-kissed" oranges the sun does sometimes hide its face so that shipping has to depend upon other than visual navigation.

If we accept the claims that have been made for the submerged channel cable, the kind that was installed in New York harbor, it seems that such might have solved the foggy harbor problem as well as or better than a radio beacon. Such a cable, carrying 500 cycle current, enabled a ship equipped with suitable listening coils to come into harbor through a narrow channel, without ever seeing a channel buoy. Because of the ever-increasing density of radio traffic the popular slogan should be. not "Do it by radio" but rather "Don't do it by radio unless other methods fail."

Voluntary Contributions for Radio Programs

STATION WHB, at the Sweeney Auto School in Kansas City, is apparently endeavoring to win our $500 prize for the solution of the "Who is going to pay" problem by direct experimental methods. Its listeners have been asked to send in voluntary contributions as their share in the upkeep cost of the "invisible theater." This station manager, in common with many others, has concluded that the advertising received by the school was not sufficient to warrant the expenditure for musicians, artists, royalties, and other necessary items of upkeep.

"We believe it is only fair," says their announcement, "for those sharing the pleasure to pay a portion of the expense." We agree with this idea heartily and are glad to note that at the latest report $3,100 had been contributed by the invisible audience. Of course that amount won't go far towards keeping a broadcast station running, but the audience is indeed showing an appreciative spirit.



RADIO PROGRAMS ARE DISPENSED WHOLESALE

Through this arrangement of apparatus by the telephone company at Fredonia, Kansas. Subscribers who purchase loud speakers for their homes through the telephone company are given the radio service free from this receiving station. This service is in its second year and more than 200 loud speakers are in use

The Radio Corporation View

IN A recent speech at Chicago, David Sarnoff, vice-president and general manager of the R. C. A., expressed his views on the probable and reasonable source of revenue for the support of radio broadcasting. After expressing the view that broadcasting would, in the future, be car-

ried out by a few superpower stations (R. C. A. stations we presume) he ventured the guess as to the proper source for the money to meet the ever increasing cost of maintaining a station.

"Broadcasting, in my judgment," said he, "will be primarily supported by the radio industry itself and from the returns on the sale of radio apparatus. A fair method of determining the amount to be paid by each member, or portion of the industry, will be worked out and this will be based on a percentage of the sale price of the radio devices."

Naturally, to the business man, this seems the logical solution. It is probably the simplest solution of the problem and possibly it will be the final one. A reasonable percentage on the sales profits in tubes, batteries, accessories, etc., will maintain a good many stations, even after the sale of new sets begin to fall off, and this falling off, by the way, is still a long way in the future.



© Harvey Patteson, San Antonio

RADIO AIDED THE GOODYEAR III TO WIN

The recent national balloon race. Pilot Ward T. Van Orman carried a four tube reflex set which he built himself. The photograph shows the start of the race at San Antonio, Texas. During the winning flight of the Goodyear III to Rochester, Minnesota. where the balloon landed stations at Los Angeles, Cleveland, Davenport, Springfield (Mass.), Troy, and Schenectady were among those heard. The Goodyear Radio Club of Akron, Ohio, arranged with 16 broadcasting stations to send out regular meteorological information which proved of great value in navigating the balloon

Holy Communion by Radio

ALTHOUGH it must be confessed that nowadays we seldom enter into the Church's most solemn service, feeling that perhaps God is as much present in our flower garden (where Sunday morning is spent with the cultivator) as he is at the fiery debates of Modernist versus Fundamentalist, still we are just human enough to be unable to throw off the idea that the celebration of the Holy Communion is really a solemn rite, not to be entered into lightly and not to be used for Church advertising.

Perhaps that feeling is a little old fashioned and squeamish. It did jolt us to hear coming in over WJZ's radio channel recently "Jesus took bread and blessed it and gave it to his disciples and said, Take, eat, this is my body." It was the communion service being broadcast from the West End Presbyterian Church of New York, the Rev. Dr. Edwin Keigwin officiating. We happened to listen-in just as the solemn words were being pronounced, and the effect was anything but religious and sacred. One has naturally to compose his thoughts to be in a mood to appreciate this, the most solemn of the Church's ceremonies. Whether or not we believe in the Transubstantiation, whether we are religiously inclined or not, we cannot help but feel that this service is one which should not be participated in by those who have not come to it voluntarily, such as church attendance indicates.

Of course the minister who thus uses radio broadcasting may feel that he is accomplishing good in that a few of his parishioners may be bedridden, yet in



SECRETARY WILBUR

Of the Navy, inspecting the central naval radio control office in Washington where the high power stations at Arlington, Annapolis, Sayville and others are controlled



THE RADIO PRINTER

Designed and developed by William H. G. Finch, radio editor of the New York *American*, for the International News Service. The system uses a radio transmitter of 200 watts power and a wavelength from 60 to 150 meters. This is the transmitting sending typewriter and instrument panel

this manner be permitted in the communion service. This number is however comparatively few and the minister could just as well, or better, visit them in their homes, there to commune with them in the quietness such service demands. At the risk of being called old fashioned and out of date we venture the opinion that this minister did the Church a dis-service, by distributing his communion service, his most precious possession, in places where it wasn't welcome.

New Edition of Circular No. 74

EVERY technical and semi-technical radio enthusiast desires to have available reliable and workable tables and data on radio circuits and apparatus. One of the very best of the books giving such information is published from the Bureau of Standards under the title of Radio Instruments, Circular No. 74. The first edition of the circular met with great favor so that the Bureau staff has found it worth while to revise it thoroughly and bring it up to date. The new edition of this circular is now ready and can be obtained for $.60 from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Good "Radio" Voices Are Rare

WHEN we ventured to criticize the attempted French accent of one of the well known announcers some time ago his "boss" replied that it was not easy to get "a good radio voice." One would think that any body could talk intelligibly over the radio but such is not the fact. A prominent minister who has broadcast many sermons has a lamentably poor voice with which to actuate a microphone. The explosive voice, which throws quick, staccato, accents at the listeners is poorly adapted to the microphone. The violent emphasis on one or two words paralyzes the microphone. The listener gets the effect of a series of grunts. A cough, which is not especially unpleasant when occasionally heard from the lecture platform, sounds like a hippopotamus sneeze over the radio. A cough should never be permitted at a radio studio until the microphone has been short circuited.

We had a treat a short time ago listening to a series of oddly modulated voices. The modulation was actually so poor that the event was extremely amusing. The menagerie of a circus was "put on the air" for half an hour, and the microphone went through all sorts of contor-

tions trying to follow the gentle accents of the elephants, lions, and the like. And didn't the sea lion enjoy broadcasting! She (it must have been a she) seemed to feel there were several listeners being charmed by her dulcet tones and she did her best. Even after her turn was over we could hear her triumphal squeals, penetrating through the hyena's laugh. Few of the listeners had probably heard the hyena laugh before since he is generally a quiet kind of a beast.

Following this interesting bit of Nature broadcasting we hear that 2LO intends to sneak a microphone out into the dells where the nightingale holds forth and thus give to this far-famed songster an audience of the size he really deserves. And Paris, not to be outdone, is going to put on similar Nature programs.

If this type of broadcasting increases in popularity it will be necessary to adopt some new scheme of modulation or else to train the elephants and lions to be more gentle.

How Radio Saved U. S. Troops from the U Boats

AT A recent meeting of the Federal Club at the Bureau of Standards, one of the speakers, Commander D. C. Bingham, of the Naval Communications Division, gave a short but illuminating talk on the part radio played in the successful transportation of American troops through the submarine-infested waters around the British and French coasts. The radio direction finder, according to Commander Bingham, was largely responsible for the ineffectiveness of the German U boats in preventing the movement of our troops to France. The submarines had radio, and of course, they used it, perhaps not more than they had to, but still enough to give themselves away. Allied shore-stations, equipped with direction finders, could locate them and follow them through their journeys. The approximate location of the boats being known, the troop ships on their way across were routed in such a way that they missed the waiting submarines.

In case a submarine kept quiet for a day or two, ever-widening circles were drawn around the point where she was last heard from, thus indicating the territory in which she must be, because of her known cruising speed and the time elapsed. The troop ships were, in so far as possible, kept outside these circles.

We well remember one troop ship thus being kept outside an imaginary circle and the circle got so big that it seemed we nearly hit Iceland before instructions were received by radio to turn towards port.



THE RECEIVING RADIO TYPEWRITER

And its inventor, W. H. G. Finch (right). An accuracy of 99½ per cent. at 65 words a minute was attained at its first public trial at the Waldorf Hotel, New York, during a recent convention of newspaper publishers

Come With Me 'Neath the Family Tree

Read the Story of the Radio Detector's Best Booster, the Ever-present Help in Time of Trouble—Radio-frequency Amplification. Applying Family Tree Methods to the Hundred-and-one Trade Names for this Form of Amplification

By JULIAN KAY

This is the second of a series of avowedly breezy explanatory articles designed to put the non-technical reader at his ease when staggering radio terms and phrases and circuits are conversationally hurled at him. The reader will find in the "Family Tree" an orderly and unusual grouping of radio names and circuits which he will do well to preserve. The first article—which classified radio receivers and circuits—appeared in June.—The Editor.

EVERYONE who has a radio has a detector in some one of its many forms. This is the essential part of any receiving equipment about which all the other apparatus is grouped. In the first article of this series, something was said of the function of a detector likening it to our ears as the organ that "hears" the radio signals.

Now, given a detector, what can we do to increase its value?

The thing that naturally comes to mind is to use amplifiers, and since everyone is talking "radio-frequency" amplification, we shall apply our previous Family Tree methods to it. So much is claimed for this method of amplification that one almost considers it as a general palliative for all modern radio ills. If your radio is weak and pale, unable to go great distances, liable to get nervous and confused if two stations are transmitting at the same time, if, in short, it is in a state of general debility, what can be done?

Do You Know—

—The difference between radio- and audio-frequency amplification?
—When radio amplification is better for a given result than audio?
—What part transformers, variometers, and resistances play in a radio-frequency circuit?
—Why transformers are better for inter-stage coupling than other coupling devices?
—How radio-frequency amplification compares with regeneration for sensitivity?
—What impedance-coupling means?
—Why "heterodyning" is advantageous?
—What "tube capacity" is and what difficulty it causes in receivers, and how this difficulty is commonly obviated?
—What a "losser" is and what receivers use them?
—What the $57\frac{1}{2}^\circ$ angle is?
—What to do for a "pale and weak radio"?

The answer is radio-frequency, for it will do the following things to your present set:

1. Add selectivity.
2. Increase the receiving range.
3. Add volume to the final signals.
4. Help to overcome static.

For instance, with one stage of radio-frequency amplification before a regenerative detector and two steps of low-frequency amplification—four UV-199 tubes in all—it is possible to hear Chicago stations in a New York city apartment when five local stations are transmitting.

Without the radio-frequency stage, local stations can be separated only when the detector tube is oscillating and making the neighbors swear, and distant stations are not heard clearly until after midnight.

For the city dweller, this type of amplification to help the detector do its tricks is a great boon; for the fortunate country home it makes many of the magazine advertisements come true.

The methods of adding a stage of radio-frequency amplification have been previously described in RADIO BROADCAST, and those who have made it work already know its value. If it does not work to suit the builder, one of two things must be wrong, either it is not properly constructed and operated, or perhaps the builder expected too much.

If one should suddenly see Niagara Falls without having heard of this natural wonder, he should be amazed and awed at its grandeur, but having been brought up from childhood in the belief that it is unsurpassed, we are only awed and amazed when seeing it for the first time that we believed all the wonderful things said about it. The statistics are interesting—the fall is 168 feet high and not a mile, and one million several hundred thousand newly-weds gaze at it each spring—but—

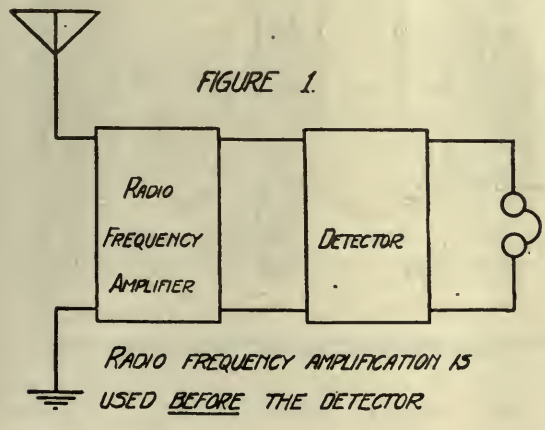
The trouble is that we expect too much.

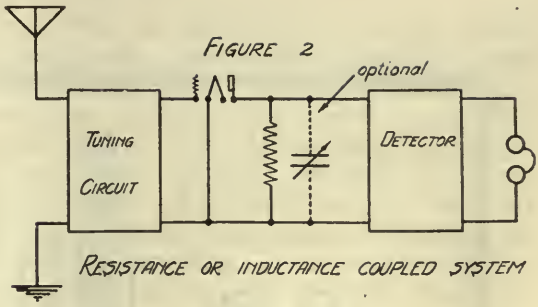
HOW R. F. AMPLIFICATION WORKS

DETECTORS are peculiar devices. They do not follow the "straight and narrow" but go off on a tangent and act according to what is known as a "square law." Their function is to distort the inaudible energy coming down the antenna in such a fashion that the ear, with the aid of accessory apparatus, hears audible sounds.

The square law comes in the picture in the following manner. If twice the voltage is applied to the detector in one case as in another, the detector output will be multiplied by four instead of two. Here is where radio-frequency amplification, which takes place before the detector, gets in its good licks.

If an amplifier boosts the incoming energy three times and then delivers it to the grid of a detector, the latter in turn will deliver nine times as much voltage as it would without the previous amplification.





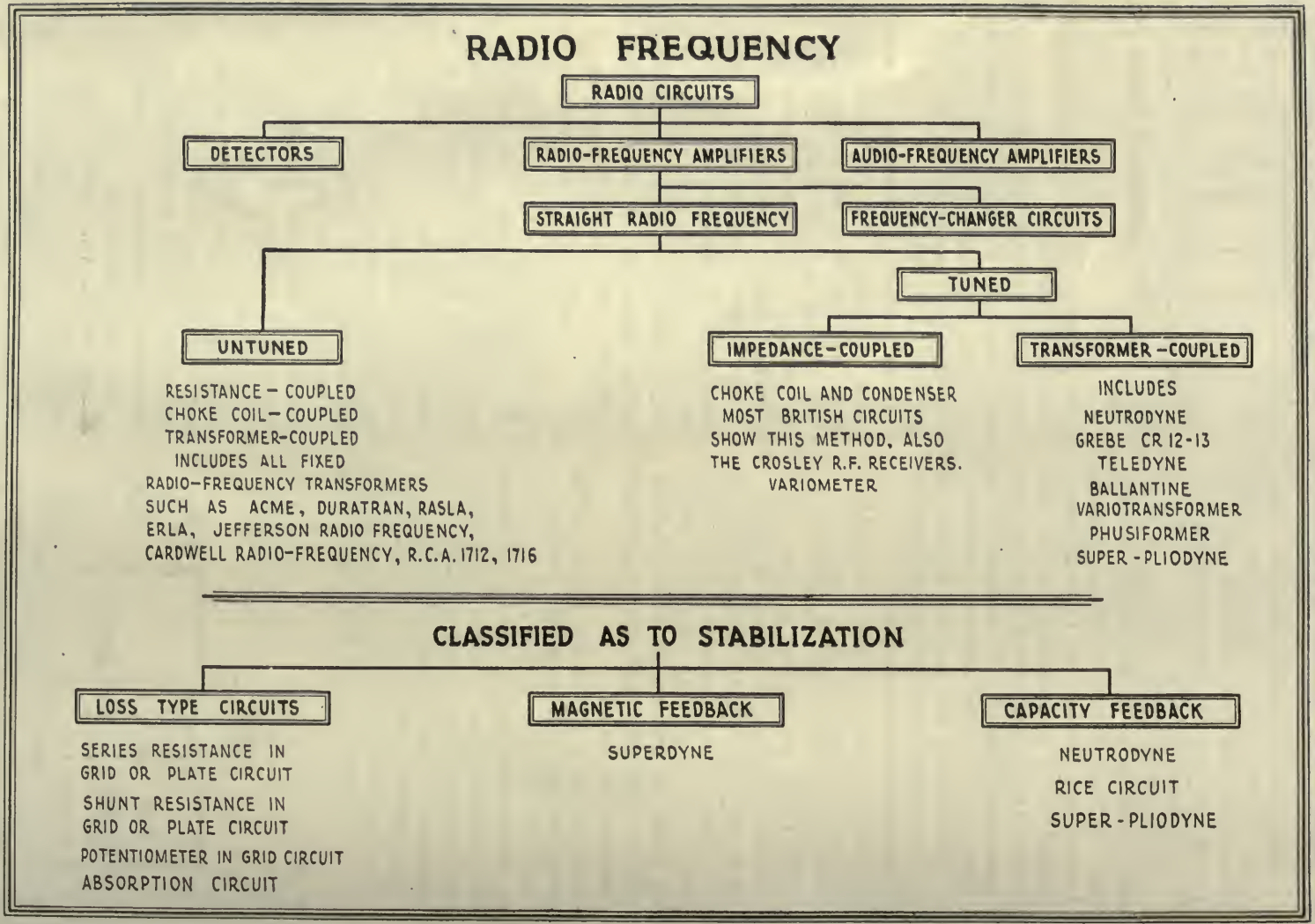
Of course we shall not hear nine times as much sound, for the ears have some idiosyncrasies of their own—but you can see what radio-frequency amplification does to a weak and debilitated detector.

There is another advantage in amplifying before detecting. The currents after the detector tube are all of low frequency, since it is these that we actually hear. For this reason any noises in the circuit itself—say, bad B batteries, loose connections, microphonic "bongs"—all will be audible and increased in strength by the low-frequency amplifiers, but are not so likely to cause trouble in a high-(radio) frequency amplifier. Still another advantage lies in the difficulty of making distortionless audio amplifiers.

THE R. F. FAMILY TREE

THE principle of radio-frequency amplification is simple. The input or grid is tuned to the incoming signal which is amplified by the tube and then passed on to the next amplifier or detector. The many types and names arise from the many methods of coupling the various stages together, and the methods of keeping the amplifiers from oscillating.

The Family Tree shows the two general methods of coupling: resistance and inductance. The first is not used for radio frequencies because of the short circuiting effect of the tube capacity (grid to plate). Inductance-coupling can be of two types, either a single coil known as impedance-coupling, or a two-winding transformer. Naturally, either of these methods can be tuned to the wavelength desired with added selectivity and amplification. If the coils are merely used to couple the tubes together, say by using an Acme or Duratran or any of the transformers mentioned on the Family Tree, one tuning control is eliminated.



THE FAMILY TREE FOR RADIO FREQUENCY

A single stage of untuned radio-frequency amplification is not as good as a single regenerative detector, but by tuning this one stage, remarkable results can be had. The transformer has two advantages over the single coil such as a variometer, that of greater

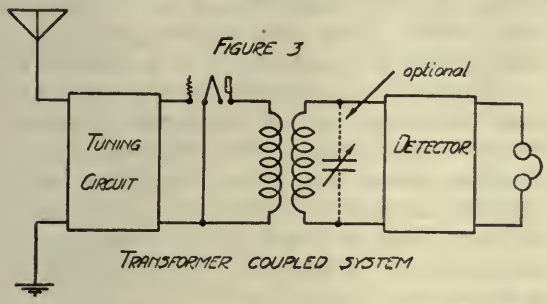


FIGURE 3
TRANSFORMER COUPLED SYSTEM

tuning range and the fact that such amplifiers are easier to reflex. The greater amplification resulting from pure inductance tuning—variometer—may be offset by using a "step-up" in the transformer. On the other hand the losses are greater in two windings of a transformer than in the one winding of a single coil.

It should be noted that when a single winding or a variometer is used, a condenser must be inserted before the grid of the next tube to keep the B battery voltage from that grid.

The Teledyne receiver described in RADIO BROADCAST for May uses one stage of tuned transformer-coupled radio-frequency amplification. Other receivers now on the market using this general method of attaining distance and selectivity are the Atwater Kent five- and six-tube receivers. All Neutrodynes, some Superdynes, and the Grebe CR-12 use this method and are explained in detail in following paragraphs.

Reflex methods usually use untuned transformers, but the loss by such methods is made up by passing the energy through each amplifier two or more times. These receivers are simple to operate, for there are at most two tuning controls, and with efficient radio- and audio-frequency transformers they should give good results over the entire broadcast range. The Acme Triflex, the Grimes Inverse Duplex, the Sleeper Monotrol, and the DeForest Reflex, are good examples of commercial receivers employing this method of amplification.

RADIO-FREQUENCY DIFFICULTIES

LIKE most good things on this earth, radio-frequency amplification is fine—except for one small difficulty. This trouble arises from an inherent defect in our present vacuum tubes, the fact that there is a small electrostatic capacity existing between the grid and plate. This provides a path for the alternating plate current to get back to the grid circuit where it is again amplified and passed to the plate. This process keeps up until the circuit oscillates. The result is that a large oscillating current passes around from grid to plate and back again so that the minute antenna currents are lost in the shuffle. All we hear is a shriek and groan and neighbors probably say,

"By golly, there's that single circuit hound again."

At the present time there are three methods of attacking this problem of feed-back currents:

1. "Losser" methods.
2. Reversed feed-back (Superdyne).
3. Balancing methods. (Neutrodyne).

The first of these three is an old scheme and is usually disguised under the general term of "stabilizers." It is used on receivers built by manufacturers who are not licensed to use the more modern and efficient methods disclosed by Rice and Hazeltine.

Fig. 4 shows the "losser" methods. Here enough resistance is added to the circuit, either in series or shunt to cut down the amplification to a point where oscillations do not occur. The other method is that of placing a potentiometer across the A battery with the variable arm connected to the grid return end of the input tuning coil. When the circuit starts to oscillate the operator shifts this variable

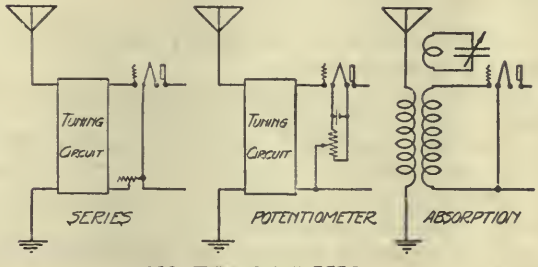
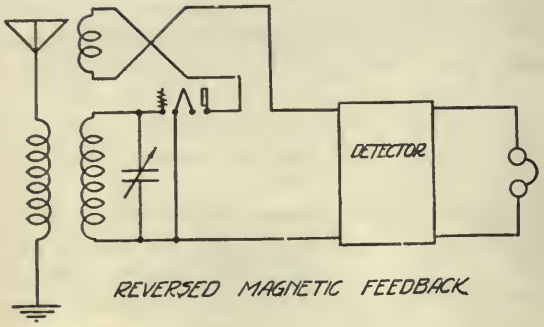


FIGURE 4
LOSS TYPE STABILIZERS

arm until the grid becomes slightly positive thereby stopping the oscillatory currents.

Both of these methods involve adding losses to the amplifier, in other words, decreasing the amplification. This of course is inefficient although simple to operate.

FIGURE 5.



REVERSED MAGNETIC FEEDBACK

The second method, the reversed tickler, is used in the Superdyne and does not introduce losses into the circuit except for what voltage is lost in the tickler coil. The scheme resembles the "tickler" feed-back detector except that the tickler coil is reversed in direction so that instead of forcing the circuit to oscillate, it prevents oscillation. If the circuit should break into oscillation no signals can be received and the operator will at once be aware that his amplifier is in trouble.

Both of these two methods have the disadvantage that they require adjustment—one more dial to turn. In the Superdyne receiver this is not such a bother, since the circuit can be adjusted for each wavelength and brought as near actual oscillation as is desired.

THE NEUTRODYNE RECEIVERS

THE balancing methods, of which the Neutrodyne is the typical example, are perhaps the best for eliminating the bad effects caused by grid-to-plate tube capacity. The advantages of the Rice and Hazeltine circuits over other schemes are apparent when one considers the following:

1. Once adjusted for a particular tube, the balancing need not be changed.
2. There are no added controls, no more dials to juggle.
3. No losses are introduced, that is, the full gain of the amplifier may be utilized.
4. Many stages of amplification can be worked if each is properly neutralized.
5. The balancing is practically independent of wavelength.

The Neutrodyne principle is one of balancing the small feed back current by another capacity current of an exactly equal strength but fed into the circuit in opposite direction—the result being that no current actually flows. This method isolates the grid and plate circuits so that they may be sharply tuned to the same wavelength without sensible interaction. The grid of the tube can be kept negative by C batteries, and large values of B battery voltage used thereby getting the maximum benefit from the amplifier tubes.

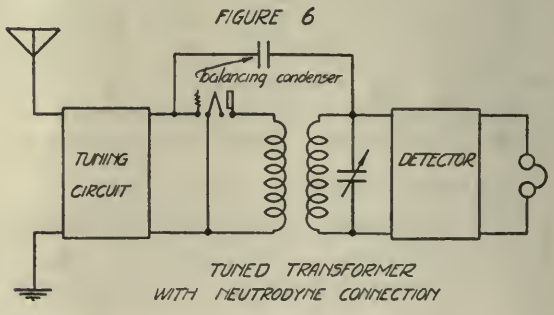
The Hazeltine method is shown in outline Fig. 6. The neutralizing condenser, commonly called a "neutrodon" is connected to the following tube in such a manner that the proper magnitude and phase of the balancing current is maintained. The actual method of adjusting these small capacities has been described in Radio Broadcast. It is quite important that the exact point of balance be found, for over-neutralizing is just as bad as no neutralizing at all.

The Rice circuit has a slight advantage over the usual scheme in that the balancing capacity is kept in the circuit of the tube being neutralized. Thus any type of output can be used. Care must be taken here that the neutralizing condenser does not short or the B battery will be on the amplifier filaments.

The usual "five-tube receiver" is a Neutrodyne in which two tubes act as radio-frequency amplifiers, one as a detector, and two as audio-frequency amplifiers. It is possible to use small tubes, say UV–199, for the first three, but larger capacity tubes such as the UV–201—A should be used in the last stages to handle the output without overloading. The two radio tubes can be reflexed, that is—the audio-frequency currents delivered by the detector can be sent back through the first two tubes, but in general there is little to be gained in such a method. The four-tube sets are of one of two types; either they have but one stage of radio amplification, or but one of the radio tubes is reflexed. The Fada "160" and the Garod are examples of the latter.

Some confusion seems to exist about the need for neutralization or for stabilizers. The rule of whether to use some one of these oscil-

FIGURE 6

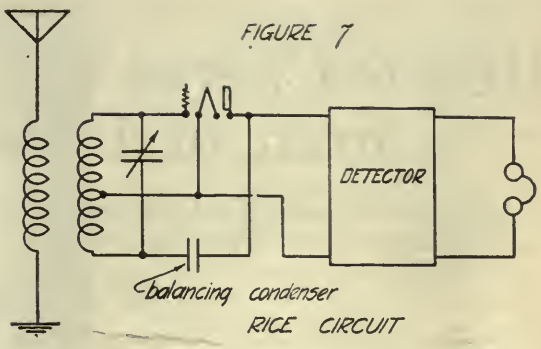


TUNED TRANSFORMER WITH NEUTRODYNE CONNECTION

lation preventing methods or not is simple; if the radio-frequency circuit oscillates at the lower wavelengths, neutralize or stabilize it. If the circuit does not oscillate, there is no necessity of complicating it. Sometimes the disposition of coils and leads is such that neutralization is automatically affected without further trouble—*but*, if the tube does not oscillate, it is usually a sign that it is not in an efficient circuit.

For example, let us take the Hazeltine (Neutrodyne) circuit. If the primary winding of the radio-frequency transformers has but few turns, it is probable that the circuit will not oscillate, but the full gain of the tube will not be realized. The remedy is to increase the number of primary turns until oscillations actually occur on the longer wavelengths, then neutralize the tube. Those who use the Rice circuit can do the same thing by removing the filament tap from the center of the coil and bringing it nearer the bottom or plate end of the coil. This increases the voltage across the input, and a point will be reached where the circuit actually oscillates. There is no need to neutralize before this point is reached.

In all neutralizing schemes, it is important to have no electromagnetic coupling between the various coils. This can be accomplished by placing the coils at right angles to each other and far apart, or by assuming the well known "$57\frac{1}{2}$" degree angle of the coils.



A well-made receiver employing two stages of radio-frequency amplification—or one stage plus detector regeneration—should be able to cover the entire United States broadcasting area. Where one wants strong signals and great distances, the 201-A tubes are unexcelled; for less powerful signals the 199's are extremely economical and efficient.

Radio has been referred to as the magic carpet on which we may ride to the ends of the land. This is theoretically possible—radio-frequency amplification makes a pleasant theory into practicality.

In the next article, the super-heterodyne, another and very well-known radio-frequency receiver, will be described.

SOME of the prize-winning receivers and stations in our "How Far Have You Heard" distance contest will be described in the August number of RADIO BROADCAST.

How to Charge Your Storage B Battery from an A Battery Rectifier

A Few Feet of Lamp Cord, a Socket, a Hundred-Watt Lamp, and an Ammeter are the Simple Essentials Required to Convert any A Battery Rectifier into a B Battery Charger

BY ZEH BOUCK

In this article, Mr. Bouck tells how the various types of A battery chargers now on the market can be made to charge storage B batteries without expensive auxiliary equipment. He also touches on the theoretical operation of the rectifiers he describes so the reader may more perfectly comprehend the principles with which he is experimenting. Many enthusiasts are no longer satisfied merely to "read" radio. Instead, they study it. It is only by understanding both the theoretical and practical aspects of an electrical problem that the experimenter can obtain the highest efficiency from his apparatus.—THE EDITOR

RECTIFICATION, as most of us know, means the changing of an alternating current, which in commercial frequencies reverses its direction of flow from twenty-five to sixty times a second, to a direct current that, though it may be pulsating, maintains its periodic push in one direction. Rectification is most simply accomplished by smothering or cutting off one half of the A. C. alternation so that (say sixty times a second) we shall get very decided unidirectional electrical impulses.

Several electrical processes, such as the charging of storage batteries, require direct current, and where A. C. is the only convenient power source, rectification is the most simple and logical method of supplying this one-direction current. Due to certain advantages in alternating current distribution, a majority of homes are electrified with A. C. in preference to D. C. Most of our readers are therefore familiar with the principle of rectification through the common use of rectifiers for charging storage A batteries, which, until the advent of the dry-cell tube, was the only practical way of lighting the tube filament.



FIG. 1
A typical lead-plate acid storage B battery

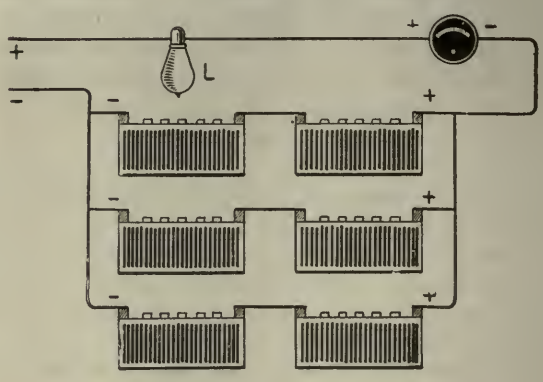


FIG. 2
Charging a B battery from direct current lighting mains. Note the series-parallel connection

The popularity of the multi-tube receiver, and more particularly special cases as the superheterodyne and resistance-coupled amplifiers, has bespoken the very pronounced advantages of the storage B battery, and again presents the problem of rectification which the dry-cell A battery had perhaps tended to eliminate.



FIG. 3
The two meters in the upper right illustrate the inaccuracy of the standard D. C. meter on a pulsating current. The upper meter is correct

Storage B batteries are obtainable in two electrical types, generally recognizable by certain consistent mechanical characteristics—the lead-plate-acid cells and the Edison nickel-iron battery. The lead plate cell, a battery of which is shown in Fig. 1, is a minature A battery in both appearance and construction. These batteries are generally manufactured in 24-volt blocks, two or more sections being connected in series for high amplifying potentials, and in parallel for charging.

The Edison cells are usually built up in a test-tube rack, such as the battery shown undergoing charge in Fig. 7. Sizes of these are obtainable in tapped voltages up to one hundred and forty volts. Switches are provided which break up the battery into smaller units and connect them in parallel for charge.

The characteristics of each type of battery will have a different appeal to individual experimenters, and to an extent will affect their adaptability to taking a charge from various A battery rectifiers. The lead battery probably holds its charge longer or more consistently, will give greater current, and suffers less from voltage drop during a normal discharge. The Edison cell, on the other hand, is cheaper when high voltages are desired, and, as it is apparently immune from abuse, has a longer life. It goes without saying that the maintenance of these batteries differs with their differing electrical characteristics, and the instructions of the individual manufacturers should be studied and observed in every case, occasionally modifying the charging instructions with the suggestions given in this article.

CHARGING THE BATTERY

IF THE reader is one of the fortunate minority whose home is lighted by direct current, (D. C.), he may of course charge his battery without the aid of a rectifier. Fig. 2 shows how this may be done, and also illustrates the principle of series-parallel connection. Six 24-volt batteries giving a series potential of 144-volts, have been broken up into

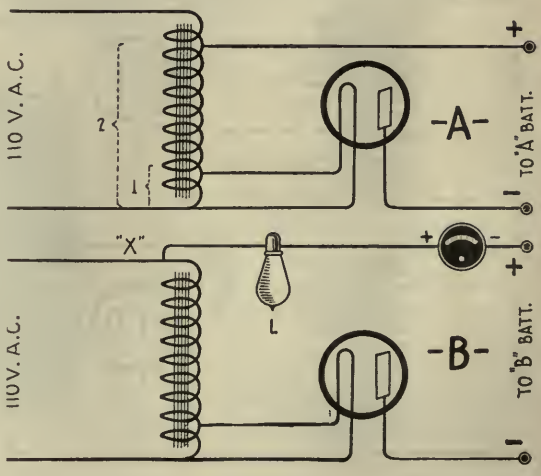


FIG. 4
Converting the Tungar type A battery charger

48-volt units and connected in parallel. L is a 75- or 100-watt lamp which passes a charging current of about .4 ampere. The meter is not necessary but it is very desirable as both a polarity indicator and an indication of the charging rate.

In charging from alternating current, a rectifier is needed in addition to a 100-watt lamp and the meter. The meter should read from zero to one ampere, but in the case of a rectified current it is an indication of polarity rather than a reliable reading of the charging current. As before mentioned, the rectified current is pulsating, rising from zero to maximum and falling to zero again. Due to the reactance in the winding of the direct current meter, a quality which, as we have had occasion to explain before, opposes any current change, only a small amount of the available current is permitted to actuate the meter. The meter indicates only about two thirds of the total *direct current* passing through the circuit. Fig. 3, showing a hot-wire meter connected in series with a magnetic meter, illustrates this discrepancy, the former meter registering the true current. The D. C. instrument is emphatically unreliable in the case of chemical rectifiers, where the alternating current inadvertently passed through the cells has no effect whatever on the needle but will register a very definite deflection on the hot-wire meter. The D. C. meter, however, is preferable in all cases, for the one third allowance is easily made, and the needle is a reliable indication of the direction of current, which is most important.

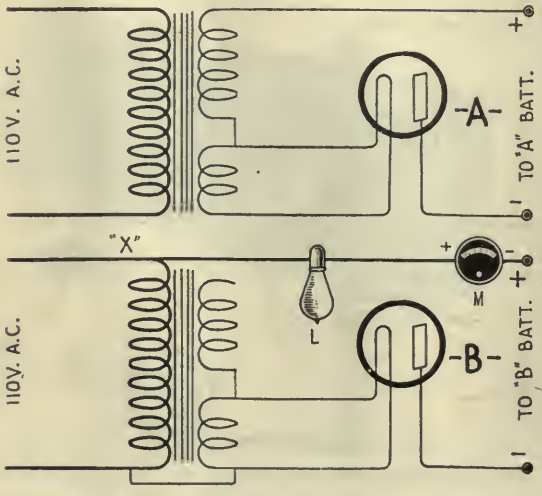


FIG. 5

Doing the same with the separate winding transformer

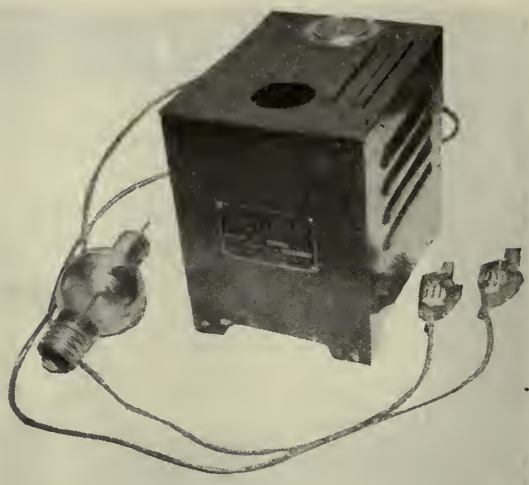


FIG. 6

A typical bulb rectifier designed for charging storage A batteries. This article tells how to charge B batteries with it

THE RECTIFIER

THE rectifiers we shall discuss in this article are those originally designed for charging storage A batteries. These arrange themselves into three classes, designating the principles upon which they function. The first, and probably the most popular, is the bulb rectifier, such as the Tungar, Rectigon, and King. The next most common is the mechanical, or vibrating rectifier, good examples of which are found in the Leich, Valley, Apco, Handy Charger, Unitron, Homcharger and La France. Last in place, but by no means so in merit, is the efficient chemical rectifier such as the Fansteel Balkite.

The manufacturers of one or two of these chargers, anticipating the demand that is following the widespread appreciation of the storage B battery, have designed attachments which adapt their chargers to higher voltage batteries. These attachments, however, are generally superficial additions of which the experimenter can easily avail himself without further expense. A few feet of lamp cord, a socket, a 100-watt lamp and the meter are all that is necessary to convert any A battery rectifier into a B battery charger.

CONVERTING THE BULB RECTIFIER

MOST enthusiasts who are at all familiar with the action of the three-element vacuum tube comprehend the principle upon which the two-element valve, such as the Tungar, functions. When the positive half of

the cycle is applied to the plate of the tube, electrons are drawn over from the filament, and current passes through the bulb and the battery, which is included in the plate circuit. On the negative half of the cycle the plate charge is reversed, the "like charge" repels the electrons thrown off by the filament, and no current passes.

There are two types of bulb rectifiers in use for battery charging, one employing the auto-transformer (Fig. 4A) and the other using the conventional transformer with separate primary and secondary windings (Fig. 5A). In the auto-transformer diagrammed in Fig. 4A, the entire winding functions as the 110-volt primary. The turns braced by 1 act as the filament lighting secondary, while the section braced at 2 furnishes the higher potential for charging the battery. The Tungar rectifier is of this type, and is quite easily converted into a B battery charger.

As is shown in the diagram, one side of the A. C. line connects to the filament. It is first necessary to determine which side of the line this is. Disconnect the connection to the plate of the rectifying tube by slipping off the Fahnestock clip, and plug the rectifier into a lamp socket. Now take an electric light bulb and connect one side of it to the filament of the rectifier. The free end of the connections leading to this bulb is touched first to one side of the alternating current line and then to the other. The side on which the 110-volt lamp lights to its full brilliancy is quite evidently the side *not* connected to the filament. A tag or other means of identification should be affixed to it to designate this wire as "X" of Fig. 4B. The remaining connections are



FIG. 8

An A battery charger of the vibrating type

followed accordingly. "X" runs to the lamp; from the lamp to the meter; from the meter to the plus of the storage B battery, and from the minus of the battery to the plate of the tube.

A charger of the separate-winding type is illustrated in photograph Fig. 6. If the experimenter is in doubt as to the connections of his charger, the test suggested in the preceding paragraph for locating side "X", will determine the type of transformer used. If the test lamp does not light on either adjustment, it is evident that there is no connection between the primary of the charger and the filament lighting secondary, i, e., the circuit of the charger is that shown in Fig. 5A. In converting a charger of this type, one side of the 110-volts is connected deliberately to the rectifier filament, while the remaining side, "X" again, is connected to the lamp and meter in the same way as with the Tungar machine. Fig. 5B shows the separate-winding rectifier arranged for charging storage B batteries.

L, in both Figs. 4 and 5, is the 100-watt lamp, and M is the direct current meter already described. If more convenient, an electric soldering iron may be substituted for the lamp. Fig. 6 shows the A battery



FIG. 7

Charging a forty-volt B battery (three sections in parallel) from a converted A battery charger. On discharge this battery gives more than 120 volts

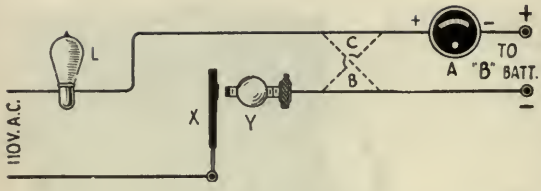


FIG. 9

How to connect the vibrating charger for charging a forty-volt B battery. The vibrating mechanism is connected to the 110 volt line as usual

charger made by the King Electric Company charging an Edison storage B battery.

THE VIBRATING OR MECHANICAL RECTIFIER

THE mechanical rectifier is nothing more than an automatic switch for connecting the battery to the charging potential when the current is in one direction, and breaking the circuit on the other half of the cycle. This is most simply accomplished magnetically, through a combination of permanent- and electro-magnets, the winding of the latter being placed over the former as a core. When an alternating current is passed through the coils, the core is given a magnetizing impulse first in one direction and then in the other (the polarity of an electro-magnet is of course determined by the direction of the current responsible for its magnetism.) Thus on one half of a cycle, the magnetic attraction of the permanent magnet for a near-by armature will be augmented by the electro-magnetic effect while on the other half, due to the opposing magnetic fields, there will exist little or no attraction. The armature will therefore be pulled to the magnet sixty times a second, and, if suitable contacts are provided, mechanical rectification becomes an obvious and simple matter. Other types of magnetic rectifiers utilize a polarized armature, but the principle of opposing and coöperative magnetic fields remains the same. Fig. 7 is a photograph of one of the most efficient rectifiers of this type, and upon which the experiments described in the following paragraph were made.

In converting magnetic A battery rectifiers for charging higher voltages, the various rectifying circuits—and they are several—need not be considered individually. The actual original circuit may be partially ignored, and the reader's attention concentrated on running two free leads, one to the vibrating arm (X in Fig. 8) and the other to a stationary contact (Y). On most rectifiers, two contacts will be found placed on opposite sides of the vibrating armature. It occasionally happens that only one stationary contact is connected to the A battery charging circuit, which makes the free contact particularly adaptable to our purpose. However, either contact may be used.

It is next necessary to determine if the armature and *both* stationary contacts are isolated from the 110-volts. A test lamp is best employed, after the manner described for tracing the bulb rectifier circuits. One terminal is connected first to the contacts, one at a time, and then to the armature, the remaining terminal being touched to each side of the 110-volts. The test is, of course, made when the rectifier is plugged into the lighting circuit. Negative results indicate the desired isolation. As separate winding transformers are used in the majority of magnetic rectifiers, this will probably be the case. If, however, the tests show a circuit complexity, it will be necessary to break the undesired connections, leaving the stationary contact points free from direct connection with the 110-volt line.

The armature and contact point are then wired as shown in Fig. 8. L and A are the lamp and meter already described. It is a fifty-fifty chance that it will be necessary to reverse the leads at BC as suggested by the dotted lines. Fig. 9 shows the ensemble in action.

THE CHEMICAL RECTIFIER

THE chemical rectifier is one of the oldest known means of converting alternating current into direct current. The improvements which have made it a very efficient and convenient system to-day, have not altered the principle of its functioning. On half of the alternating current cycle, one of the two electrodes is enveloped in bubbles, forming a gaseous and insulating film which breaks the circuit until they are dissipated by the reversal of the alternating current.

The Fansteel Balkite is the best and perhaps the only representative of this type of rectifier available to the broadcast enthusiast for the charging of storage A batteries. This rectifier may also be used for charging a 24-volt unit of storage B battery without any alterations whatever, half of a 24-volt battery merely being clipped into the circuit in place of the usual six-volt accumulator. The higher potential of the B battery reduces the potential difference between the output of the

rectifier and the battery undergoing charge, with a corresponding reduction in the charging rate which drops to about .3 ampere. The manufacturers of this rectifier will send to interested readers corroborative data on this particular method of charging.

A 24-volt battery may also be charged as a single unit, by leading the 110-volts directly to the rectifying cell, and from there to the battery as shown in Fig. 10. Again it may be necessary to reverse the leads at BC. Fig. 11 shows this arrangement charging 24-volts of B battery, and the reader may observe the connections soldered to the rectifying cell terminals. The Balkite rectifier, fed from 110-volts, A. C., does not charge satisfactorily when the normal battery voltage is over thirty. In using the Fansteel charger for B batteries, it is suggested that they be connected in parallel units not exceeding this voltage.

While this system of rectification works well on all batteries, it is more satisfactory on the lead plate cells, due to the efficiency with which such batteries accumulate a charge at very low rates. The Edison cell takes a charge best at a comparatively high amperage. For this reason, when charging the latter type, particular care must be observed to maintain the electrolyte at the proper height in the Balkite cell, or, more technically, at the proper specific gravity. It is at this strength that the solution offers the least resistance to the current, and therefore passes the highest amperage. Needless to say, the efficient operator will maintain the desired specific gravity at all times, regardless of the type of battery being charged. Very few of us are efficient operators.

CONCLUSION

EXCEPT where the voltage is specifically stated in the foregoing paragraphs, it has been assumed that the battery will be



FIG. 10

Charging the B battery with the vibrating rectifier. An electric soldering iron may be plugged in, adding the needed resistance in place of the electric light bulb

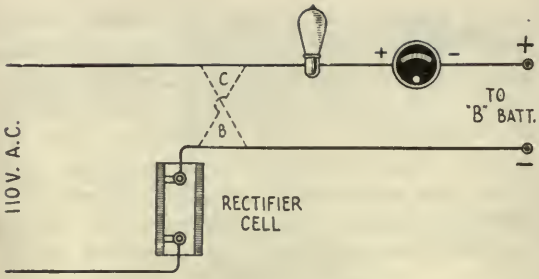


FIG. 11

How to connect the 110 volts directly to the Balkite rectifying cell for charging a B battery as a twenty-two-volt unit

charged as a 48-volt unit. It is difficult to charge a higher voltage than this without recourse to a step-up transformer. The experimenter, however, may charge his cells as a 24-volt battery. This is particularly convenient in the case of a 72-volt battery built up of three 24-volt blocks. No change in the charging apparatus is necessary to compensate for the current, which automatically adjusts itself by flowing through more parallel units.

The B battery should be disconnected from the receiver while undergoing charge, and the possibility of a grounded connection should be assiduously avoided. Do not attempt to charge A and B batteries simultaneously from the same rectifier, unless you are sure, very sure, of your circuit. It can of course be done, the author does it, but he has discovered that in doing so it is a good idea to supplement one's genius with a supply of fuses.



FIG. 12

The Balkite B battery arrangement in action. The transformer of the rectifier has been substituted for the usual electric light bulb

HOW an amateur can make a receiver for very short waves will be the subject of the next of Mr. Bouck's how-to-build-it articles, appearing in August. A very sensitive and economical non-radiating circuit never before used for the reception of 100-meter waves is employed.

Man-Made Static

Showing That Some "Static" is Native to Poorly Built Receivers—How to Test a Suspected Set

By A. F. VAN DYCK
Engineer, Technical Division, Radio Corporation of America

PART III

TWO previous articles have described various causes of interference with radio reception originating in electric power circuits or devices, and methods of eliminating those disturbances. There are some general aspects of the subject, not covered in these previous articles, which should receive consideration by every broadcast listener who believes that interference which he experiences is due to such causes. Then the broadcast listener can find a solution for his particular problem, with minimum trouble to himself and to others.

As the number of broadcast receivers increases, the number of cases of interference reported grows also. The number of cases reported to radio and power companies has attained large proportions. This has given such agencies good opportunity to study such interference.

The most interesting and important discovery brought to light by these companies is that a large percentage of complaints of interference are not due to outside interference at all, *but are caused by defects in the complainant's receiver.* This has been found especially true of home-made receivers built by persons with little or no electrical experience. Bad contacts, poor soldering (or no soldering at all) broken wires, run-down B batteries, are sources of noises which are none too easy for the novice to find, so that he very often concludes that the noises he hears are due to "interference." He may blame the amateur, the commercial station, the power company, or any one else on whom his imagination may alight.

All That Scratches

Isn't static, as Mr. Van Dyck points out. Inexperienced enthusiasts can build a receiver fairly bristling with potential scratchings and howlings by being satisfied with little or no soldering, poor contacts—and careless workmanship in general.

Power companies aren't altogether to blame for the unearthly noises your set may vent—but when they are to blame, they are mighty willing to "shoot trouble." Here is some good advice to look carefully before you take a petulant radio leap and blame your "interference" on all and sundry.—THE EDITOR

HOW TO TEST FOR A FAULTY RECEIVER

THE first thing to do when noises are heard in a receiver is to make sure that they are not originating in the receiver itself. A first and informative test is to connect together the antenna and ground terminals of the receiver with a piece of wire. This prevents any voltages in the antenna from actuating the receiver, and if the noises are still heard it is absolutely certain that they are being caused within the receiver, and are not coming by way of the antenna. When such a connection is made on a receiver which is in good condition, perfect silence in the loud speaker (or headset) will be had.

The next general observation of importance made in study of large numbers of complaints to power companies, is that much trouble is caused by standard devices connected to power lines by individual owners, and therefore, over which the power companies have no control. Devices such as heating pads, violet-ray machines, elevator motors, etc., may cause interference—but through no fault of the power company whose responsibility is merely to supply power to the user. It is important to appreciate this, because it is useless to ask a power company to eliminate a source of interference over which it has no control.

GET THE FACTS BEFORE YOU COMPLAIN

THE second thing for a broadcast listener to do when he experiences interference of this sort, provided the first test has proved that the trouble is not in his receiver, is to determine the nature and general source of the disturbance, or if he can't carry out this work personally to engage the services of a radio expert to do so. The object of this second test is to determine whether the trouble is caused by any electrical device or circuit in the same house with the receiver, whether it comes into the house over the power lines which furnish power to the house (these questions can be studied by switching off all devices in the house and finally by opening the main switch, usually located near the meter, or removing the fuses—if the interference is actually coming in on the house power wires it will be affected by opening the switch, although not necessarily stopped) and whether the other receivers in the neighborhood experience the same interference. Intelligent execution of this second step is essential before anything else can be done and before any complaints can justly be made to any one. If the source of the trouble is located, it is then possible to complain to the proper party and thus obtain correction most quickly, and incidentally to avoid unwarranted complaint to other parties not responsible for the difficulty. If the test described above shows that the noise is coming in on the house power lines, the search can then be continued. The fact that it comes in over the lines does not mean necessarily that there is a fault on the power lines. It may be caused by some device connected to the lines at some point. Or it may be caused by the power lines acting merely as collector of a disturbance which originates on other wires near them at some point.

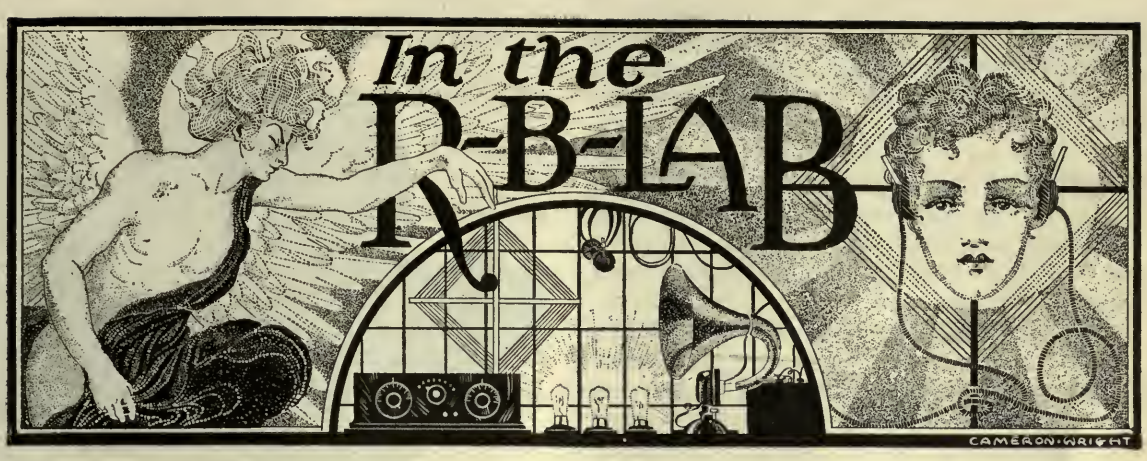
Power companies take care of the maintenance of the lines which supply and distribute electric power. Faults on lines themselves, which cause radio interference, occur sometimes, but such faults make only a small percentage of all sources of interference, as shown in the table below. Power companies try to maintain their lines in good condition, and most lines are regularly inspected, so that serious faults are likely to be discovered before they have existed very long.

The following table of classes of interference caused by electric circuits, is based upon approximately one hundred verified reports.

NATURE OF INTERFERENCE	PERCENTAGE OF TOTAL CASES
Telephone Bell Ringers	25%
Gas Engine Plants	21%
Miscellaneous Industrials (Trolleys, motors, rectifiers, signals etc.)	17%
Town lighting plants and street lighting	13%
Household Appliances	12%
Power Lines	10%
Electric Precipitators	2%

It should be appreciated by broadcast listeners that interference may be caused by some electrical devices which are in normal working order. Examples of such devices are heater pads (thermostatically controlled), violet-ray machines, trolley cars, store and factory motors, elevator machinery, etc. In many cases, operation of such apparatus can not be stopped for the sake of broadcast reception, and unless some of the remedies described in preceding articles (Radio Broadcast for April and May, 1924), can be applied, through cooperation of the broadcast listener and the owner of the apparatus, the broadcast listener should be satisfied with reception of signals which are strong enough to dominate the interference. Exceptional cases of this sort may arise, however, where such electrical apparatus operation affects the radio reception of a sufficiently large body of listeners to constitute a public nuisance, and in such cases, special remedies may be justified.

WIDE interest has been excited by the Radio Broadcast *$500 prize contest "Who Is to Pay for Broadcasting—and How?" Full particulars appeared in the magazine for May and June. All entries for the contest must be in the mails by July 20, 1924, addressed* Radio Broadcast *Who Is to Pay Contest, care American Radio Association, 50 Union Square, New York City.*



HOW TO BUILD A RADIO "TESTOMETER"

IT IS often exasperating, or worse, to await the opening of a local or particular broadcasting station in order to determine whether or not a new receiver is operating. The radio "Testometer" is a convenient name for a small buzzer transmitter that may be used to generate radio signals for the testing and comparison of receiving sets. The testometer enables the experimenter to test the sensitivity of any receiver by using this kind of portable standard, and to determine approximately its wavelength range, quite independent of S O S's and the caprices or operating hours of broadcasting stations.

Technically, the testometer is nothing more than a buzzer excited wavemeter—the accuracy of which would send the Bureau of Standards into convulsions. However, it is quite adequate for the purpose for which we recommend it, and it is so simple that it may be almost thrown together in a few minutes, if the experimenter does not care to construct the testometer as a permanent piece of laboratory equipment shown in Figs. 1, 2 and 3. The circuit is diagrammed in Fig. 4.

B is the buzzer, preferably of the radio type, with an adjustable contact, and vibrating very rapidly. C1 is a by-pass condenser around the buzzer coils. C2 is a tuning condenser, an active part of the oscillating system that eliminates the necessity for a many-turn coil at L. Both capacities are fixed Micadons. Using a .00025 mfd. condenser at C2, L is wound on a three-inch form with twenty turns of approximately No. 22 wire, tapped in the middle. A three-point switch is mounted under the buzzer, giving "off" to the left, and low and high wave on the respective points to the right. With the suggested values of capacity and inductance, the circuit will oscillate on the middle tap at approximately 1,111 kilocycles (270 meters) and at 667 kilocycles (450 meters) on the higher wave—giving a good idea of the ability of the receiver under test to cover the broadcast range.

Three dry cells, or a six-volt storage battery are used to actuate the testometer. In

What the Lab Offers You This Month

—How to build a "radio testometer"—a simply built adaptation of the wavemeter which indicates at once the wavelength range and state of sensitivity of your receiver.

—Illustration of commendable super-heterodyne construction from RADIO BROADCAST *articles.*

—How to build a self-supporting loop.

—An illustration of a neat three-tube RADIO BROADCAST *Knock-Out receiver built by a reader.*

—How an audio-frequency transformer may be connected, still to perform good service as an impedance-coupling for the last tube of your audio-frequency amplifier.

—How to build a very inexpensive and very stable crystal detector which should be valuable in a reflex receiver.

—Results of using the WD-11 and WD-12 tubes in the RADIO BROADCAST *one-tube Knock-Out receiver.*

—Suggestions for the growing laboratory.

merely testing a receiver, the wavemeter is placed on the operating table, alongside of the set, as shown in Fig. 3. The testometer is operated on either high or low wave, and the note tuned for in the receiver. The sound received is not the comparatively pleasing tone of the buzzer, but is a rather rasping note, sounding somewhat like a poorly adjusted spark coil transmitter or the raspings of a violet-ray machine.

The testometer should first be tried with a receiver of known excellence, and the contact of the buzzer adjusted until the signals are most steady and loud. No antenna is required for these tests. As a criterion for future comparisons, it is a good idea to note how far from the receiver the transmitted buzzer signals are audible. The testometer is removed from the operating table, and carried to other parts of the station or home until the signals can just be heard—i. e., at "threshold" audibility. During these tests, the buzzer and its inductance should be rotated for maximum intensity, as the directional effect of the miniature transmitter is quite noticeable.

It is now possible to compare the sensitivity of any other receiver with your standard set, by noting how far from receiver number two the buzzer signals can be heard at threshold strength.

A standard announcing buzzer may be used in the testometer if the experimenter cannot secure the high tone type.



FIG. 2
Rear view of the Testometer

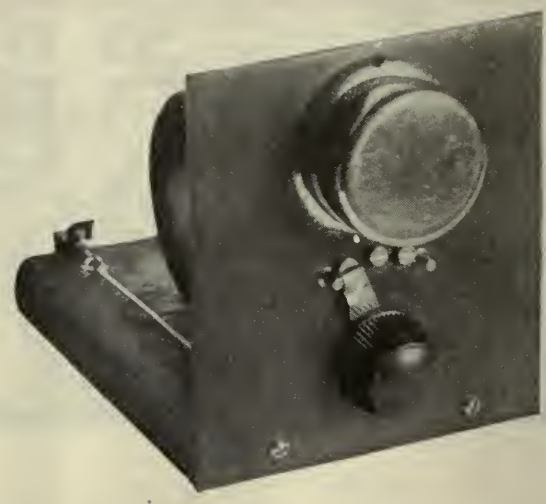


FIG. 1
Front view of the Radio "Testometer"

SOME EXCELLENT EXAMPLES OF SUPER-HETERODYNE AND REFLEX RECEIVER CONSTRUCTION

THE enthusiast does not truly begin to enjoy radio until he applies his own ingenuity to the problems that inevitably confront him. The pleasure derived from operating and displaying a set which reflects one's own mechanical or electrical ability far exceeds the merely passive pleasure of tuning a receiver that some one else has built and installed for you.

The photographs, Figs. 5, 6, 7, and 8 are expressions of original thought in the construction and mounting of receivers. Figs. 5 and 6 are views of the super-heterodyne built by E. F. Weber of Chicago, Ill., from data published in Radio Broadcast.

Mr. Weber is to be commended, not merely on the electrical details, such as individual meters, etc., which are evidences of deviation from Mr. Haynes' description of his super-heterodyne, but for the ensemble—the desk-cabinet which adequately provides for his entire equipment. The B battery is contained in the desk compartment, and can be seen in the photograph. The storage A battery is in the lower left hand cabinet, and just above it is the motor-generator charger.

Particular attention is called to the very original construction of the loop aerial. It is two feet on a side, and built entirely of rigid bus-bar wire. This eliminates the usual cross-bars and makes the loop self-supporting.

Three quarters of an inch spacing between turns is about right.

A shortened broom stick may be used for the central support. Toward the center of the loop, single lengths of bus bar wire will suffice for both horizontal and vertical wires but clipped pieces will be necessary for each of the four sides of the outer turns.

Figs. 7 and 8 show the very neat three-tube set built electrically from the description of "A Three Tube Knock-Out," published in the February RADIO BROADCAST, and mechanically from the imagination of the builder, F. W. Becker of Gloversville, New York.

The photographs are self-explanatory. The cabinet houses the receiver, B battery and loud speaker, the bell of which is directly behind the burlap screen in the upper right hand portion of the photograph.

The finished instrument is equally worthy of a place in a well appointed library, or in the radio laboratory.

AN EFFECTIVE WAY OF USING A BLOWN OUT AUDIO-FREQUENCY TRANSFORMER AS IMPEDANCE COUPLING

WHEN your last stage transformer succumbs to the strain of high voltages, and either the primary or secondary becomes "open," its usefulness is by no means exhausted. Utilizing the remaining winding as a coupling impedance, the last step circuit can be made over into a final stage of impedance-coupled amplification with very little trouble. Though this system may give slightly less volume than a transformer-coupled amplifier working with a step-up ratio, the resulting quality is better.

Most transformer difficulties in audio-frequency amplifiers can be traced to an open in the primary of the last stage. It is this winding that is subjected to the greatest strain. However, for the purpose of impedance-coupled



FIG. 3

Using the Testometer. It may be operated at a distance from the receiver in order to test it for sensitivity

amplification, it is immaterial which winding survives. If, as it is probable, a perfect secondary is at the disposal of the experimenter, the input efficiency of the last tube will be high. On the other hand, if a primary is employed as the impedance coupling, the output efficiency of the next to the last tube (or that tube in the plate circuit of which the impedance is placed) will be at par—so the effect is that of an average.

Fig. 9 is the diagram of a two-stage amplifier in which the second transformer has broken down, and the remaining winding "X" substituted for the separate primary and secondary. C is a combination isolating-coupling condenser such as used in resistance-coupled amplifiers. Its capacity is preferably .006 mfd., though .0025 mfd. will work very well. R is a grid leak, the resistance of which is best determined by experiment. One fifth megohm is, perhaps, the average value for R. The connection between the minus B battery and the filament lighting battery has been indicated only tentatively by dotted lines. This connection will probably be made in the tuning or detecting circuit where the polarity is often important. The amplifier will operate either way.

The theoretical functioning of the impedance-coupled intensifier is a cross between the action of a resistance-coupled amplifier (see the "Knock-Out Four Tube Receiver" in the June Radio Broadcast) and the operation of the transformer-coupled amplifier. There is, of course, a potential drop across X which is applied to the grid of the succeeding tube through condenser C as would be the case were X a pure resistance. There is

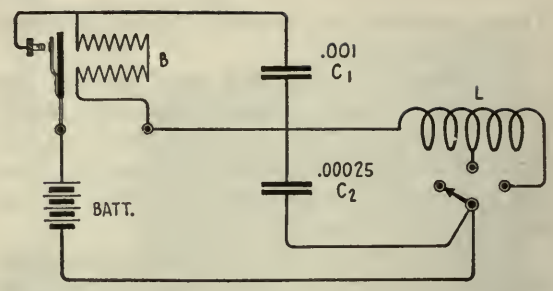


FIG. 4
The circuit of the Testometer. It is merely a wavemeter with two adjustments

also a self-induced potential, an auto-transformer action, caused by the rise and fall of the magnetic flux about the winding, that is similarly impressed on the grid of the last tube. Impedance amplification has the advantage over resistance coupling in that no higher plate voltages are required than are usually applied in the conventional amplifying system. The quality, as before mentioned, is superior to that of a transformer-coupled amplifier. This is partly because there is no step-up ratio which has the effect of magnifying distortions. Also, there are many less turns of highly inductive winding which have an inherent tendency to distort. Due to the perfect quality of output, impedance-coupled amplifiers are used in the Bell system for amplifying telephone speech.

The substitution of impedance for transformer-coupled amplification is not, of course, confined to the last stage. Three reasons, however, recommend it in the final stage. The probable transformer break-down in this position makes its substitution a particularly simple matter, and the impedance-coupled amplifier is much more effective when fed with the "kick" from the first stage of intensification. Also, the last step of amplification, where quality is especially impaired, is the logical position for a stage that amplifies with a minimum of distortion.

The secondary of a Ford spark coil or a telephone repeater coil makes an excellent coupling impedance and might quite well be used by the curious experimenter.

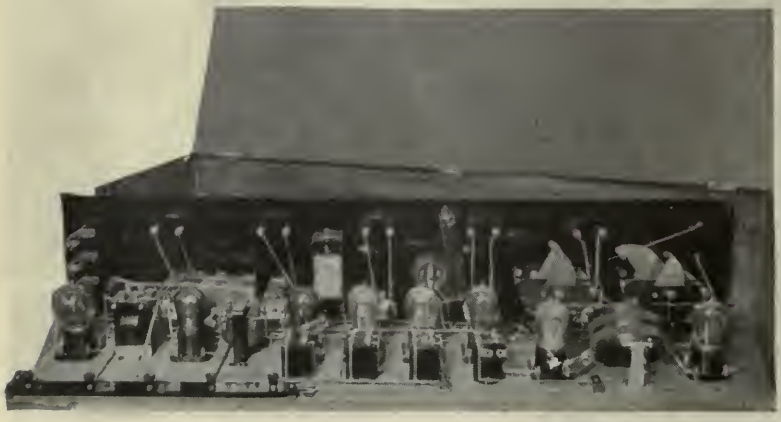


FIG. 5
Behind the scenes in a super-heterodyne built by one of our readers

HOW TO MAKE A VERY STABLE CRYSTAL DETECTOR

FIG. 10 is a photograph of a clever crystal arrangement devised by J M. Dockstader of Perth Amboy, New Jersey. It was designed for use with the single-tube reflex receiver as a compromise between the fixed crystal and the adjustable detector. Mr. Dockstader's little device possesses the stability of the fixed crystal, while permitting the desirable adjustment of the old-style detector. Used in this laboratory, it maintained its sensitive adjustment for two weeks, during which period it was moved about, from shelf to the operating table and back again several times.

Photograph 10 shows the crystal arrangement mounted on a small individual base made of Mahoganite panel material. It can, however, be mounted more conveniently on the panel or base of the receiving set proper. The photograph shows the construction very clearly. The size of the base is about two inches by two inches.

The prongs may be bent from any very stiff wire (they are not delicate cat-whiskers). The designer recommends No. 20 German silver. Two and three quarters inches of wire will be enough for each prong. Small loops are formed in one end, while the other end is flattened and cut with snips or pliers to a spear point. The prongs are then mounted in the position indicated by the photograph (most conveniently with wood screws on the base of the receiver) so that they meet the crystal at right angles to its surface, and with the contact points separated not more than $\frac{1}{4}$ inch. The closer the points are together, the more surface of the mineral there is available for exploration.

The crystal is silicon, *not galena*, and is mounted in a small slab of bakelite or hard rubber. An oblong hole is drilled and cut in the insulating strip to a depth that will flush mount the crystal, which should have a flat surface. A bit of sealing wax is melted into the hole and onto the reverse side of the crystal. While the wax is hot, the mineral is pressed into the hole. Two or more crystals may be mounted on the single strip as suggested in the photograph.

The tension on the two wires should be about equal, and sufficient to hold the crystal firmly against the base. The points should follow the crystal rather than glide over it when it is moved. In some cases it may be of advantage to blunt one of the wires.

The detector is adjusted by moving the crystal with the fingers or tapping with a lead-pencil.

THE WD-12 AND THE REFLEX SET

THE designer of the crystal detector described above, also sends us some operating data on using the dry cell tube in the one-



FIG. 6
A home fit for a super-heterodyne. Note the self-supporting loop

tube reflex receiver, which corroborates our own experience with these tubes as amplifiers.

Mr. Dockstader finds that superior results are obtained with the WD-11 and WD-12 when a higher voltage A battery is employed with a thirty- to sixty-ohm rheostat. The rheostat is placed in the negative filament lead, while the grid return, through the secondary of the amplifying transformer, runs to the negative terminal of the "A" battery. As Mr. Dockstader suggests, the increase in efficiency is due to the bias secured by the potential drop across the rheostat. A fixed resistance should be substituted for part of the extra resistance in order to prevent possible burning out of the tube if too little resistance is used, such as might well be the case if a rotary rheostat were used alone. Equally satisfactory results can be obtained by placing a small C battery, of one and a half to three volts,

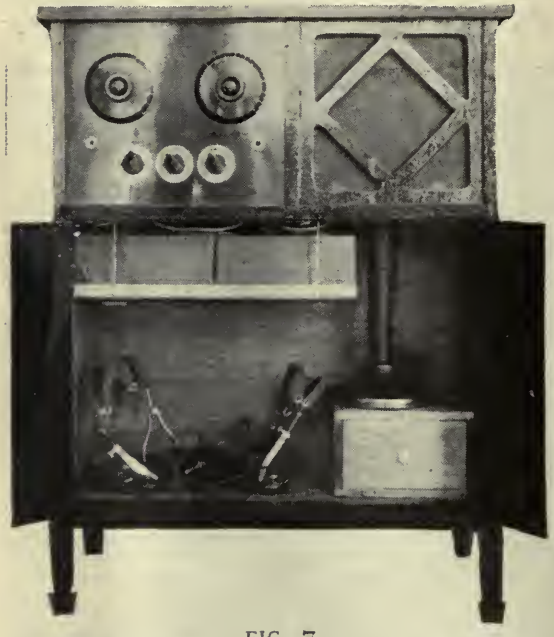


FIG. 7
An interesting example of original construction

negative to the grid, between the lower side of the transformer secondary (T3 in all of our single-tube reflex diagrams) and the negative of the filament battery.

WHERE TO BUY INDIA INK

HIGGINS White Label India Ink, such as was used in the home manufacture of grid-leaks described in the R. B. Lab a number of

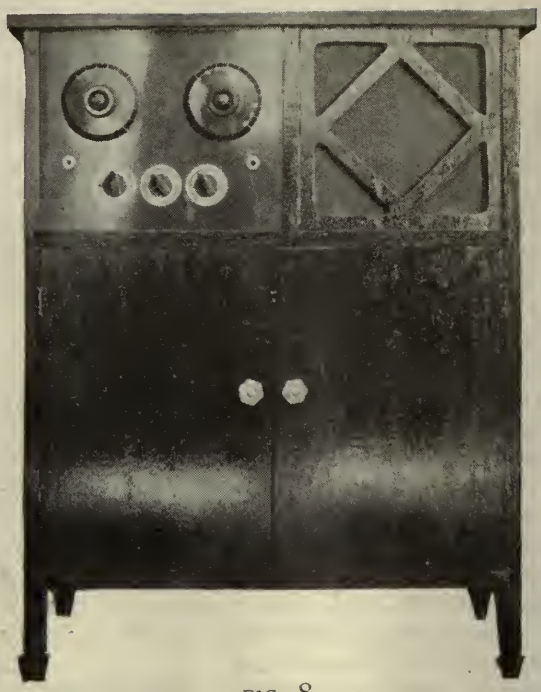


FIG. 8
A Radio Broadcast circuit plus the ingenuity of the builder

months ago can be bought from any large stationery store handling artists' supplies. However, experimenters living in small towns may find it rather difficult to obtain through a local dealer. It is suggested that readers having difficulty in securing this particular grade of ink, order direct from Brentano's, Fifth Avenue and 27th Street, New York City. Thirty cents is the postpaid price for a small bottle—enough for a hundred grid-leaks of varying resistances.

LEAVES FROM AN OLD TIMER'S NOTEBOOK

ELECTROLYTIC RECTIFIERS: In using electrolytic rectifiers of the lead-aluminum type for the rectification of A. C.

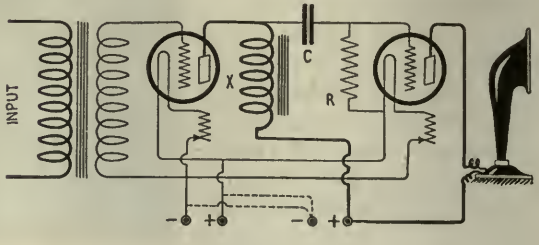


FIG. 9
How to use an amplifying transformer with a blown out winding

for the plate potential in bulb transmission, or for the charging of storage batteries, a slight purple haze about the metal elements, more noticeable in the case of high voltage rectification, is an indication of perfect operation. Defective rectifiers are characterized by sparking and general pyrotechnics in certain jars. This, as is understood, necessitates a replacement of jars, but be sure and replace the jars that do *not* spark. Those that spark are the *good jars*, and spark only because they are overloaded by the inoperation of the inactive cells!

BUILDING YOUR OWN LAB

ANOTHER month rolls by, and the lab is growing. RADIO BROADCAST suggests for July a set of "Spintite" wrenches. These wrenches may be purchased singly, in various sizes, but are most conveniently obtained in the standard set of seven as shown in Fig. 11.

The Spintite wrench is used in place of the usual flat wrench, but works much faster with a screw-driver motion. Two handed co-operation of screw-driver and wrench insures well spun nuts that will not vibrate loose when advanced construction makes access to them difficult or impossible. The intelligent use of these tools will slice many minutes, and sometimes hours, from a difficult assembly job.



FIG. 11
A handy set of wrenches for the laboratory



FIG. 10
An interesting and simple detector
It is almost a "fixed" crystal

HOW TO MAKE YOUR OWN BUS WIRE

CUT some No. 14 bare copper antenna wire into five-foot lengths. Twist one end of a length around a nail permanently fastened and place the other end in the chuck of a hand drill. Then, with a steady pull, turn the handle of the drill first in one direction and then another for a few turns. A stiff piece of round wire, far cheaper than the "store" bus wire, results.

Broadcasting Personality

How S. L. Rothafel, Better Known as "Roxie," Brings the Human Touch to Radio in His Famous Sunday Evening Capitol Theatre Concerts Sent from WEAF, WJAR, and WCAP.—Is "Roxie" the Anticipated Genius of Radio?

By JAMES C. YOUNG

WHAT does the radio public want?

"I don't know."

Such was the answer of S. L. Rothafel, one of the most successful impresarios of the air. Sitting at his big desk in the Capitol Theatre Building on Broadway he confided some of the troubles which beset a radio director.

"No general reply will answer your question," he said, "but perhaps we can state the matter a little differently. It is the personality of the performer that sways or fails to sway the great unseen audience distributed over thousands of miles, but drawn together in a common thought by the pulsations of the air.

"This is the most appreciative audience in the world and also the most critical. Above all else, it is a sincere audience, and accurately measures the human quality of the performer before the microphone.

"When a man begins to speak, let us say, the audience in his vast theater instantly divines whether he knows his subject, whether he merely is speaking in the professional sense, or sends words worth while across the reaches of space. If the man is sincere, moved by high purpose, his audience hands over its confidence; if he is prosaic, indifferent, just talking to kill minutes, his audience is likely to tune-out with one accord.

"I am convinced that the radio performer's personality is more important than his voice, his subject or the occasion. Any of these may be poor or inopportune and still a speaker will succeed. But if his personality is flat, his purpose vague, he certainly will not command respect on the radio circuit."

Mr. Rothafel has a trick of catching one knee in two strong hands, then whirling this way and that in his swivel chair, as he talks. It is not difficult to see why he has caught the imagination of radio audiences. He has a sparkling eye and a moving vitality that impart confidence and enthusiasm. His Sunday night programs broadcast from WEAF, WJAR, and WCAP, are awaited by radio owners everywhere. Certainly there is nothing of the casual, hit-or-miss quality about these programs. They have all the finesse, the completeness and satisfaction of a theatrical performance that just strikes the nail of public favor.



THE PIPE AND "ROXIE"

S. L. Rothafel in an unaccustomed moment of repose. Roxie fairly vibrates his personality through the microphone Sunday nights when he and his gang are on the air through WEAF, WCAP, WJAR

"Sometimes when I am in a radio studio waiting for our turn I study the effects of personalities unknown to me, at the moment they come in contact with the public," said Mr. Rothafel. "There is something psychic about the result. The same waves of the air which are carrying away the words or music of the performer—or other waves of much the same sort—bring back the reflection of the public mind. An experienced

observer can sense in a minute or two whether the performer is succeeding. And without exception I would say that the big factor is personality, no matter what the medium of expression."

"Can't you apply that psychic sense in advance and decide whether a performer will succeed or fail?"

"I hope you will not think me boastful," said Mr. Rothafel," but I never offered more than one number which failed. And that was my fault. I did not present it properly."

> "I am convinced that the radio performer's personality is more important than his voice, his subject, or the occasion. Any of these may be poor or inopportune and still a speaker will succeed. But if his personality is flat, his purpose vague, he certainly will not command respect on the radio circuit."—ROXIE.

The Capitol company—known to fame as Roxie's Gang—includes more than thirty-five performers and his programs range all the way from the severely classical to "Sally in Our Alley." Between times these programs dip into philosophy, poetry, folk lore, and musical compositions of every possible shade. But the presiding genius of this company and these programs is his own most popular performer. The typical Rothafel prelude, introductions and final "Good night," are awaited weekly by an expectant host wherever the far-flung radio waves travel.

The next time a reader hears one of those programs, let him employ his imagination a bit and transport his psychic self to the studio. Here is the microphone, everything is ready, a girl singer steps up to the instrument. Now just observe the impresario. He raises a finger, the girl watches his face, and at the sign of an eyelid she begins to sing.

HOW ROXIE TURNS ON THE PSYCHIC TAP

AS THE first notes rise Mr. Rothafel "registers" for her benefit how she is getting on. Her eyes never leave his face. A wag of the head, a shake of the finger, a change of expression, govern her efforts. For the moment the director is her audience, taking the place of all that multitude, perhaps listening to some old ballad. Mr. Rothafel is no mean actor. He conveys to the girl every emotion which she stirs. He has a plastic, expressionable face; for the moment his own personality drops away. He literally is the audience, sensing just how it feels, and as the girl goes on he carries her over every bad spot in the road—if there happen to be any.

Perhaps her expression is a little over-drawn; maybe the pathos is a trifle too deep. Right there the director shakes his head and frowns and the expression comes down a key, into the more natural, easy mode which is needed. If the girl were singing by herself—on her own, so to speak—she never would know that she had reached a little too far, that her technique had faltered. But with a director at her elbow who literally turns on the psychic tap and interprets for her how the audience responds, she has a valuable aid to genius.

Still Mr. Rothafel says that he cannot gauge what the public wants. That statement is no gesture of modesty; he means to imply that the public wants many things at many times.

"It is deceptive to speak of the public taste," he said. "We have to consider the individual tastes of a great audience we never see. Every person in that audience, if asked the question, would express a different opinion about any number suggested, or any subject. Therefore we must try to unite all of these minds on themes which touch their imagination."

Mr. Rothafel is a bit of a seer when he is not directing programs. Philosophic observations stand forth from his speech. Here he indulged in an analysis of the public mind.

"Imagination is the greatest power in the world," he said. "It is the thing that moves mountains and captures audiences. The public has a quick, sympathetic imagination. We hear a great deal about what the public wants and what it does not want. Once in a while the public has a chance to choose for itself and the choice is always well made. This public of which we hear so much has more intelligence and good taste than it is usually credited with having. There is one secret route to the public heart—first, be sincere; then lay hold of its imagination."

This emphasis on sincerity cropped out several times in Mr. Rothafel's conversation. "We have taken the radio seriously," he resumed. "As yet I do not believe that its potentialities

are understood. It is in a fair way to become one of the greatest mediums of public intercourse. Radio furnishes a similar parallel to moving pictures. As the film performance was an extension of the drama, so the radio widens the possibilities of the spoken word. It brings a speaker or performer in contact with an audience so much greater than we ever conceived of before that one man's power of communication is infinitely magnified.

WHAT RADIO CAN DO FOR OUR SENSES

I BELIEVE that the radio will give us a new appreciation of what language means. In many ways it is the most elastic medium of speech. When we go to a theatre or a public address virtually all of our senses are put to use. We see the speaker or dramatic spectacle, we hear the words or music, we are comfortable or otherwise. Each faculty is employed in some way. The radio audience, seated quietly in its thousands of homes, employs but one sense. All of its faculties are concentrated in listening, probably the simplest of all our conscious efforts, simpler even than the use of sight. Few distractions affect the radio audience. It is at ease. The whole power of its collective intelligence centers in the sound waves which converge in the receiving instruments. Therefore a performer receives a fixed attention impossible to obtain in any other way. For that reason his audience is more critical, more understanding. It comprehends his personality fully and accurately. Its sympathy is whole-hearted when he can command it. Sometimes I have asked audiences to listen in darkness to our programs. The effect is heightened until the man a thousand miles away is in just as intimate contact with us as if he stood in the same room."

When the Capitol company achieved its continued success many cities and organizations invited Mr. Rothafel and his artists to appear in public. That raised a nice point of psychology.

"I was doubtful about the result," he said. "Every person familiar with our radio programs had a conception of how we looked and



"ROXIE" AND HIS CAPITOL THEATRE GANG

Who broadcast each Sunday evening from WEAF, New York. These are thirty-five of the most popular entertainers on the air; they are:

TOP ROW: Clark Robinson, Alfred Lufrio, Joe Wetzel, James Parker Coombs, Pierre Harrower, Victor Arden, Phil Ohman

THIRD ROW: Carl Scheutze, Alex Gluck, Hyman Barmasch, Attilio Bianco, Chas. Thetford, David Mendoza, Ignace Nowicki, Herman Hand, Robert Denti, Louis Schmidt, William Roeschell.

SEATED: TOP ROW: Ava Bombarger, Marjorie Harcum, Gladys Rice, Evelyn Herbert, S. L. Rothafel ("Roxie"), Betsey Ayres, Marguerite McKee, Florence Mulholland, Eugene Ormandy ("The Blue Blond").

SEATED, BOTTOM ROW: Yasha Bunchuk, Tommy Dowd, Douglas Stanbury, Maria Gambarelli ("Gamby"), Susan Dunbar, Bully Robyn ("Wee Willie"), Dr. William Axt ("Dr. Billy"), Alex Kosezgi

acted. It might be a severe strain on their friendship to see us in life. We fully comprehended that we were just ordinary folk like everybody else. Our radio entertainment was the best thing we could do, our finest efforts. We had put into the work all of our hopes and enthusiasm. When the public saw us it might think we were a very ordinary crowd, after all."

But insistent requests brought an experiment. The Capitol company began to appear in public. And no company of entertainers in the world ever had a finer reception. So far these appearances have been few, notably in Providence and Pawtucket, R. I., and Washington, D. C.

"On the way over to Providence, we found that everybody knew us," said Mr. Rothafel. "Our public acquaintance began with the sleeping car porter. He addressed a half dozen of our performers by name just as intimately as though they had been friends for years.

"When we got to Providence the word of our coming had preceded us. I never had such an experience. A newsboy came up to me in the station and said, 'Gee, Roxie, that was a great bill you had last Sunday, and the story you told sure was a whopper.'

"Everywhere we went in Providence, people seemed to know us, first names and all. We were scheduled to appear there in a large store. When the time came a crowd filled the streets for blocks, everybody from mothers with baby carriages to staid business men. And they had such a welcome for us that we felt as if each one was our personal friend. It was a touching thing; it made us realize that we had a great responsibility to the public; that we must do better than ever before if we possibly could. The esteem of those good people was the finest tribute any of us ever had. We left Providence resolving that we would put into our radio programs the best of our hearts and minds."

The Capitol company raised $3,500 in Providence for a charitable purpose, a comfortable sum in Pawtucket, and more than $10,000 for the Walter Reed Hospital in Washington. Mr. Rothafel and his associates hope to obtain radio receiving sets for all the veterans in Washington hospitals.

The affection of radio fans is boundless. Every day or two the Capitol company receives evidence of this regard. A group of citizens in Attleboro, Mass., got together and sent the director a silver loving cup, by way of expressing their good will. It is a dull day in the Rothafel offices when a crate of oranges fails to arrive from Florida or some other token sent by friends far and near.

Each new form of entertainment, of the dramatic appeal, has brought with it the rise of some man who comprehended its

This bit of verse was written by J. P. (Daddy) Coombs and was read on the air by Mr. Rothafel after he and his Gang had made a visit to the Walter Reed Veteran's Hospital in Washington. "Roxie" is bringing all of his considerable radio influence to bear to secure contributions from his radio listeners to equip veterans' hospitals with radio receiving sets.

When darkest night
Falls on our sight
And Life seems dull and gray—
Remember friends
That nature sends
The night to follow day.

Then do not grieve
When dewy eve
Shall change to night's black pall
The breaking dawn
At glorious morn.
Will gladness bring to all.

When shadows loom
From out the gloom
This truth you'll surely find
Turn toward the light
Its radiance bright
Will leave all gloom behind.

A kindly word
Is gladly heard
And treasured in the heart
A bit of song
Remembered long
By friends tho' far apart.

So "There you are"
Friends near and far
Good night. Good night to all
You've heard the song
May joy prolong
Its echoes wher'ere they fall.

possibilities. Perhaps Mr. Rothafel is to be the genius of the radio. His efforts, and the efforts of his company, have caught the public fancy in a more pronounced way for a longer period than the efforts of any other group or individual. Radio programs still are a matter of much uncertainty. No station in the country has been able to decide what the public wants—and Mr. Rothafel says he doesn't know. But evidently the public knows and his guesses about its state of mind are remarkably accurate.

ROXIE'S PROGRAMS ARE EXPERIMENT

LOOKING over the Rothafel programs it is evident that he believes in variety; also that each program is something of an experiment. One of his recent successes was the offering of "Massa's in the Cold, Cold Ground." That is a song which but few Americans of this generation ever heard. It came from the pen of Stephen Foster, author of the many negro melodies which gradually have become American classics, perhaps our only distinctively American songs.

Mr. Rothafel, with the same sure instinct that prompted Foster to write the song, decided to test its possibilities by radio. Any one who has heard these plaintive notes will recall that it is sung almost in a monotone and is especially suited to a mellow voice.

When the singer in this case stepped up to the microphone Mr. Rothafel waited with considerable anxiety for the results from his psychic contact. But the song had not gone beyond the first bars until he signalled "all's well." Then, toward the end, he took the singer's arm and together they walked across the studio, the last melancholy notes gradually blending with the air—that insubstantial element which had just borne to an awed audience the story of an old slave's sorrow that his good master should lie "in the cold, cold ground."

It requires but little acumen to see that Mr. Rothafel is the sort of man who has studied life at close range. He was born on a Minnesota farm back in 1882 and reached New York at the manly age of thirteen. Soon he was employed as "cash boy" in a Fourteenth street store. But he lost the job because his employer thought he had too much imagination, that he was always dreaming. Since then he has changed his job pretty regularly; every time it became narrow and cramped him he struck out anew, until he is directing head of the world's largest motion picture theatre and the leading producer for radio audiences.

He has had a wide range of jobs between the two extremes. These included the work of a book agent and a Marine. He has knocked around the world and rubbed shoulders with all sorts and conditions of men. Doubtless that is why he understands the genus so well. He really got his start in a little Pennsylvania town with a second-hand moving picture machine and a few chairs in an upstairs room reached by way of an alley.

Although without technical musical education this impresario directs orchestras by the sense of feeling, arranges all of his musical selections, devises scenic and lighting effects, and does a dozen other things that are supposed to require the strictest sort of technical training. He long since proved that he understood the public mind better than most men and his later success with radio programs has greatly broadened his field of effort.

Working twelve hours a day, despite all these honors, Mr. Rothafel continues to maintain the common touch. An usher in his theatre said that he was "a regular fellow" and the elevator man thought the same thing. He looks only moderately like his photographs, because they show him in repose and he is always in action. He smiles, frowns, relaxes, concentrates, gets out of his chair and sits down again, with a regularity and rapidity that show the speed and sweep of his mental range.

And at 42 he says that he is just getting ready to do some real work.

WILLIAM H. CARY, JR. has written a tremendously interesting story telling what is the latest in radio from Paris—and the provinces. He has been in France for several months listening-in and talking with radio men everywhere. The article will appear in an early number of this magazine. They are busy with radio in France, and it is not uninteresting to know "what the other half thinks."



ONE OF THE UNITS IN THE PARADE

This super-heterodyne, which is the one described in RADIO BROADCAST last January, is bringing in WOO, Philadelphia, on a loop on Forty-Third street, New York

When Radio Replaced the Brass Band

How New York Radio Dealers Organized a Novel Band-less but not Music-less Parade

BY WENDELL BUCK

CAN you imagine a real, honest-to-goodness parade without brass bands? No. And neither could we until a few weeks ago we saw a truly wonderful parade without a single band in it. But don't mistake us: there was music, and lots of it.

Some weeks ago the New York Edison Company held an electric truck parade down Fifth Avenue. More than four hundred electric vehicles of almost every conceivable size and appearance lined up at Fifth Avenue and Sixtieth Street for the parade. Loops, loud speakers, and receiving sets were installed on many of the trucks. Neutrodynes and super-heterodynes were prominent, particularly the "supers," which certainly did themselves proud so far as supplying good, clear music for the parade was concerned.

The Super-Heterodyne built by the RADIO BROADCAST Laboratory was there in all its glory. Before the parade started, WOO, Philadelphia, came in on a loop loud enough to be heard half a block away, despite the heavy rumble of city traffic. Later KDKA came in fully as loud as WOO.

A hundred odd spectators gathered for the informal morning concert from Philadelphia, clustered about the truck, and asked the wide variety of questions which only real radio fans can ask.

By two thirty all the trucks were lined up with their many loud speakers pouring forth plenty of music to supply ample atmosphere for the parade.

A few minutes and they started down the Avenue.

Thousands of pedestrians stopped, looked, and listened. Several thousand more came pouring from the side streets and stores along the way.

Whenever the trucks stopped for a moment —which was seldom—a good-sized group gathered around each truck to see just what was

going on, and to try to complete their radio education.

Everybody in the parade was happy until the trucks reached certain more or less untravelled streets in Greenwich Village. Then the RADIO BROADCAST super had its acid test, and emerged victorious.

After standing the wear and tear of, let us say, five thousand cobblestones, the five thousand and first proved too much. The R. B. super with its loop fell three feet to the floor of the truck. And, believe, it or not, it worked just as well (possibly a bit better) during and after the disaster.

However, we hardly suggest dropping your own set from anything higher than a book case.

Here's a Good Idea

A thing of interest and novelty itself, there is little more of novelty which can be brought to either selling or owning radio. Radio has definitely arrived at the stage in its development where it has cast off the knickerbockers of novelty and assumed the long trousers of stability. Radio has arrived. But there are always generous quotas of doubting Thomases in every sizeable community whom the radio dealer ought to convince. A parade, such as Mr. Buck describes would be as interesting to the spectator as effective for the dealer.—THE EDITOR.

WHERE THE RADIO DEALER COMES IN

FROM the point of view of manufacturers and radio dealers, the parade was particularly successful. It put radio before the New York public in a novel and impressive way. Thousands who had merely a casual acquaintance with radio, who had a vague desire to know more about it, or even were on the point of purchasing a set, must have been brought a step or two closer to a purchase when they saw the truck parade roll down the Avenue. And many a skeptic regarding radio must have been converted on the spot.

Think of it! Seventy-five radio sets mounted on electric trucks rolling over rough streets and supplying uninterrupted music all the way. And these were not only local programs, but distant ones as well.

The Edison Parade certainly did radio a great deal of good. It didn't make people rush to the nearest radio store to buy a set. *But it sold the practicality of radio* to thousands of new prospects. The next time Mr. So and So, who saw the parade, passes a radio store, he will undoubtedly drop in to hear the various sets demonstrated—and he will probably end in purchasing one.



Courtesy New York Edison Company

READY TO ASTOUND THE NATIVES

A neutrodyne truck in the radio parade swinging into action



Courtesy New York Edison Company

THE PARADE AT REST

Lined up on Fifth avenue alongside Central Park. Signals were poured wholesale from the large loud speaker for'ard on this well arranged Sleeper truck

Radio dealers and manufacturers should profit by the New York example. Why not hold a radio parade in your city? It is sure to arouse widespread interest; and if properly managed should be the talk of the town. Local newspapers will be only too glad to give so novel an event considerable space. And there is no reason why the articles shouldn't be well illustrated. I don't see any reason anyhow for radio and radio dealers hiding their light under a bushel.

How the Radio Voices Look

WGY WOC WLAG WFI



AT WLAG
Is Eleanor Poehler, who announces and directs its radio destinies

AT WOC
Is Frank W. Elliott, manager and occasional announcer of this widely heard and popular station





AT WFI
Is John Vandersloot, announcer and studio director



AT WGY

Is this battery of announcers; they are:
FRONT ROW, left to right: Robert Weidaw, Kolin Hager (chief announcer), Carl Jester;
BACK ROW: William Fay, Asa O. Coggeshall and Edward H. Smith

How to Build a Good Low-Power Transmitter

Using Standard Parts and Good, Yet Not Expensive Methods of Construction

By ASHLEY C. DIXON

This set was built by Mr. Dixon on his ranch at Stevensville, Montana and is known to radio listeners as KFJR on broadcasting, and 7IT, and 7XAF on code work. Amateurs who are interested in building a small transmitter for code and voice should have no difficulty in duplicating Mr. Dixon's transmitter. RADIO BROACAST readers will recall "What Radio Means At a Rocky Mountain Ranch," by Mr. Dixon in this magazine for January.—THE EDITOR

THE following article describes in as non-technical language as possible, how to build an all-purpose transmitter of low power and exceptional range. By all-purpose transmitter is meant one which may be used for amateur CW telegraphy, ICW or modulated buzzer, phone, as well as for broadcasting. This transmitter uses two 5-watt tubes, giving an actual output of about 15 watts on CW and 6 on broadcast. No attempt is made to go into theory or technical details, nor into alternative designs or substitution of parts. It is taken for granted that an exact duplicate of 7IT-KFJR is to be constructed by a person with enough knowledge of radio transmitters to permit his holding an amateur license.

Three pictures of the panel assembly are shown, Figs. 1, 8, and 9, one of the 50-henry choke, Fig. 4 showing comparative size and details of construction, and one of the transmitting room showing location of batteries, switches, etc. There is a panel diagram, Fig. 3 one of the top stage, Fig. 7, another of the base, Fig. 10 and the hook-up, Fig. 2, which many readers will instantly recognize as the Hartley circuit, with Heising modulation system for telephone.

The panel may be selected from any one of the several kinds of panel material now on the market. The writer used mahoganite. The dimensions are 12″ x 20″ x $\frac{1}{4}$″. This panel should be strengthened by some strips of $\frac{3}{8}$″ x $\frac{1}{2}$″ maple around the sides and top edge. Fasten these strips by $\frac{3}{4}$″ brass screws.



FIG. 1

The base is 12″ x 14″, as is the "top stage" upon which will be seen the oscillation transformer, tubes, etc. These two platforms should be of some substantial hard wood about $\frac{3}{4}$″ to 1″ in thickness. Fasten them securely to the panel with 1″ brass screws, and brace in the rear with maple strips as shown in the pictures. You now have the frame upon which to assemble everything but the filter system, and power supply.

WHAT GOES ON THE PANEL

STARTING in the upper left-hand corner of the panel, we find the antenna ammeter. This should be of the thermo-coupled type, and have a scale range from 0 to 1½ amps. In the diagram this instrument is indicated at A. In the right corner is a filament voltmeter, having a scale of 0–10 volts DC. This voltmeter is cut into either tube circuit by a series-parallel switch, both instruments being represented in the drawing at V with the switch just above. The connections as shown permit the voltmeter to be cut out at the vertical position, cut into either tube circuit by turning to the left or right. In the center is the milliammeter, used to indicate the plate current flow. It is represented at M.

These instruments are flush-mounted and considerable care should be exercised in cutting the holes for them. The writer drew circles of the proper diameter, and then cut them out with a hand bracket saw, using ordinary scroll-saw blades. The job is fairly easy if one does not try to hurry it. Just below the top stage, are located the filament rheostats, the knobs of which can be seen in the front view. These are RCA Model PR–535 instruments, and are marked on the diagram. They must be placed in the positive filament lead.

Below the rheostat knobs, and between the two dials can be seen two screws. These hold the inductance L2, which is a 50-turn Giblin-Remler coil, and which is back panel mounted. This inductance, together with the variable condenser C2, is used to control the modulation when the set is used for telephone work. We will return to them later on.

The dials control two .001 mfd. (43-plate variable condensers. Any of the better sort of receiving condensers may be used. C1 is in series with the counterpoise lead (left dial), and is used for wavelength adjustment when working below 220 meters. For broadcasting (258 meters at KFJR) this condenser is cut out by a series-parallel switch which may be seen mounted on the side of the top stage in the pictures, but which is not indicated in the schematic drawing. However, wiring in this switch is a very simple matter.

C2 is the above mentioned modulation condenser, and should have a vernier adjustment as a very fine graduation of capacity is necessary for securing the best modulation and radiation when using the set for telephone transmission.

Below the dials are three jacks. The center one is a "closed circuit" jack into which is plugged the key connection. The key circuit is indicated at K in the drawing. The key is con-

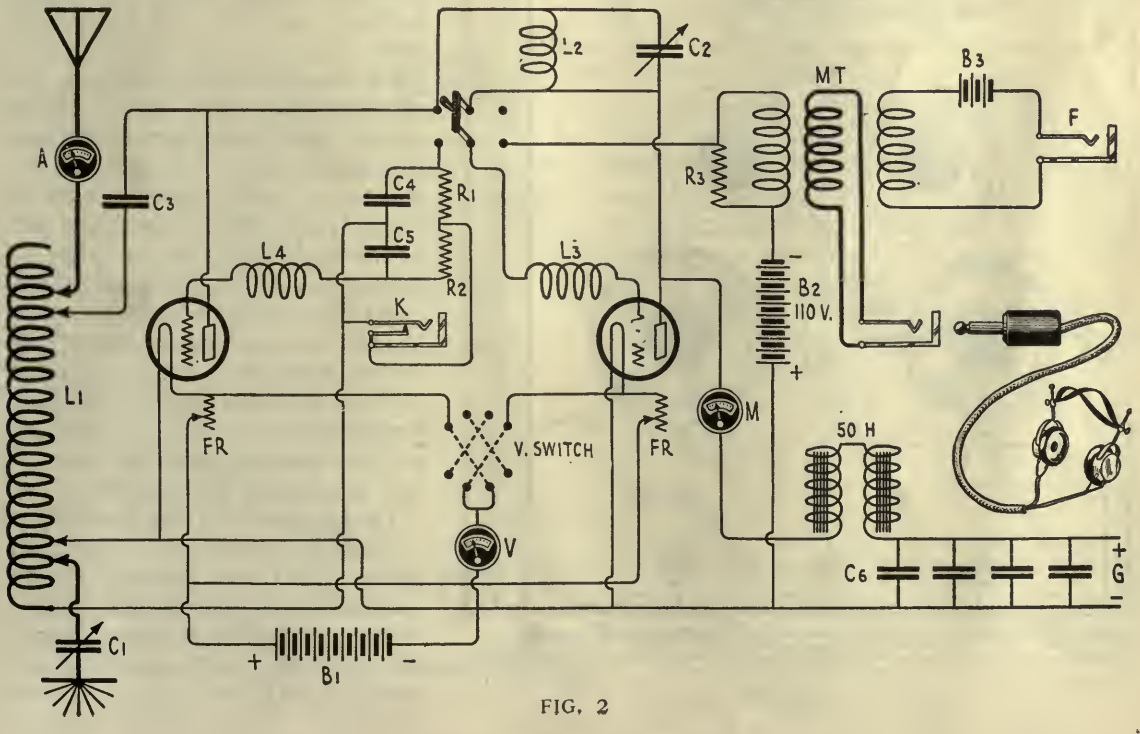


FIG. 2

nected in for CW work with an ordinary plug. The jack at the left is used to connect a headset into the microphone transformer circuit to check up on the volume as shown at MT in the diagram. The microphone F is plugged into the right hand jack which leads to the primary of the microphone transformer. This is a RCA Model UP–414, and is indicated at MT.

THE PARTS USED

ON THE top stage are located the two 5-watt tubes, the grid inductances L3 and L4, the fixed condenser C3, and the oscillation transformer L1. The last is a most important item since an otherwise good transmitter may be ruined by a poor transformer. The one used here, and recommended, is the RCA Model UL–1008. It has the lowest capacity losses of any type of transformer known to the writer.

The condenser C3 is a model UC–1014 Faradon, having a capacity of .002 mfd. and is intended to stand voltages up to 3000 DC.

The tube sockets are placed in front of the oscillation transformer, and are spaced on 6" centers. On either side of each tube is located a small grid inductance, L3 and L4 in the diagram. Here we come to the first piece of home-made apparatus. They are made by winding 20 turns of No. 28 enameled wire on short sections of pasteboard tubing $1\frac{3}{4}$" in diameter. The tubes are mounted on a couple of wood spool ends, screwed to the stage; and the coils connected into the grid circuit as shown.

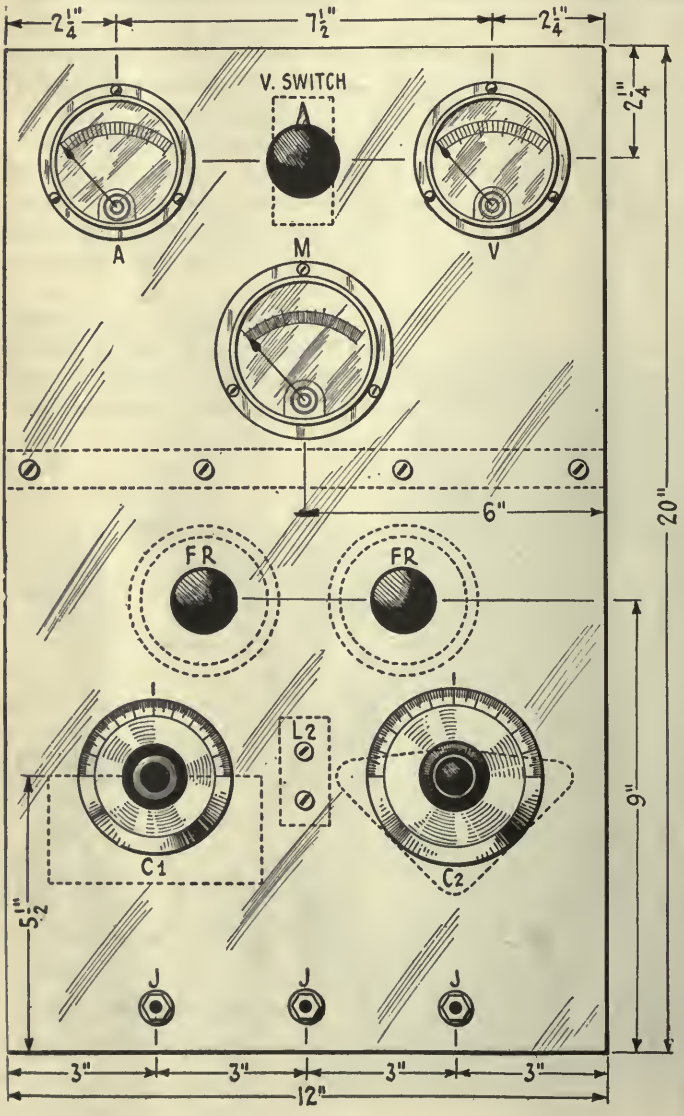


FIG. 3

Next comes the base on which are mounted the following items, all of which can be seen by consulting the two side views of the set. At the back are placed five small No. 4156 Burgess B batteries. These function as grid bias or C batteries, maintaining a negative potential on the modulating grid. There is practically no current drawn from these batteries, and they will last a long time.

On the right side of the base is a small double-pole double-throw switch, used to change over from CW to telephone. In the first instance the tubes are connected in parallel, and in the second, one will act as modulator and the other as oscillator. This last hook-up of the tubes provides for what is known as the Heising or constant current system of modulation, which is, in the writer's opinion, by far the best system known to-day. This switch and its five connections will be noted just below L2 in the drawing.

In the center of the base is the modulation transformer, referred to above as MT, and on the left are located two UC–1014 Faradon transmitting condensers of .002 mfd. each; also two transmitting grid leaks made by the Radio Corporation and



FIG. 4

listed as UP–1719. They have a resistance of 5000 ohms each. The condensers are diagrammed as C4 and C5, and the leaks as R1 and R2.

One more item of especial value is R3. This is an ordinary grid leak of 1½ megohms resistance, and is of a considerable value in clearing up the modulation of music and speech. It is shunted directly across the secondary of MT.

Use ordinary No. 14 hard drawn copper wire for all connections, and cover with a good grade of oiled cambric spaghetti. Use rosin for flux, and have a good connection at every soldered joint.

There are six terminal connections to be brought out, two for the antenna and counterpoise, two for the filament battery, and two for the plate current supply. These may be conveniently located by mounting a couple of small pieces of panel on the side and rear of the top stage, and soldering the several connections to binding posts screwed into these.

Next in order, and quite important from a telephone standpoint, comes the filter system. The inductance in this filter also acts as a plate circuit reactor, keeping the plate current supply constant—a most essential item for the Heising modulation system.

BUILDING THE CHOKE COIL

THE picture of the 50-henry choke coil (50H) gives a good idea of the size and construction of this item. It is made by winding 12,000 turns of No. 30 enameled wire in the form of pies, 1000 turns to each pie. These are wound on a ½″ wide, and 1¾″ diameter square wood spindle, which is fastened to a thin flat board about 3″ square on one side, with a similar piece clamped to the other side, so it can be removed to facilitate taking off each coil as wound. The spindle

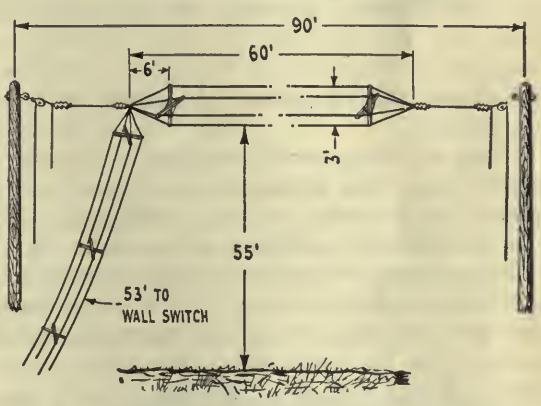


FIG. 5

and side-boards are mounted on a shaft of some sort (a ¼″ bolt will answer nicely) and turned with a crank. It will materially aid in removing the pies of wire if a single layer of string is wound on the spindle before each winding is started, and then pulled out after the side plate is removed.

Each coil, as removed, should be carefully wound with insulating tape capable of stand-

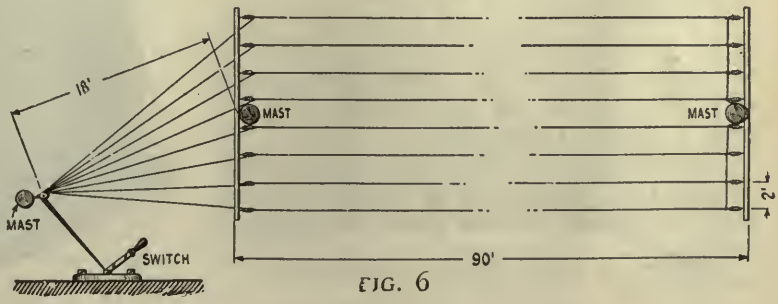


FIG. 6

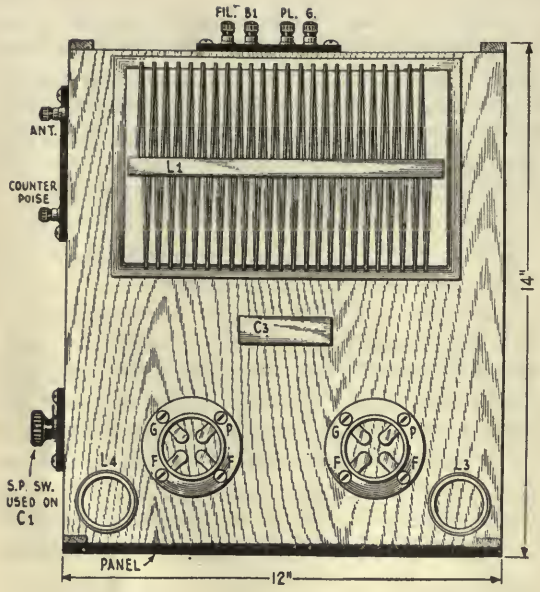


FIG. 7

ing twice the potential delivered by the dynamotor.

The core of the choke is built up of thin strips of silicon steel, alternating long and short pieces on each side, so that the finished job will be of an even diameter at the corner joints, with the sides. The built up core should have a cross section diameter of 1". The thickness of the laminations is of no particular note, except that for convenience the gauge of the metal should permit of its being easily cut to size with a pair of tin snips. The pies of wire are next slipped upon the steel core, and connected up in series, terminating at two binding posts. Four appear in the picture, but only two are used.

A very necessary feature in the core construction is the air gap which will be noticed at the top of the core. This should have an opening of half an inch, or slightly over. The complete inductance may be mounted as shown, or in any way that suits the ideas of the builder. The frame should be of hard wood.

A technical description of the 50 henry choke is given by Ballantine in his *Radio Telephony for Amateurs**, page 178. With the exception of using 500 turns less of wire, our choke is a copy of the Ballantine choke.

The other part of the filter system is simply four 1 mfd. condensers (Faradon UC–490) placed in parallel directly across the generator terminals. These are noted as C6 in the diagram, and their relative position with reference to the choke can be seen. In the general view of the station it might be noted that the choke and condensers are placed in a box behind the switch panel, and directly under the transmitter.

The last item to complete the indoor part of the station is the power source. The plate supply is derived from a 500 volt DC Esco dynamotor. The filament supply is derived from an 8 volt storage battery. Due to the fact that there is no electricity at our ranch, the dynamotor is driven from 12 volts of storage cells. Others more fortunate can use ordinary 110 volt or 220 volt AC supply to run the motor of the motor-generator.

THE ANTENNA SYSTEM

THE writer firmly believes that most of the remarkable success achieved with this particular 10-watt Hartley set is due to the antenna system used. It was adopted after several months of experimenting. And having a goodly number of acres upon which to string wire, the size was not evolved from any lack of space, but rather from the indicated needs of the transmitter.

The masts are too wood poles, about 55′ high above ground, and spaced 90″ apart. The



FIG. 8

*Published by David McKay. Philadelphia, Pa., Price $2.00 net.

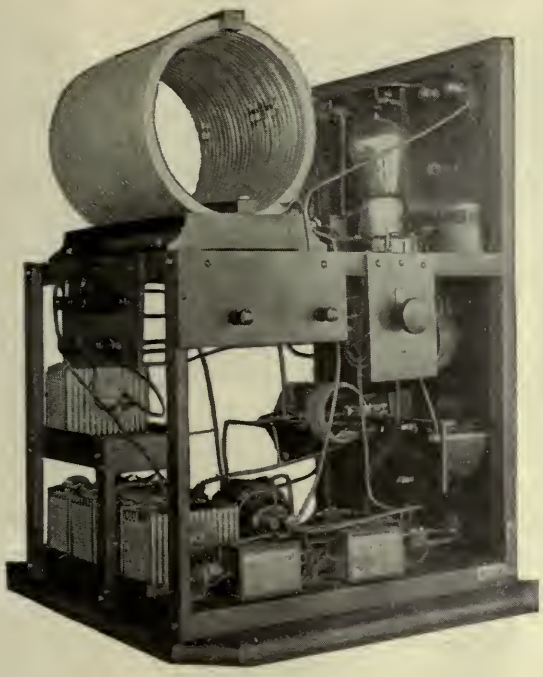


FIG. 9

one at the lead-in end of the antenna is 20′ from the wall of the transmitter room.

The horizontal portion of the antenna consists of four wires in the form of a cage, spaced by light wooden spreaders to a diameter of 3′. The cage is 60′ long, and tapers to a point at each end. The tapering sections are 6′ each. The antenna is supported by two wires extending from each mast and broken by two 10″ electrose insulators at each end. The reason for spacing the masts on a 90′ center, while the antenna is only 60′ long, will be presently seen.

The lead-in is also a cage of four wires, spaced 16″ apart at the top, and tapering to a junction at the grounding switch. The lead-in spreaders are of heavy gauge wire, soldered to the lead-in, and are 8′ apart.

The counterpoise is made of 8 No. 14 copper wires, directly under the antenna, and spaced on 2′ centers. A 14′ piece of 2 x 8 is bolted to the outside of each mast, eight feet above the ground, and the counterpoise wires stretched between insulators fastened to these cross members. The counterpoise wires are connected electrically at the "off" end by a wire soldered to each one, bridging them together. At the lead-in end they are continued past the mast, and drawn together in a long 18′ taper, making the total length of the counterpoise 108′. All eight wires are then twisted into a cable and brought 12′ to the grounding switch, mounted on the outside wall of the transmitting room. It is three feet through the wall and up to the binding posts, from the grounding switches of antenna and counterpoise. The connecting wires are led through 18″ porcelain wall-bushings, protecting the wires for a space of 5″ on each side of the wall.

TUNING THE SET

THE Hartley circuit is very critical in adjustment, and a maximum radiation at the several wavelengths can only be secured by experimenting with the clip contacts on the oscillation transformer. But just as a starting point, the writer will give a couple of adjustments as used at 7IT–7XAF-KFJR. For 195 meter CW work the key circuit is connected at the first turn, the counterpoise at the fourth, the negative filament at the seventh, the plate at the sixteenth, and the antenna at the seventeenth turn. The counterpoise-series condenser is set at 65 on the dial. By adjusting this condenser, wavelengths from 220 to 145 may be secured.

When used for broadcasting on 258 meters, the following adjustments are made. The series condenser is cut out; the grid or "key" circuit is left at the first turn; the counterpoise is connected to the seventh; the filament to the tenth; the plate to the twenty-third; and the antenna to the twenty-fifth turn. Other ad-

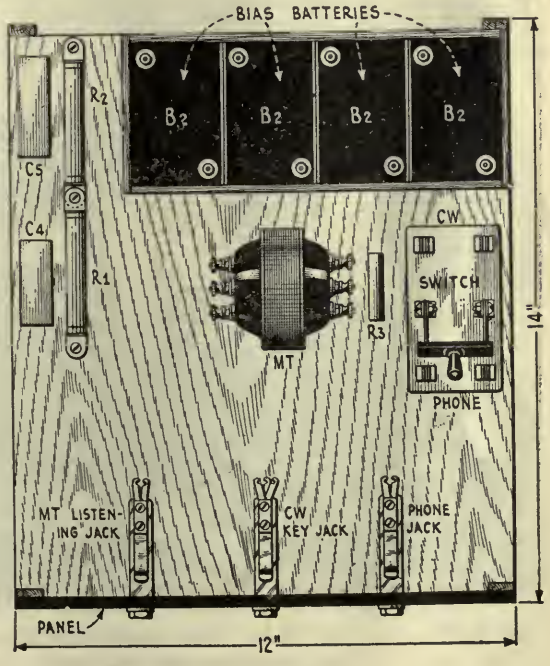


FIG. 10

justments will be found by the experimenter. But in every instance the indicated plate current should be kept below 100 mills for CW and at about 60 mills for telephone. The set will only radiate from 1 to 1.4 amperes on CW and about 1.25 on telephone. But forget the radiation and watch the DX!

The transmitter built by the writer and his son, has been in use for the last six months both as broadcasting station KFJR and amateur station 7IT. As 7IT, the set has been reported as heard in all districts of the country, twice by WNP, once by Mr. W. G. Rose of 46 Trewince Road, London, England and also by Australian 3BQ, Mr. Maxwell Howden, Melbourne, Australia. With it, stations on both coasts have been worked, as have a host of others as far south as New Mexico. The consistent range for CW seems to be something more than 1,500 miles under average winter conditions.

LIST OF PARTS REQUIRED

1 Weston Thermo-ammeter 0–1.5
1 Weston DC Voltmeter 0–10 v.
1 Jewell Milliammeter. 0–300
2 RCA PR–535 Rheostats
2 Branston R-67 Series-Parallel Switches
1 4 inch double-pole double-throw knife Switch
1 43 Plate Dayton Condenser
1 44 Plate Duntley Vernier Condenser
2 Premier Open Circuit Jacks
1 Premier Closed Circuit Jack
1 50L Giblin-Remler Coil
3 RCA UC–1014 Faradon Condensers
2 RCA Tube Sockets
1 RCA UL–1008 Oscillation Transformer
1 RCA UP–414 Microphone Transformer
2 RCA UP–1719 Grid Leaks
1 RCA 1½ Meg. Leak
4 RCA UC–490 Condensers
2 RCA UV–202 Radiotrons
6 Eby "Commander" Posts
500 Volt Esco Generator (Dynamotor or Motor-Generator)
5 lbs. No. 30 Enameled Wire
5 lbs. Silicon Steel (Sheet)
30′ No. 14 Copper Wire, hard drawn
30′ Spaghetti.
1 Mahoganite Panel 12″ x 20″ x ¼″
Hard Wood Base, Maple Strips, Screws, etc.



THE FINISHED TRANSMITTER INSTALLED

At Mr. Dixon's Montana ranch. By following the instructions in the accompanying article, the reader can easily duplicate for himself this transmitter



THE PIT

Center of the world's grain trading. Here daily meet the traders whose transactions regulate the wheat prices of the nation. Through the coöperation of the Chicago Board of Trade and their radio station WDAP, all interested farmers in the vast wheat belt can daily listen to the prices and stock exchange information directly from the Pit

Linking the Farmer with His Market

How the Chicago Board of Trade Brings the Wheat Pit to the Farm

By ROBERT H. MOULTON

MORE than six centuries ago Roger Bacon was scoffed at when he said that machines for navigation were possible without rowers, so that huge ships guided by one man might be borne with great speed; that cars might be made so that they could be moved without a draught animal; and that even flying machines, a device with artificial wings in which a man might soar through the air like a bird, were possible.

What would these scoffers have said if the prophetic Bacon had only gone a little further and added that it was possible, too, for a man situated alone in an isolated spot to hear the voice of the world by use of a seemingly simple device; for the farmer tilling his acres on some remote prairie to snatch from the air a voice which would tell him the exact value of his produce in the world market at almost any hour of the day!

WHAT IS HAPPENING

AND this is precisely what is happening under the latest method of broadcasting grain price quotations by radio telephone. A special survey recently made by the Government through county agricultural agents located in the different states, disclosed that in 2,850 agricultural counties alone there is an average of 51 sets of radio per county, or a total of more than 145,000 sets in such counties.

One of the most important radio stations now broadcasting market news and price

quotations is station WDAP, located on the top of the Drake Hotel and owned by the Chicago Board of Trade. The Board of Trade, indeed, was a pioneer in this work. This radio magic had scarcely astounded the country when the grain trade leaders of Chicago recognized its great value in distributing market information. They were quick to see that it would perform the invaluable feat of linking the country grain merchant with his market, and of keeping the farmer in close and constant touch with all factors which might affect the price of his produce.

Accordingly, the Board of Trade early in the spring of 1922 started its radio service, the market quotations being broadcast from station KYW of Chicago. In spite of the somewhat limited facilities and the newness of the venture its success was instantaneous. Letters and telegrams began pouring in, commending the service, and urging that it be continued and extended. They came not only from individual farmers, but also from country elevators, shippers, banks, business houses and even educational institutions that use the Board of Trade price quotations in class work.

More Than Music From the Air

One farmer in Ohio tells how he got a tip from the ether which yielded him $19.60. The tip was an unexpected rise in the live stock market, coming at a time when the farmer was preparing to sell a shipment of hogs to a local buyer. As a result of listening-in he got in touch with the city market and $19.60 was his profit over the local buyer's quotations, after all shipping expenses were paid.

Since then the farmer has made good use of radio. This is how he links the ether with his agricultural business:

"When I installed my outfit in 1922, I determined to get something from the air besides music. I could receive reports from two large city markets, and a number of smaller ones; and to keep tab on these I bought a ledger.

"At the top of each blank page I wrote down the city where the market was located and the names of the principal dealers therein, with their addresses. This book is kept on the table where the radio is located, and when I have something to market I get in touch with one of these cities, and write down quotations as I receive them. Then I 'tune in' for another city, and get their prices. Afterward, I go over these reports and compare them.

"It is a simple matter then to estimate distance, shipping cost, and so forth and from this I can select my market.

"Dealers in these cities are aware of my method, and I have made arrangements with them by letter to accommodate my shipments at any time. This not only applies to live stock, but to poultry, eggs, and butter. The latter articles are shipped by parcel post the morning after the quotations are received.

"I have a wide range of markets to select from, where formerly I was compelled to depend upon a local buyer's quotations, or those in the newspaper, which were always two days late.

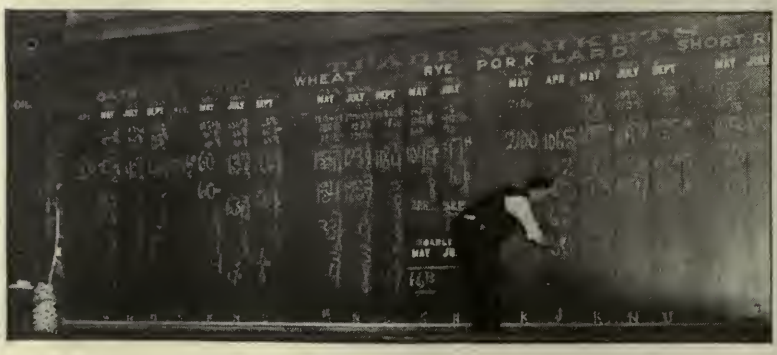
"And the radio offers another advantage: By getting weather reports and crop conditions from different parts of the country, I can guess pretty accurately the trend of the market."—News item in the New York *Times*.

Definite advices soon showed that in Illinois alone nearly five hundred towns and villages were using the quotations. Hundreds of farmers not in easy communication with towns obtained small radio receiving sets for home use. Reports from other states told a story of similar interest in the new service.

HOW WDAP WAS BOUGHT

IT WAS then that the Board of Trade determined upon a permanent, continuous broadcasting service. This led the association to purchase outright the big radio sending station WDAP. The power of this station at that time is indicated by the fact that on many occasions messages were repeatedly sent to steamers 2,500 miles at sea off the Atlantic Coast, the messages being confirmed back by radio telegraph. Yet even this failed to satisfy the requirements of the Chicago exchange, with the result that the station was recently remodeled (July, 1923), making it one of the most complete of any in America.

To-day a lone dealer in any isolated district of the grain belt may tune-in with his small receiving set and in a moment be as



THE RECORD

On this blackboard are posted the price changes as they occur. The radio operator gets his information here and sends it broadcast

fully informed of the value of his grains as are the best posted merchants in the great central markets. Not only does he receive the quotations then being established by trades on the exchange floor of the Board of Trade, but he likewise receives the most intimate and important current market news. This news includes receipts, visible supply, weather, conditions in foreign lands that might have a bearing on the value of American grain, and such other items of interest that help to make up the daily budget of information covering grain production and distribution. Fortified with this knowledge, the dealer, once largely in the dark, is prepared to be judicious about shipping his grain to market.

"RAPID FIRE INFORMATION"

AS FOR the farmer, listen to this letter from a tiller of the soil: "We live on a farm 100 miles northwest of St. Louis, Missouri, and 15 miles away from any railway station. Six months out of twelve we consider a trip to the railroad station a 16-hour job—get up at 4 A. M. and get home around 8 P. M. ourselves and teams worn to a ragged edge. We seldom got prices on wheat, corn, oats, and hogs until they were a week or more old, and so we just had to guess at when it might be a good time to ship our stuff to market. But now, with our little receiving set we get rapid fire information, and we always listen-in to reports before we start to market with our grain, and quite often the neighbors gather here to hear the markets."

This homely letter suggests how one radio receiving outfit can benefit hundreds of farmers, congregating around the crossroads' store or other assembling points. Country banks, mills, and elevators have come to see the importance of having radio receiving outfits for the benefit of the farmers, the market news being posted on bulletin boards where all who come may read.



THE PIT REPORTERS
Who observe and record all price changes in the pit

BEHIND THE SCENES IN CHICAGO

IT IS interesting to go behind the scenes and see the manner in which the price quotations on grain, which reach the farmer by radio, originate.

The daily sessions on the Chicago Board of Trade open at 9:30 in the morning and close at 1:15, except on Saturday when the closing hour is noon. A few minutes before the opening, the spacious trading floor of the exchange is astir. Traders are changing from street coats to light jackets before entering the pits. Messengers are scurrying about, hands crammed with order blanks. From one corner of the room comes the steady click of countless telegraph instruments.

Suddenly, on the stroke of nine-thirty, a giant gong sounds. It is like the crack of a pistol at the start of a hundred yard dash. The pits are galvanized into life. Overnight orders to buy and sell grain and provisions are rapidly executed Buyers, representing the consumer, seek the lowest price. Sellers, representing the producer, seek the highest price. The figure at which these two forces meet represents world values.

In one corner of the room is a huge blackboard on which a man posts the opening prices within a second or two after they are registered in the pits. Seated in a glass cage and overlooking this blackboard is a radio announcer. He is in direct communication with radio station WDAP a-top of the Drake Hotel a mile away, and without an instant's delay is calling off the quotations to an army of dealers and farmers scattered throughout the grain belt.



THE W D A P ANNOUNCER
Sending out the market quotations from his desk in the Board of Trade

One of these farmers, for example, is Jim Pepper, far out on a lonely ranch in South Dakota. He wishes to learn whether the time is opportune to ship his wheat. He steps to his little radio receiving set, tunes in to the 360-meter wavelength, and what he hears runs about as follows:

"This is station W–D–A–P Drake Hotel, Chicago Board of Trade—— Station W–D–A–P. . . . Opening prices on the Chicago Board of Trade. . . . May wheat. . . . One, twelve and a quarter. . . . July wheat. . . . One ten and three-eighths. . . ." So it goes.

The opening prices of the three active futures in each grain, wheat, corn, oats, rye, barley, and in pork, lard and ribs are given. This information is followed by important market comment such as receipts and shipments; estimated car lots; Liverpool cables; estimated cattle, hogs, and sheep; live stock receipts and prices; weather forecast; receipts of hogs; cash grain prices, and so on. Additional market information, including closing futures quotations, is sent out at the close of each session. In the evening, beginning at seven o'clock, musical programs are given which entertain city folks as well as farmers.

It is in connection with his grain, however, that the farmer looks upon the radio news service maintained by the Board of Trade as a real blessing. It has always been a difficult matter for him to choose what he considers the most opportune time to ship his grain. Usually he is not in a position to study the daily price changes, and certainly not on the very day the changes are taking place.

2500 PRICE QUOTATIONS—FREE DAILY

BY THE new radio method the farmer is closely linked with his market. He may have, hot off the wires, the latest news that is likely to affect prices of grain and provisions; he may have the freshest statistical information from Government and other crop reporting sources; he may have price quotations almost while they are being posted. Indeed, all the facilities of the vast crop-reporting system of the Chicago Board of Trade, which have ever been one of the marvels of modern commerce, are now placed at the disposal of the farmer free of charge.

An average of twenty-five hundred quotations, or price changes, on wheat, corn, oats, rye, barley, pork, lard, and ribs are issued from the Chicago exchange on every business day. A majority of this average daily number concerns wheat. Since Chicago is the largest and most important grain exchange in the



"BUY AND SELL"
Orders come in and are signalled to the traders in the pits. Prices at which the transactions are made are noted by the pit reporter and flashed by Morse code to the blackboard operator who posts them. The WDAP announcer then reads these quotations into the microphone

world, these quotations are of vital interest to everyone concerned with the production of distribution of these commodities and to persons in scores of related industries.

Even before radio broadcasting grew to be generally used, every one of these quotations was available in all cities and towns throughout America, where wire facilities are maintained, within a few seconds after the price is registered in one of the pits. This almost instantaneous service is possible by means of the complex and ingenious "ticker" system, which is more or less of a mystery even to members of the grain trade.

Let us follow a single quotation. Commission houses that are members of the Board of Trade have their representatives in the trading pits. We will suppose that a commission house receives an order from a miller or cereal manufacturer to buy ten thousand bushels of May wheat at, say, a dollar and ten cents a bushel. This order is immediately telephoned to the firm's telephone operator on the trading floor. He rushes a memorandum to the firm's representative in the pit and the latter immediately executes the order.

The price at which the transaction was made is noted by an official reporter on a raised platform over the pit. This is possible because all trades, both as to quantity and price, are carried out through the medium of the sign language, or system of signalling with the fingers, employed by the traders, and which is an open book to one familiar with it. The pit reporter writes the price on a slip of paper and flips it to a man at his side, who stamps the paper with a chronograph, a machine which registers the time of the trade down to the second. A third man on the "telegraph bridge" receives the slip, stamps it with another chronograph, and hands it to a telegrapher who operates a master key.

A flash by Morse code places the quotation in the offices of the ticker company. There it is put on the keyboard of the ticker, and is immediately clattering along to hundreds of offices. Meantime, a master circuit on the telegraph bridge has sent the quotation through six automatic repeaters which work with lightning speed and to which is attached a network of wires covering the United States and Canada.

Such rapidity has been attained that the average time consumed from the moment the trade is made in the pit until the price appears on the ticker is only three and three-fifths seconds.

In the past the Board of Trade has spent fortunes in an effort to give the farmer first hand information on the ever-shifting world supply and demand. With the radio, the effectiveness of this service is vastly increased. The complete ownership and operation of station WDAP brings the association no financial return. But it is working to the mutual advantage of the members and their world-wide clientele. It is a step forward in the endeavor of the exchange to acquaint the public in the grain business and out with the operations of the world's greatest grain exchange and the largest international enterprise located in the Middle West.

According to Henry A. Rumsey of the Board of Trade radio committee, plans are now under way to send out from station WDAP complete educational courses, ten minute talks, covering various subjects in agriculture. The first courses will probably deal with grains, beginning with the preparation of the soil, then the planting, harvesting, marketing, and on down the line through the trade channels until it reaches the consumer.

"Our primary object," Mr. Rumsey said, "Is to send out unbiased market reports. In broadcasting reports we do not give out anything that would tend to express opinion of influential persons. We try to give only fair, unbiased information gathered from official sources and a correct report of the value of the products. From this information we hope the farmer will be able to determine the value of his products and know when he is being offered a fair price. Our interest in the radio is from a strictly service point of view." The president and secretary are the only members of the Board of Trade who are allowed to speak from station WDAP.

ONE of the best-known old timers in wireless is John R. Irwin the operator at Siasconsett in 1909 who received the CQD distress signal from Jack Binns on the "Republic" and so took a most important part in one of the first radio rescues at sea. Mr. Irwin was the first air wireless operator on Walter Wellman's dirigible "America" which set out in 1909 to cross the Atlantic —and failed. But Mr. Irwin and his pioneer wireless outfit saved that brave crew of six from drowning. He tells the story himself in RADIO BROADCAST *for August.*

Results of the "How Far" Contest

Who Won the Six Prizes in the Two Contests and How Far They Heard

DECIDING one of RADIO BROADCAST's distance receiving contests is only a shade less difficult than the biblical difficulty that wise King Solomon had in deciding the ownership of the infant. The decision in both the divisions of the contest—that for home built sets and that for bought or ready made receivers—was not altogether based on the total mileage, but on the entire character of the contest entry, of which the requested photographs, description, and diagram, as well as the log, were a part.

Entries there were of all sorts, some of which admittedly did not comply with the terms of the contest but were sent in as a bit of sport—most of these were fine. For instance, there was R. Bartholomew, of Garrochales, Porto Rico, who won our last "How Far Have You Heard?" contest, who sent us in a carefully typewritten log of stations he heard on his prize set, the De Forest D-10 which he received last May. And from Apia, Samoa, came a long-delayed letter from Mr. Quincy F. Roberts, the American vice-consul, with his entry, which contained some phenomenal "longest single jumps." And, it must be confessed, there were some entrants whose riotous imagination led to ridiculous entries on their logs. Those few got scant attention.

THE WINNERS

READY MADE RECEIVERS

		Prize Won
First Prize	Mrs. Eva L. Rhodes Utica, N. Y.	Mu-Rad, type MA-15 receiver
Second Prize	O. B. Evans, Mount Pleasant, Michigan	Fada Neutrodyne "160"
Third Prize	Alex. B. Nicol, Bogota, New Jersey	Sonochorde Loudspeaker

HOME BUILT RECEIVERS

First Prize	Dr. W. C. Wolverton, Linton, North Dakota	Complete set of parts for Haynes super-heterodyne
Second Prize	M. F. Winne, Webster Groves, Missouri	Complete set of parts for a "Knock-Out 3-Tube Set" described in February RADIO BROADCAST
Third Prize	Kenneth Danielson, Thermopolis, Wyoming.	Complete set of parts for "Knock-Out 3-Tube Reflex Set" with Sodion detector tube.

A FEW REMARKS

IN OUR distance receiving contests, the first prize has been won by a woman. It was accomplished by Mrs. Eva L. Rhodes of Utica, New York, who logged a total distance of 85,510 miles, with best single jump of 2,480 miles, and a total of 140 stations heard. The second prize winner in the first group, Mr. O. B. Evans, of Mt. Pleasant, Michigan logged 84,620 miles, his best single jump was 2,345 miles, and he heard a total of 129 stations. Mr. Alex. B. Nicol, of Bogota, New Jersey was the third prize winner. He heard 93 stations totalling 68,520 miles with best single jump of 3,149 miles.

ABOUT THE HOME BUILT SETS

ONE of the best and most complete logs of reception we have ever seen came in with the winning contest entry of Dr. W. C. Wolverton, of Linton, North Dakota who received 148 stations during the contest period totalling a distance of 121,535 miles with the longest single jump 3,000 miles. The second prize winner, Mr. M. F. Winne, of Webster Groves, Missouri heard 175 stations with a total distance of 115,088 miles, and his best single jump was 2,070 miles. Kenneth Danielson of Thermopolis, Wyoming, won the third prize in the home built sets division with 149 stations totalling a distance of 135,190 miles. His best distance jump was 2,180 miles.

WHAT THE CONTEST PROVES

IN AN early number, we shall publish a list of the entrants in the contest, the distance they succeeded in attaining, and the type of receiver they employed. These facts, taken together with the location of the contest entrant should provide some very interesting reading for those who are curious to know what a given type of receiver with ordinary intelligent handling will do in a given locality. Many receivers were ruled out of this contest because they were radiating. RADIO BROADCAST is firmly opposed to radiating receivers. If radio receiving is to be made pleasantly for everyone, radiating receivers cannot continue in use. And in this connection, it is interesting to note how generally interference from radiating receivers was recorded on the logs of the contestants. So, every receiver whose performance was considered in this contest was a non-radiating receiver. See what they did!

How the Vacuum Tube Works

WHAT MAKES THE WHEELS GO 'ROUND: V

By WALTER VAN B. ROBERTS

The central feature of most radio receivers—and indeed of modern radio transmitters as well—is the vacuum tube. It cannot, therefore receive too much attention. "How the Vacuum Tube Works" is the fifth article in Mr. Roberts' series which began in March. Each article is a unit in itself and those who did not start reading with the first article will have no difficulty in starting now.—The Editor.

A QUALITATIVE idea of the process of detection can be got from Fig. 21. A simple but complete receiving set is shown, along with the grid potential-plate current characteristic of the tube for the particular plate battery voltage used. A three-volt C battery is assumed, and the dot on the characteristic at minus three is called the "operating point" because it is about this point that fluctuations occur. When radio waves of the frequency for which the antenna is tuned are arriving, they cause current of the same frequency to flow in the antenna circuit, of which the coil is a portion. These currents flowing through the reactance of the coil produce alternating potential differences between the ends of the coil and hence fluctuations of the grid's potential relative to the filament. From the way the characteristic curve bends, it is easy to see that if the grid potential moves one volt to the right the plate current will increase more than it would decrease if the grid potential moved one volt to the left. Thus if the grid potential is fluctuating between the values —2 and —4 (at any frequency) the average value of plate current will be greater than if the grid potential were fixed at — 3. Furthermore, if the grid potential alternates between — 1 and —5 the effect is still more pronounced. As a result of this we may say that the average value of plate current is increased by the presence of high-frequency current in the antenna, and the amount of increase is greater the greater the current in the antenna. Hence the average current through the receivers varies in the same way as the voice current used at the transmitting station to modulate the radio waves, so that the voice is reproduced by the receivers. A "soft" or gas-filled tube detects in the same way, but is more sensitive owing to peculiarities in its characteristic. However, to get the advantage of these "kinks," a critical adjustment of filament current and plate voltage is required, for which reason the "soft" detector is not recommended for general use.

46. THE "SQUARE LAW" FOR DETECTION

THIS same result may be reached in a more quantitative fashion by using the previously mentioned equation for plate current, $i_p = K (B + \mu \times \text{grid potential})^2$. For suppose the voltage input to the grid is a sin pt, where a is the amplitude of the alternation of grid potential. Then $i_p = K [B + \mu (C + a \sin pt)]^2 = K [(B + \mu C) + \mu a \sin pt]^2 = K (B + \mu C)^2$ which is direct current of constant strength $+ 2 K \mu (B + \mu C) a \sin pt$ which is radio-frequency current, for above audible frequency $+ K \mu^2 a^2 \sin^2 pt$ which reduces to radio-frequency current of twice the wave frequency plus a new direct current of strength $\frac{1}{2} K \mu^2 a^2$. This last term is the addition to the normal direct current through the receivers, and is greater the greater the amplitude of the incoming waves, as was concluded previously. This analysis however shows *ex-*

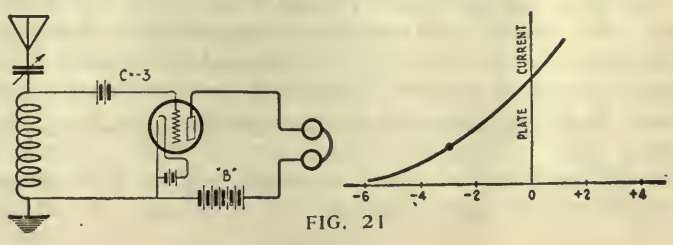


FIG. 21

actly how the average current through the phones varies with the amplitude of the incoming waves; it varies as the *square* of the amplitude. The fact that the detected current varies as the square, and not merely directly as the amplitude, is very important, for reasons that will be taken up in connection with radio-frequency amplification later on.

47. DISTORTION

TO OBTAIN a complete analysis of demodulation, however, we must substitute in the equation for plate current the whole sum of frequencies that compose the modu-

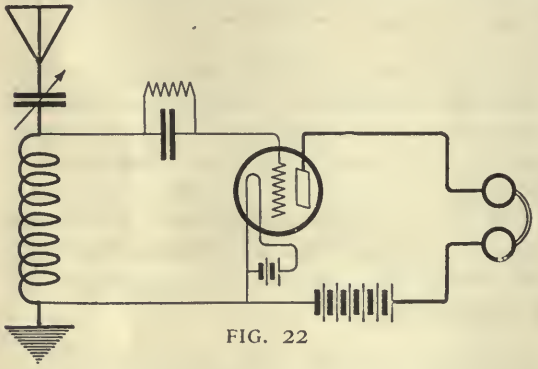


FIG. 22

lated waves. Let the voltage input due to the carrier be a sin pt, and that due to the upper side band $\Sigma\, b_i \sin (p + q_i)\, t$ and that due to the lower side band $\Sigma\, c_j \sin (p - q_j)\, t$ where $\frac{q_{i,j}}{2\pi}$ may be any frequency from say 30 up to 5000, and b_i and c_j are the amplitudes. The Σ indicates in a shorthand way that we are considering the sum of all such terms present. The equation for plate current then becomes $i_p = K[(B + \mu C) + (a \sin pt + \Sigma\, b_i \sin (p + q_i)\, t + \Sigma\, c_j \sin (p - q_j)t)]^2$. The expansion of this into a sum of simple terms is quite straightforward but rather tedious. Neglecting steady direct currents and currents of frequencies above audibility, we get as a result of the expansion not only the terms proportional to $\Sigma\, ab_i \cos q_i t + \Sigma\, ac_j \cos q_j t$ *either* of which represents the frequencies present in the original voice, but also a term proportional to $\Sigma^2\, b_j c_j \cos (q_i + q_j)t$ which represents frequencies not necessarily present in the original voice, but of small magnitude compared to the desired terms if the coefficients b_i and c_j are small compared to a. If these coefficients are very small the quality of the received voice is good but the incoming waves are so little modulated that the signals are weak. If the coefficients are large (that is, the waves are strongly modulated) then the signals are strong but the quality is impaired by the extraneous frequencies becoming noticeable. A compromise must be struck at the transmitting station between overmodulation and consequent distortion and undermodulation and loss of signal strength.

48. DETECTION AND HOW THE GRID CONDENSER AND LEAK OPERATE

A DIFFERENT method for detection than the above is the one commonly used as it is somewhat more sensitive. The difference as shown in Fig. 22 is the removal of the C or "grid bias" battery and the substitution of a small capacity condenser shunted by a very high resistance. The operation of the circuit may be roughly outlined as follows: in the absence of incoming waves the potential of the grid is the same as that of the filament. Incoming waves cause the grid to become alternately more positive and more negative than the filament. While the grid is more negative nothing happens, but while it is more positive it attracts electrons. These electrons cannot get off the grid once they are on it (the grid is not hot like the filament) except via the high resistance which is called the grid leak. If for

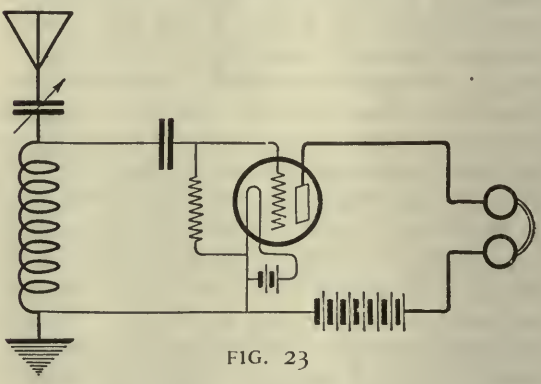
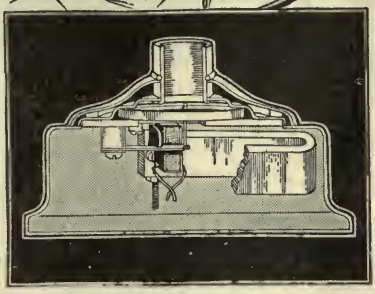


FIG. 23

the moment we suppose there is no grid leak provided, we can see that after a very few waves have come in the electrons drawn to the grid will charge it to a steady negative potential equal to the maximum instantaneous potential of the top of the coil in the antenna circuit. This steady negative potential causes a reduction in the plate current. Even if the waves cease coming in or their amplitude is diminished, the grid retains its negative charge since there is no way for the electrons to get off it. So we put in a very high resistance path by which they may slowly (compared to the wave



THE mechanical principles of Magnavox Reproducers are as marvelous as the vocal chords of a great singer.





M4

The latest Magnavox Reproducer; beautifully finished. Requires no battery.

$25.00

The Reproducer Supreme with a Human Throat

The semi-dynamic mechanism of the new Magnavox M4 Reproducer, shown above, insures utmost clearness of tone—a remarkable advance over the ordinary instrument requiring no battery. There is a Magnavox for every type of receiving set.

Magnavox Reproducers—R3 and R2 electro-dynamic with Volume Control; M4 and M1 semi-dynamic, requiring no battery . . . . . $25.00 to $50.00

Magnavox Combination Sets—the only instruments combining electro-dynamic Reproducer and Power Amplifier in one unit $59.00, $85.00

Magnavox Power Amplifiers—the most efficient audio-frequency Amplifiers; one, two and three stage $27.50 to $60.00

To obtain the fullest usefulness and enjoyment from your receiving set, equip it with Magnavox—for sale at good dealers everywhere.



R3

New Model with Volume Control

The famous electro-dynamic Reproducer; operates soft, medium or loud as desired.

$35.00

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frequency) escape so that if the amplitude of the incoming waves slowly (i. e., at voice frequency) diminishes, electrons will leak off until the grid potential drops to the new maximum value of potential at the upper end of the coil. Thus the potential of the grid more or less faithfully follows variations in the *amplitude* of the incoming waves and hence causes the plate current to do the same, which is exactly what is required for the purpose of demodulation. In this system, the greater the strength of incoming waves the *less* the plate current, exactly the reverse of the other system. The connections shown in Fig. 23 are often recommended. In this case the grid being connected to the positive end of the filament draws electrons all the time, but similarly to the type of demodulation (first described, the grid current increases more during the positive half wave than it decreases during the negative half, so that the result is the same.

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM APRIL 19 TO MAY 16 INCLUSIVE

CALL LETTERS	LOCATION	(KILOCYCLES)	WAVE-LENGTH	POWER (WATTS)
KFPX	Pine Bluff, Ark.	1240	242	100
KFPY	Spokane, Wash.	1060	283	100
KFQB	Fort Worth, Texas	1180	254	100
KFQC	Taft, Calif.	1320	227	100
WCBW	Macon, Ga.	1330	226	10
WCBX	Newark, N. J.	1290	233	100
WCBY	Buck Hill Falls, Pa.	1120	268	10
WCBZ	Chicago Heights, Ill.	1210	248	50
WDBA	Columbus, Ga.	1270	236	20
WDBB	Taunton, Mass.	1310	229	10
WDBD	Martinsburg, W. Va.	1120	268	5
WDBE	Atlanta, Ga.	1190	252	10
WDBH	Worcester, Mass.	1120	268	100
WDBI	New Orleans, La.	1240	242	10
WDBJ	Roanoke, Va.	1310	229	20
WDBK	Cleveland, Ohio	1210	248	100
WDBL	Stevens Point, Wis.	1080	278	500
WDBN	Bangor, Maine	1190	252	5
WGN	Chicago, Ill.	810	370	1000
WRBC	Valparaiso, Ind.	1080	278	500

LIST OF BROADCASTING STATIONS DELETED MARCH 1 TO APRIL 30

CALL	LOCATION	CALL	LOCATION
KDYW	Phoenix, Ariz.	WEAS	Washington, D. C.
KDZF	Los Angeles, Calif.	WIAR	Paducah, Ky.
KFCM	Richmond, Calif.	WJAF	Muncie, Ind.
KFDL	Denver, Colo.	WJAZ	Chicago, Ill.
KFEJ	Tacoma, Wash.	WJH	Washington, D. C.
KFHS	Lihue, Hawaii	WKAY	Gainesville, Ga.
KFJW	Towanda, Kans.	WMAW	Wahpeton, N. Dak.
KFOB	Minneapolis, Minn.	WMAZ	Macon, Ga.
KNV	Los Angeles, Calif.	WPAH	Waupaca, Wis.
KSS	Long Beach, Calif.	WPAQ	Frostburg, Md.
KUS	Los Angeles, Calif.	WQAD	Waterbury, Conn.
KXD	Modesto, Calif.	WQAV	Greenville, S. C.
WABK	Worcester, Mass.	WRAD	Marion, Kans.
WBAD	Minneapolis, Minn.	WRAZ	Newark, N. J.
WBBI	Indianapolis, Ind.	WSAH	Chicago, Ill.
WCAY	Milwaukee, Wis.	WSAL	Brookville, Ind.

TOTALS

Number of U. S. broadcasting stations	584
Number of Canadian broadcasting stations	44
Number of Cuban broadcasting stations	34



★

R E L

$5.00

ULTRAFORMERS
Types A and B

New improved long wave frequency transformers, especially designed by R. E. Lacault, A.M.I.R.E., Consulting Radio Engineer of this company and inventor of the Ultradyne.
The Ultraformer (Type B) may be successfully employed in any circuit where long wave radio frequency transformers are essential.
To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. Ultraformers are guaranteed so long as the seal remains unbroken.



Send for 32 page illustrated book, giving latest authentic instructions on drilling, wiring, assembling, and tuning 6 and 8 tube Ultradyne receivers.

50c

Selectivity

WDAR—PHILADELPHIA—395.
12.02 P. M.—Arcadia Concert Orchestra; organ recital.
2.00 P. M.—Arcadia Concert Orchestra.
5.15 P. M.—Dance music.
7.30 P. M.—Dream Daddy.
8.00 P. M.—Palmetto Coon and soloists.
10.00 P. M.—Features from Fay's Theatre.

WDAF—KANSAS CITY—411.
5.30 P. M.—Musical program.
10.00 P. M.—Dance music and comedy.
3.45 A. M.—Nighthawk Frolic; Coon Sanders Orchestra.

PWX—HAVANA, CUBA—400
7.30 P. M.—Bedtime story for children.
7:40 P. M.—French Night at the Hotel Kimball studio; program to be announced by Attorney David Lavigne.
8:50 P. M.—Concert by Laurilla Hallingerson, soprano; Jaroslav Polica, harp; Orchestra, Ted Jones's

WOR (405 Meters).
6 00 P. M.—Alabama Theatrical and Instrumental exservice men under direction of Professor Gil.
8 00 P. M.—Continuation of program by Anna Bassig, soprano. Program—"The Rosary," "Suchtime," "Light," "Four-leaf Clover."
8 45 P. M.—Violin solos by Lillian Dell.
6 15 P. M.—Music While You Dine.

WEAF (492 Meters).
4 00 P. M.—Bob Fridkin's Clifford Lodge Orchestra.
4 00 P. M.—Marjorie Fullerton, coloratura soprano, accompanied by Eleanor Owens. Program—"Hot Mrs. Piper" (Curran); "The Giraffe" (Kern); "If No One Ever Marries Me."
4 30 P. M.—William F. Sweeney, baritone, accompanied by Winifred T. Barr.
5 00 P. M.—Women's program under the

—*A dominating feature*

An Ultradyne Receiver operating in New York City can easily tune out the powerful broadcasting of WOR Newark, N. J., **405 meters** and bring in WDAR Philadelphia—**395 meters;** PWX Havana, Cuba—**400 meters;** WDAF Kansas City—**411 meters.** Regardless of close similarity in wave length, the Ultradyne selects any station—brings in broadcasting clearly, distinctly, faithfully.
The "Modulation System" of radio reproduction is used exclusively in the Ultradyne. It is the latest achievement of R. E. Lacault, A.M.I.R.E., Consulting Radio Engineer of this company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.
The "Modulation System" increases the sensitiveness of the Ultradyne over that of any known receiver. Weakest signals are made to operate the loud speaker. A superior instrument to even the famous Super-Heterodyne.

Ultradyne performance is the envy of the radio industry.

Write for descriptive circular

ULTRADYNE

The Improved

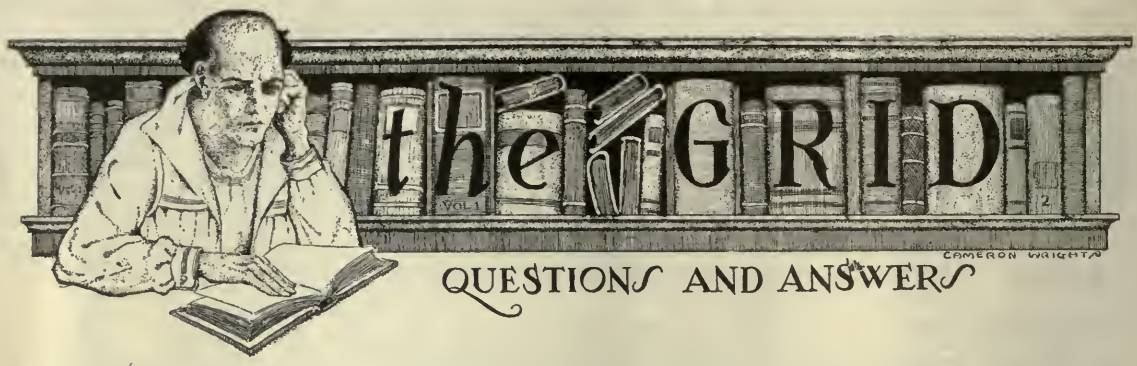
SUPER-HETERODYNE

PHENIX RADIO CORPORATION
5-7 Beekman St. New York



"The Standard of Comparison"

★ Tested and approved by RADIO BROADCAST ★



QUESTIONS AND ANSWERS

QUERIES ANSWERED

PLEASE EXPLAIN IN DETAIL THE NEUTRALIZATION OF THE ROBERTS CIRCUIT . . . *J. B. D.*, Galveston, Texas.
WHAT IS THE ADVANTAGE OF USING A COUNTERPOISE WITH MY RECEIVER? . . . . *G. B. N.*, Cleveland, O.

PROPERLY NEUTRALIZING THE ROBERTS CIRCUIT

HERE is a further explanation of the system employed by Mr. Roberts to overcome oscillation in the radio-frequency amplifier. Detailed instructions for their construction appears in the articles by Mr. Roberts in the April and May issues of RADIO BROADCAST. The winding N is used to prevent regeneration. The coils N and P are wound on the same form and as close together as is physically possible.

Assuming that the set has been made, proceed as follows: Turn the tickler coil up so that it is closely coupled to the secondary coil in the detector circuit. Using the variable condenser shunted across the secondary, tune-in the whistle of a transmitting station and then fix this adjustment. Then slowly rotate the first variable condenser, first one way, then the other, listening to the changes in intensity, not pitch, of the squeal. If it so happens that the squeal first increases gradually then quickly slumps down, then quickly increases and quickly decreases, it is evident that the proper balance has not been obtained. Try sliding the neutralizing tube in the opposite direction of its original position for only a short distance and repeat the variation of squeal intensity. When the neutralizing tube has been adjusted so that at a certain point on the dial of the first condenser there is a comparatively quiet spot a few degrees either side of this point but gradually and equally increasing, and decreasing as the dial is rotated further away from this point, the proper location for the neutralizer has been found. This explanation will be better understood by referring to Fig. 1. "X" shows the silent point extending from B to C while A-B indicates a gradual increase in intensity and C-D indicates a gradual decrease in squeal intensity.

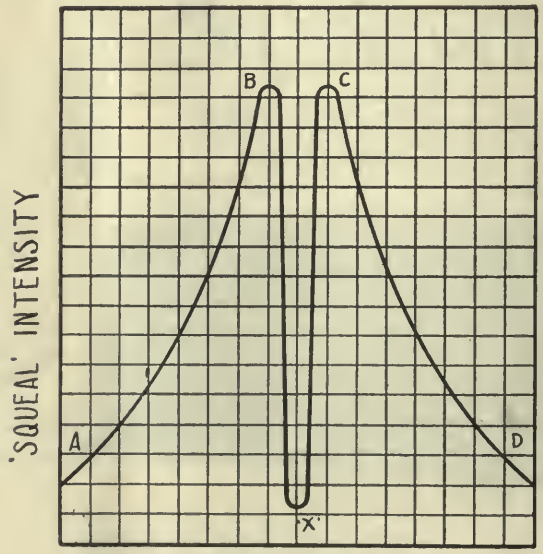


FIG. 1

A COUNTERPOISE FOR THE RECEIVER

SHARPNESS of tuning without any sacrifice of volume has been the goal of many constructors who "build their own." The need for sharper tuning has manifested itself more in the larger cities having several broadcasting stations, and when using certain types of receivers, especially the reflex set.

One of several ways to obtain this sharpness of tuning is by the use of a counterpoise instead of the usual grounding arrangement. A counterpoise is very similar to an antenna, is composed of one or a number of wires and is insulated in the same manner as an antenna. Usually it is placed beneath the antenna and elevated from the ground by several feet, to suit the taste of the individual constructor. If there is danger of tripping persons by having it quite near the ground, then it will have to be elevated at least "head high."

For use in the city, where such a system most applies, the counterpoise may be erected in the cellar or basement of the house, when the other space is not available. If this is the case, suspend the wire or wires from the ceiling far enough so that there is no chance for it to touch other objects.

The important point to remember is to have the counterpoise insulated up to the receiver. A general idea of counterpoise construction may be had from Mr. Dixon's article in this issue.

"The Choice of Radio Experts"

Specially Designed

For the Super-heterodyne and Long Wave Reception



Shielded Electro-statically and Electro-magnetically

TYPE 271

Medium Frequency Transformer

AMPLIFICATION of wavelengths around 10,000 meters falls between the ranges of radio and audio frequencies. It, therefore, requires a transformer materially different in design from radio or audio frequency transformers. The type 271 M. F. Transformer is specially designed to meet the specific requirements of medium frequency amplification. For use in the Superheterodyne and in long wave reception it is unequalled.

It is shielded electrostatically and electromagnetically.

Very compact and rugged. An instrument of high electrical efficiency.

★ *Price, $5.00*

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New Equipment



THOROPHONE LOUD SPEAKER

The new Thorophone is built on the solenoid principle, with a constant air gap which prevents varying impedance in the receiving set when the speaker is being used. It has a power amplifying unit, and the horn is of thorite. This composition is cellular and it will not resonate with any sound wave. It is a very good speaker. Made by Winkler-Reichmann Co., 4801 So. Morgan St., Chicago, Ill. Price $45.00



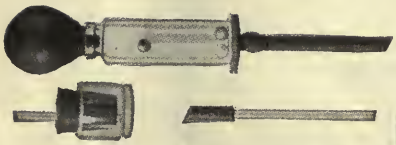
NA-ALD SUPER DE LUXE DIAL

Like the other Na-ald dials, the Super De Luxe is manufactured from black bakelite. It is made in the $3\frac{1}{8}$" size with the graduations clearly marked in white. Made by Alden Mfg. Co., Springfield, Mass.



TUFGLAS BATTERY TRAY

A practical and satisfactory means of insuring your rugs and carpets against damage from the acid electrolyte. Made by Russell B. Cressman, 200 Fifth Ave., New York. Price $1.50



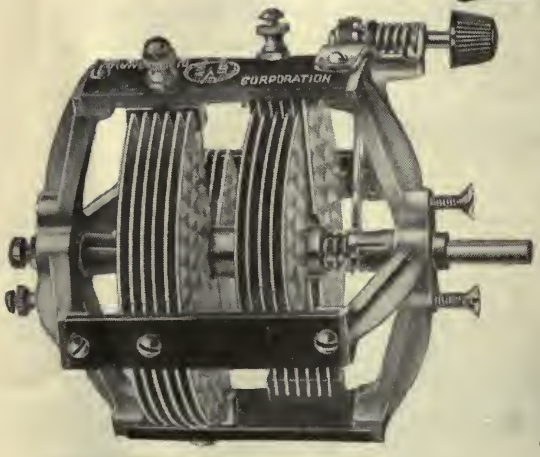
THE CHASLYN BALL BATTERY TESTING SET

Consisting of a Ball Battery Tester, a Battery Depth Gauge, and a Battery Water Filler. A complete and efficient equipment for learning the condition of your storage battery. Made by the Chaslyn Co., 3845 Ravenswood Ave., Chicago, Ill. Price $1.00



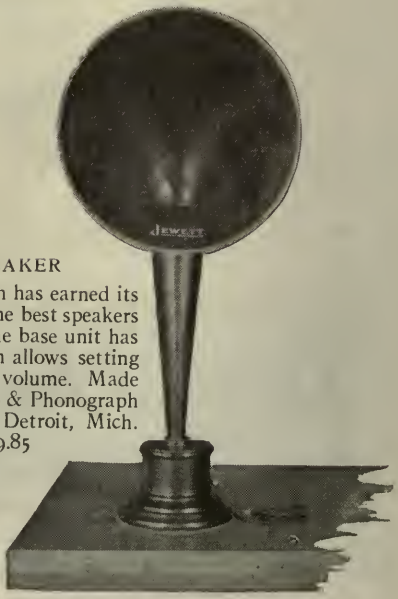
OPERADIO RECEIVER

In this carrying case the manufacturers combine a six-tube receiver, batteries, loud speaker and loop antenna very effectively. The loop is built inside the top of the case, which is shown open in this cut. Made by Operadio Corp., Chicago, Ill. Price complete $190



BRUNO ULTRA VARIO CONDENSER

A well designed condenser in both electrical and mechanical details. Its construction makes its use possible as two separate .00025 mfd. condensers, or in series to produce a capacity of .000125 mfd. Its regular maximum capacity is .0005 mfd. Made by Bruno Radio Corp., 300 Water St., New York City

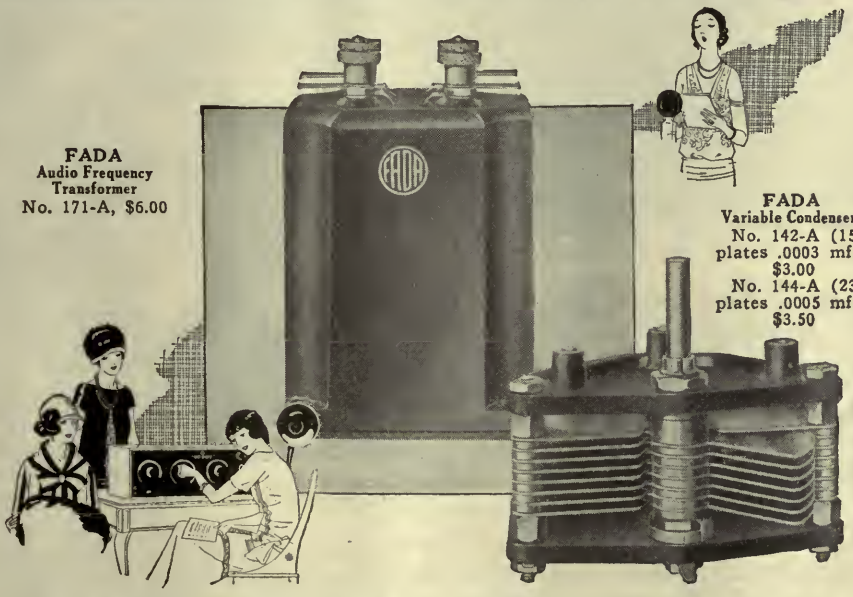


SUPERSPEAKER

A loud speaker which has earned its right to rank with the best speakers now obtainable. The base unit has an adjustment which allows setting for the most suitable volume. Made by the Jewett Radio & Phonograph Co., 5680 12th St., Detroit, Mich. Price $29.85

FADA ★

Transformers and Variable Condensers



FADA
Audio Frequency Transformer
No. 171-A, $6.00

FADA
Variable Condensers
No. 142-A (15 plates .0003 mfd) $3.00
No. 144-A (23 plates .0005 mfd) $3.50

More volume—finer tuning

POOR condensers absorb radio power—that cuts down volume. Poor condensers add resistance—that broadens tuning. You can sharpen your tuning, increase selectivity and get greater volume with the new FADA "low-loss" variable condensers. Use them. The low power factor and low equivalent series resistance prove their superiority. FADA "low-loss" condensers are more efficient than many so-called precision condensers and have a capacity ratio of 40 to 1 as compared with 30 to 1 usually encountered. Two sizes—No. 142-A (15-plate .0003 mfd) at $3.00 and No. 144-A (23-plate .0005 mfd) at $3.50.

Performs as well as it looks

The new FADA Audio Frequency Transformer is encased in bakelite with nickeled binding posts and soldering lugs. It looks "quality" all over. And it performs up to its appearance. It has a high average amplification over all the broadcasting wave-bands and reproduces voice and music with a volume and tonal fidelity that is surprising. A wonderful addition to the audio frequency stages of Neutrodyne receivers and equally efficient in other types. This new transformer, No. 171-A, is made possible by correct FADA engineering principles and by uniform production methods. Ratio 4 to 1. Price $6.00.

Ask your dealer for FADA Transformers and Variable Condensers

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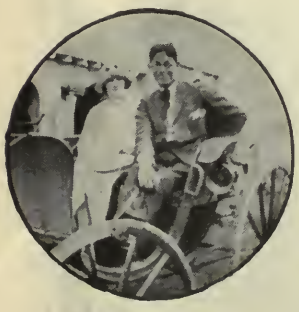
Among Our Authors

RADIO receivers sometimes temporarily impair "domestic tranquility" as well as bring enjoyment to their owners. Henry J. Peck, in the second of his covers for this magazine has rather well caught one of the moods of a radio owner, we think. We can promise the reader another cover by this artist in an early number.

WILLIAM H. CARY, JR., has left France, where he has been for some months, to begin a trip around the world. We expect to hear from him what the Indo-Chinese are doing with radio and how broadcasting is coming along with the Sumatrans. As a matter of fact, this interesting writer gave us to understand in a recent letter that he was really exploring to see how "far-flung" the ends of the earth really were.

EDWIN H. ARMSTRONG has not been back so long in New York from his honeymoon which he spent last winter in Florida. Mr. Armstrong, with his quiet manner and quite fascinating drawl, is often seen around the busy campus of Columbia University in or near the radio laboratories.

JULIAN KAY, whose second article in the "What's in a Name?" series appears this month, has left New York temporarily to do some research work with vacuum tubes in Boston, but he promises this will not prevent him from sending us the other articles in the series, the next of which will appear soon.



ZEH BOUCK

ZEH BOUCK, the editor of "In the R–B Lab" and pleasantly frequent contributor to RADIO BROADCAST, is one of the prize winners in the recent radio drama contest held by W G Y. Bouck in his eager effort to pen a stirring drama, called it *Bootleg*. The snapshot shows that "learned Theban" in a queer Bermudan carriage in front of Tom Moore's House Tavern at Bermuda, where two of the scenes of his radio play are laid. He claims to be leaving the place, but we dunno. . . .

JAMES C. YOUNG is a well-known New York newspaper man whose frequent contributions to the Sunday New York *Times* are familiar to readers of that excellent newspaper. Like all newspaper men, and Mr. Young is indeed a good one, he has a wide acquaintance. The other day he was out on a revenue cutter and. . . Anyhow, he has written an extraordinarily interesting story about radio on the "rum fleet" off New York, which will appear in this magazine soon.

WENDELL BUCK is engaged in radio advertising. Not very long ago he left New York for the uncertainties of Chicago to take up his duties for a large New York retail radio store whose Chicago branch has just been opened.



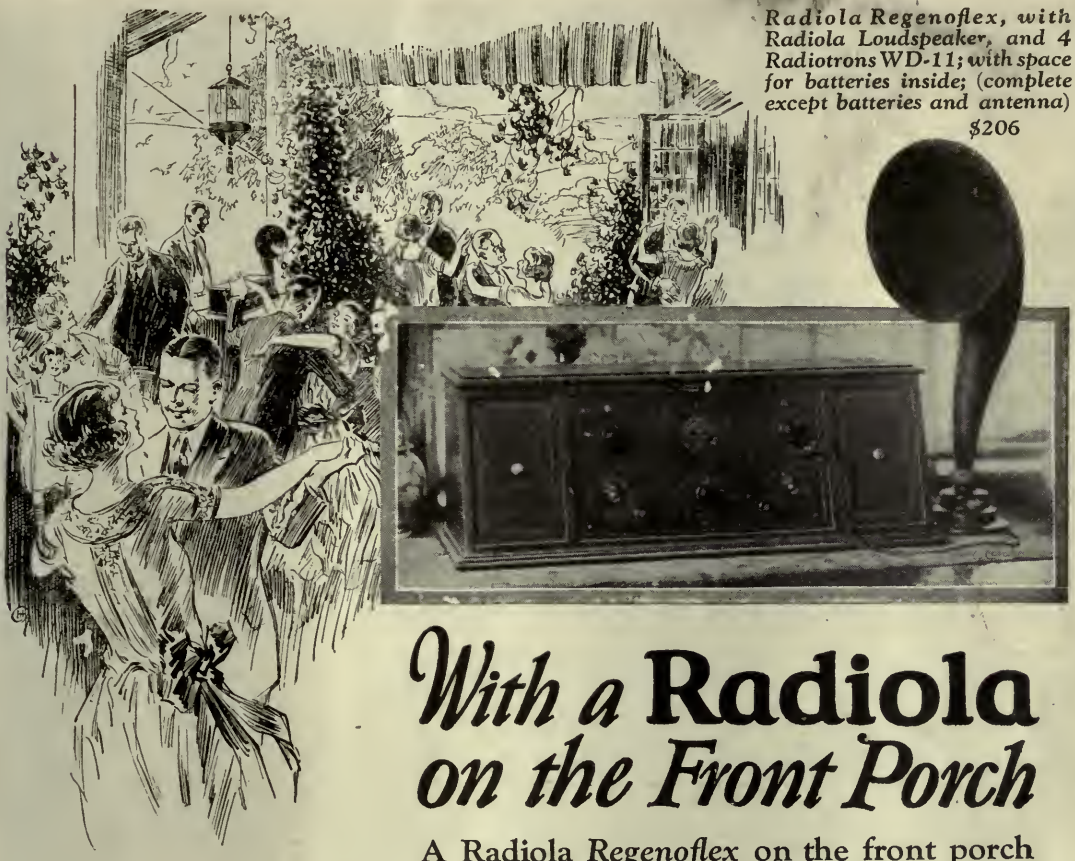
A. C. JR. AND A. C. DIXON

ASHLEY C. DIXON is a native of Chicago and attended school and the University of Chicago there. He moved to Montana in 1911 and has been there ever since on his ranch at Stevensville. "My former hobbies were hunting and amateur photography", he writes, "but now I think my present and future hobby is radio." His son A. C. Dixon, Jr. stands beside him in the photograph. Dixon, Sr. has an amateur radio operator's license, while his son, at 15 holds a commercial operator's ticket.

NO TRUE fisherman hides his prowess under even a secretive conversational bushel, and here we see Robert H. Moulton with part of a 12¾ pound fish caught in Black Lake, Wisconsin. Mr. Moulton is a graduate of Columbia University, spent some years on a Chicago newspaper, and is now in that city as a free-lance writer on a wide variety of subjects. He took the photographs which illustrate his article "Linking the Farmer With His Market" himself.



R. H. MOULTON



Radiola Regenoflex, with Radiola Loudspeaker, and 4 Radiotrons WD-11; with space for batteries inside; (complete except batteries and antenna) $206

With a Radiola *on the Front Porch*

A Radiola *Regenoflex* on the front porch —and that porch can be way up in the mountains, or off at the seashore—but it's not too far away to be in on the fun.

The improvements in its mechanism offer greater sensitivity and greater selectivity; clearer tone; and complete simplicity. Where *quality* of reception counts as much as distance, the Regenoflex is the receiver for this summer's fun!

All the jazz of the big orchestras in faraway big towns comes through *clearly* for dancing. The fine music is true, sweet toned, undistorted. The sports news rings out with all the thrill of bleachers or ringside. The Regenoflex is a leader among the new Radiolas that are making this a great radio summer!

This symbol of quality RCA *is your protection*

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Radiola

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Roger B. Whitman, *Country Life*.

A PROPER SETTING FOR A SUPER-HETERODYNE

One of the eight-tube super-heterodynes, built in the RADIO BROADCAST laboratory, operating on a loop beside the North pool in the gardens of the Doubleday, Page & Company plant, where RADIO BROADCAST is published. A radio receiver can be ornamental, and decorative as well as useful

RADIO BROADCAST

Vol. 5, No. 4 August, 1924

A Knock-Out Short-Wave Receiver

Describing How to Build this Sensitive and Selective, Non-Radiating Receiver for Very Short Waves, Employing the Roberts Circuit

By ZEH BOUCK

FOREWARNED is forearmed, and the writer maliciously announces that resonance will be treated in this article in terms of kilocycles rather than wavelengths. This is at all times the more efficient and logical consideration. Eventually, wavelength will be considered only secondarily and no better start can be made in thinking in kilocycles, than in a discussion of short waves, which we already refer to familiarly as higher *frequencies*.

As a final magnanimous concession to the vanquished, we state that the wave range to be considered in this article is from about 1360 kilocycles—220 meters—to a shade over 3000 kilocycles, a bit under 100 meters. 1500 kilocycles is the frequency of 200 meters, and 2000 kilocycles the vibratory rate of 150 meters. If the reader insists on being inefficient, and must know the wavelengths of the intermediate frequencies, he will be under the necessity of dividing 300,000 by the number of kilocycles.

A Good Thing—and a Small Package

The possibilities of very short-wave transmission and reception have been appreciated for several years, but RADIO BROADCAST has consistently declined to publish data on a high-frequency receiver while the single-circuit oscillator offered the only simple and efficient receiving system. Mr. Bouck tells you why, and our forbearance is amply repaid in the receiver he has designed.

Here is a receiver that will appeal most powerfully to the serious experimenter—the enthusiast interested in the short-wave transmission of KDKA at 3000 kilocycles (100 meters) and WGY at 2800 kilocycles (107 meters)—and to the relay amateur who will find this set designed with an especial, and perhaps instinctive regard to his particular problems by one of his own kind.—THE EDITOR.

THE REQUIREMENTS OF A SHORT-WAVE SET

THE higher radio frequencies are less stable, more difficult to tune and control than the lower conventional broadcasting frequencies. They therefore impose more exacting requirements on the possible methods of reception.

Various losses, which are comparatively negligible on the higher waves, become more pronounced and have a more detrimental effect on transmission and reception on amateur and sub-amateur waves. While it is probable that the magnitude of these losses has been exaggerated, they nevertheless exist, and every possible precaution should be taken to reduce them. Large size wires, with a practical minimum of

insulation, should be employed in wiring and winding the inductances. The size of wire, of course, determines the actual resistances in the circuits, and the elimination of unnecessary insulation does away with a dielectric, which if employed consistently and needlessly, may add materially to capacity losses.

CAPACITY EFFECTS

AS THE frequency is raised the effect of capacity upon resonance becomes much more critical and marked. For instance, an addition of ten micro-microfarads (.00001 mfd.) to a circuit oscillating at 3000 kilocycles, at which frequency KDKA transmits short-wave telephony, will decrease the frequency by about 400 kilocycles. The same capacity added to a receiver or transmitter oscillating at 750 kilocycles (approximately the frequency of WJY, WOR and PWX) will cause a decrease of only 69 kilocycles.

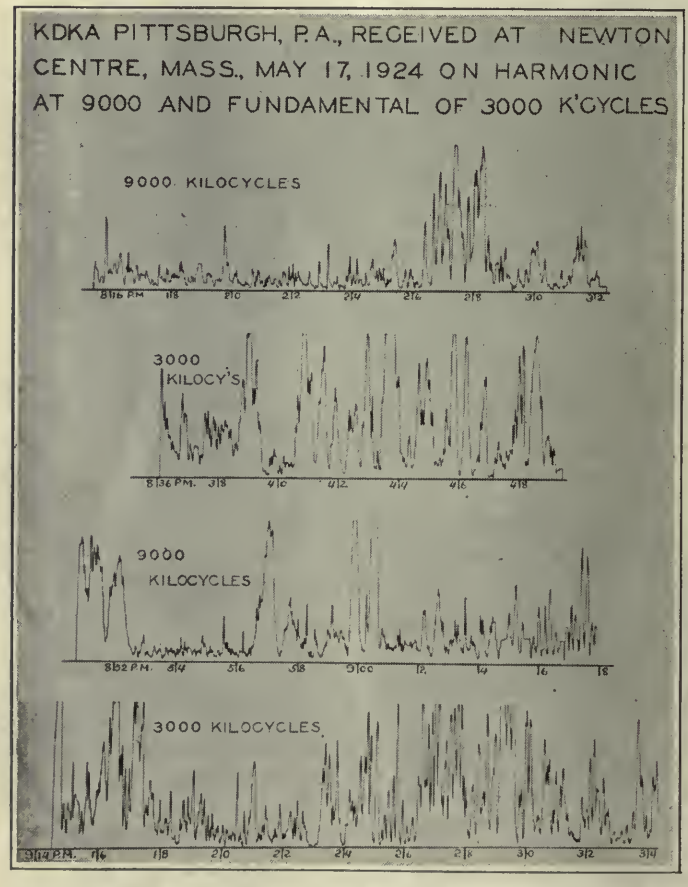


FIG. 1

Interesting graphs made by the signals themselves at the laboratory of Dr. Greenleaf Whittier Pickard. These tell why the short-wave receiver must not radiate

It is quite obvious that body capacity effects present somewhat of a genuine problem on these high frequencies, especially when it is considered that most of the receiving carried on in this region is beat-note reception of continuous wave telegraph signals. In a poorly designed short-wave receiver, a slight motion of the hand in the vicinity of the tuning controls will be sufficient to whistle a station clean across the audible scale—and out. In the receiver to be described, body capacity has been reduced to a satisfactory minimum, by mounting the oscillating coils at right angles to and away from the panel, by connecting the stationary condenser plates to the grids, and by using metal dials insulated from both the ground and the instruments they control. (Grounded shielding would immediately introduce losses. The individual control dials act partly as shields, and at the same time reduce the capacitative coupling between the body and the instruments by functioning as the common plate of two condensers connected in series).

The increased susceptibility of receivers of this type to capacity variations also makes vernier control a necessity. However, as a built-in vernier generally adds to the condenser losses, non-vernier condensers are recommended with vernier dials. The Accuratune dial, a true vernier and possessing the desirable insulated metal scale, was used by the author.

THERE MUST BE NO RADIATION

THE most important consideration of all is the necessity for a non-radiating receiver. This absolutely essential condition has proved a serious problem, for most of the communication carried on in the higher frequencies postulates a regenerative and oscillating receiver. It is an easy matter to build a single-circuit regenerator to operate in the region of megacycles but the radiation from such a receiver places it absolutely and irreconcilably beyond the pale. We are all painfully familiar with the havoc worked by such sets on the broadcasting frequencies. It is the writing on the wall, with an added and sinister emphasis, for radiation on amateur and

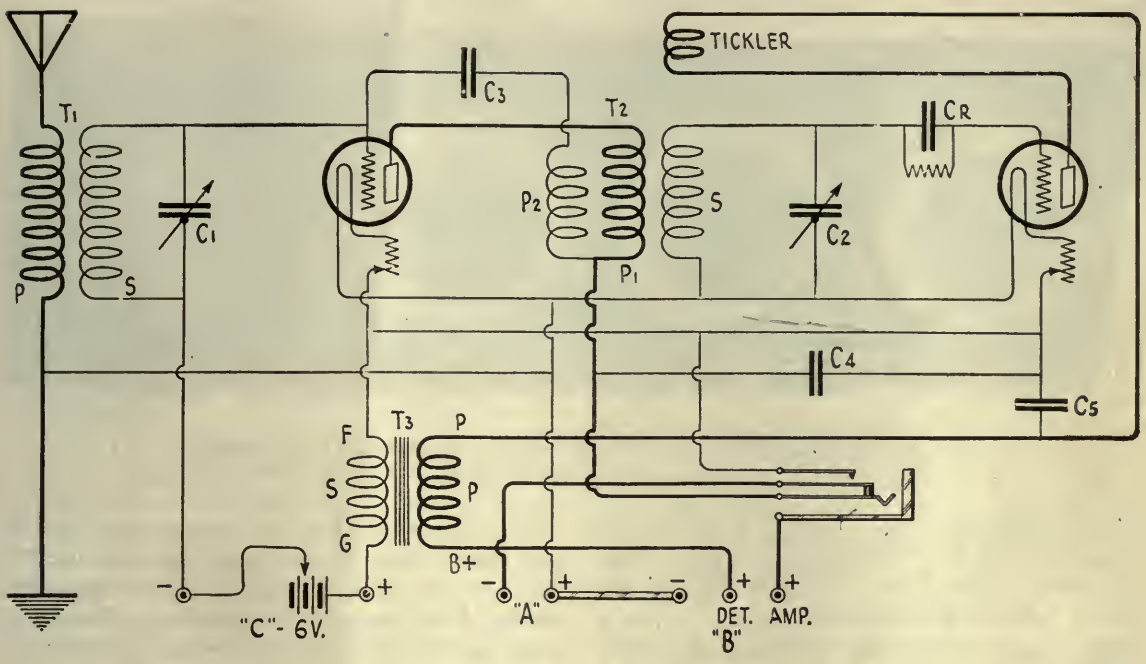


FIG. 2

The short-wave circuit. The C battery should be varied as one of the amplifier stabilizing adjustments.

sub-amateur waves possesses a remarkable carrying power that adds many miles to the radius of the interference area.

HOW THE HIGHER FREQUENCIES CARRY

THE possibilities of these very high frequencies are uncanny. Using a small regenerator with a ten *inch* antenna (needless to say, indoor), the writer has copied foreign low power stations operating in the neighborhood of 3000 kilocycles. Distant amateur stations have also been received on high harmonic frequencies which could represent only a small fraction of the already low power radiated on the fundamental. Dr. Greenleaf Whittier Pickard has had similar results in a room at the Commodore Hotel in New York City. Due to the freak element in these frequencies, distant broadcasting stations are often received much more consistently and loudly on their harmonics. KYW, at Chicago, is often recorded at Newton Centre, Massachusetts, on the 8th harmonic at greater intensity than on the fundamental. Doctor Pickard, in his study of short and long period variations, has made these extremely short waves photograph themselves; and has no unusual difficulty in obtaining a beautiful graph of the variations in WBBR's sixth harmonic at 7500 kilocycles. Fig. 1 shows a most remarkable photograph, which the author is reproducing with the kind permission of Doctor Pickard. This masterpiece of laboratory finesse shows the simultaneous variations in strength of KDKA's fundamental at 3000 kilocycles (already far above the region of conventional broadcasting) and its third harmonic at 9000 kilocycles.

HOW TO PREVENT RADIATION?

WHILE it was quite obvious that radiation must be practically eliminated, the manner of overcoming it was less apparent. A blocking stage of radio-frequency amplification will immediately suggest itself to the experienced reader, as it did to the writer. However, this would necessitate a plate coil, and as the tendency to feed back through the capacity of the tube increases with the frequency, the amplifying bulb would prove a far more powerful oscillator than the detector—unless *efficient* means were taken to stabilize the circuit.

THE ROBERTS CIRCUIT ON SHORT WAVES

IT WAS upon the suggestion of the editor of RADIO BROADCAST that the writer began experimenting in his own amateur station, radio 2PI, with the possibilities of the Roberts receiver especially designed for short waves. As our readers who have followed Mr. Roberts's articles, on his "Two-Tube Knock-out Re-



FIG. 3

Front view of the finished receiver. The dial arrangement is for left hand operation, the usual order of the tuning controls being reversed. The tickler is on the left.

ceiver" appreciate, this circuit employs one stage of tuned R. F. with capacity neutralization, bulb detection with regeneration, and one step of reflexed audio amplification. It was a happy thought of the editor and has developed into the receiver shown in the last five illustrations of this article, and which we have found to be in all ways the most desirable short-wave set we have ever operated. And we have played with many of them.

The circuit is shown in Fig. 2, and most of our readers will recognize it as the standard Roberts hook-up with a slight variation in T1. A semi-aperiodic primary has been substituted for the tapped coil which is quite unnecessary and actually detrimental in high-frequency reception.

All inductances, excepting the windings of the audio amplifying transformer, are spider-webs. The writer found it most convenient to obtain the standard Roberts broadcast wave coils, made by the Eugene Turney Laboratories and rewind them for the special short-wave set. If the reader desires to make his own forms, they should have an odd number, say seventeen winding spokes, with a first-turn-diameter of two and a half inches. Pasteboard is the preferred material.

The primary of T1 is wound with six turns of No. 18 wire. S, in both T1 and T2, has 25 turns (see General Instructions) with the inside terminals running to the grids. P1 and P2 in T2, is the combined primary and neutralizing winding. It is made as follows: Two No. 22 wires, from individual spools, are wound simultaneously for eight and a half turns. This results in two parallel coils. The *beginning* of one coil is connected to the *end* of the other, giving a common terminal which leads to the output jack. The remaining two connections run to the plate and to the neutralizing condenser C3 (it is immaterial which runs to which).

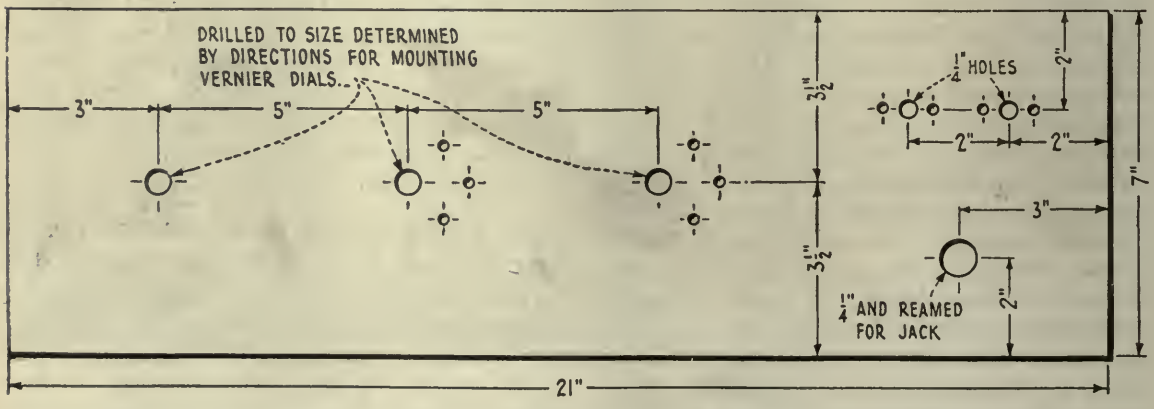


FIG. 4

The panel layout. The design is such as especially to suit the operating convenience of the majority of amateur stations

The tickler coil consists of eleven turns of No. 18 wire.

With the exception of the secondaries, all coils are wound over one, under one, in reference to the winding spokes. The secondaries, which are wound with No. 18 wire, are woven over three and under three.

Capacities C1 and C2 are .00025 mfd. low-loss, low minimum capacity variable condensers with the stationary plates connected to the grids. Duplex condensers were used by the writer. C4 and C5 are fixed capacities, respectively .001 mfd. and .002 mfd. (see General Instructions).

C4 is the grid condenser and leak, having respective values of .0005 mfd. and 250,000 ohms (refer to General Instructions). The neutralizing condenser, C3, is made by winding No. 24 wire over two inches of spaghetti tubing and slipping this on a convenient length of bus-bar wire left projecting from the grid terminal of the amplifying socket. The capacity of this condenser is varied by slipping the insulated tube farther on or off the bus-bar.

T3 is an Amertran audio-frequency transformer, connected as indicated by the marked terminals.

The output is plugged into a Carter open circuit filament control jack.

The reader need not confine himself to the specific parts used by the author. He may use the products of other manufacturers if he is certain that the substitute is of equal quality. But he must insist on this, for a single piece of inferior apparatus may impair the successful operation of a short-wave set.

THE PANEL

A BAKELITE panel, seven by twenty-one inches, was drilled according to the specifications in Fig. 3 and grained to a beautiful gray-black finish. The markers for the dial readings are scraped into the panel with the point of a dividers or scriber, and whitened with chalk or prepared paste. The simplicity of these three single lines is most pleasing, and harmonizes beautifully with the grained panel and the Accuratune dials.

CONSTRUCTION

THE various building details are clearly shown in the photographs, and adhere strictly to the theoretical implications contained in the earlier part of this article. Make all wiring as uncrowded and rigid as possible, using spaghetti sparingly and only where it is a necessity or a genuine convenience.

The writer has arranged the various controls

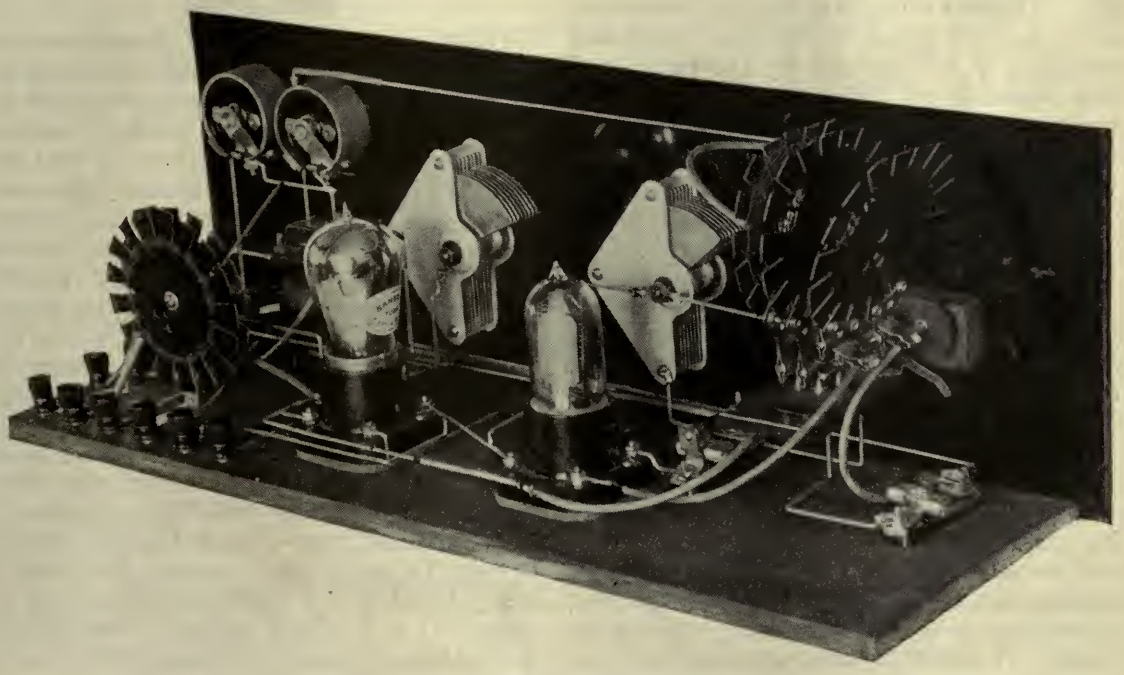


FIG. 5

Rear view. Spaghetti is used only where necessary, and on flexible leads

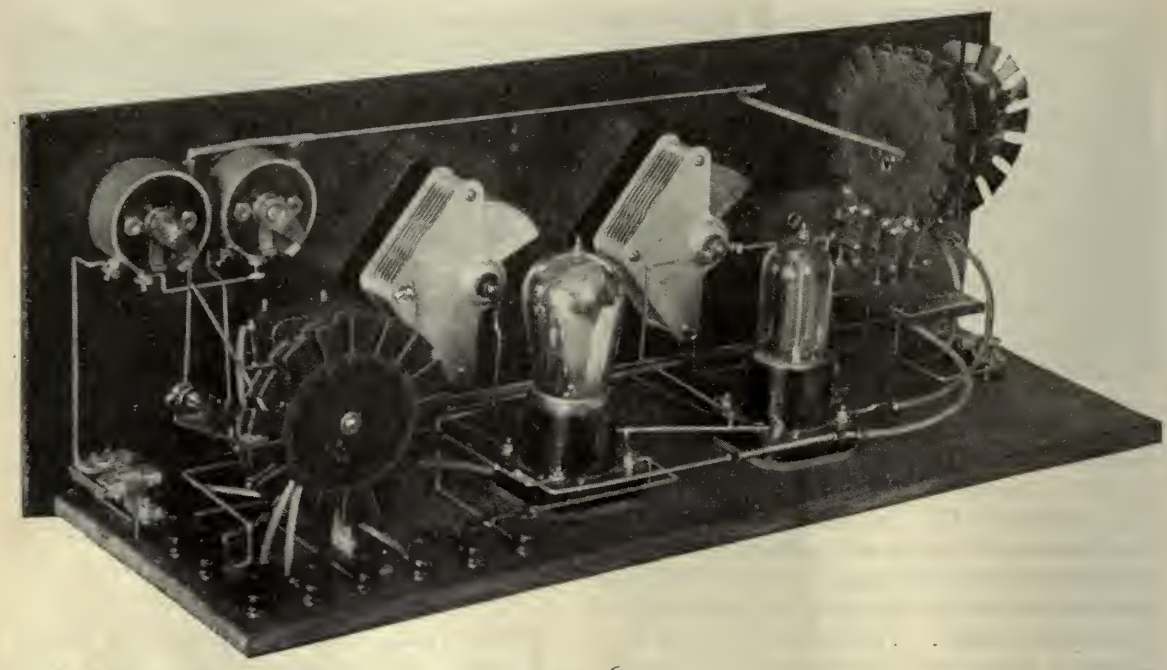


FIG. 6

The mountings for the Micadons and the combined grid leak-condenser mounting permit the clipping in and out of different values. This is desirable in the preliminary adjustment of the receiver

in an order the reverse of that usually employed, the antenna inductance and C1 begin on the right, following up to the tickler on the extreme left. This best suits the operating convenience at station 2PI, where the antenna switch and sending key are operated by the right hand and placed to the right of the receiving apparatus. The relay operator should consider these details, employ his own ingenuity, and vary the construction accordingly.

GENERAL INSTRUCTIONS

THE operation of the set is similar to that of the ordinary regenerative receiver. The three controls, C1, C2, and tickler, are quite analogous respectively to primary, secondary, and regeneration on the old and comparatively inefficient receivers.

Tubes

Your favorite detector and R. F. amplifying combination will work successfully. As will be seen in the photographs, the author employs the UV-201-A type in the amplifying circuit, and a Western Electric J tube as detector. It should be mentioned that only the modern low capacity amplifying tubes, such as the UV-199, the UV-201-A and the corresponding Cunningham and DeForest tubes, can be used in a short-wave amplifier circuit.

Wave Range

Using twenty-five turn secondaries as recommended the set will probably cover the stipulated range bounded approximately by 1400 kilocycles and 3000 kilocycles. The exact wave possibilities of the receiver are best determined by the use of a transmitting wavemeter, or a standard semi-short-wave receiver, such as the Grebe CR-3, on which the oscillating frequencies are approximately known. The wavemeter or former receiving set should be made to oscillate at 1500 kilocycles and the beat-note produced at a neighboring frequency on the new receiver. This will be quite high up on the condenser C2 scale. Now tune down for the second harmonic which will be found exactly on 3000 kilocycles. If difficulty is experienced in attaining this higher frequency, wire is removed, turn by turn, from the secondary of T2 until the harmonic beat-note is easily tuned with a few condenser degrees to spare. It is a simple matter to secure any desired high frequency by tuning for the second harmonic of a known lower frequency.

Wire should also be removed from the se-

condary of T1, until condenser C1 tunes to resonance at about the same dial reading as C2.

Coupling

The coupling between P and S of T1 is close, the two coils being separated by about one-half inch. In the case of the writer, similarly close coupling between P1 and S in T2 has proved more efficient that the loose coupling recommended by Mr. Roberts on the higher frequencies. The tickler coupling will of course vary with the degree of regeneration desired. In receiving continuous wave signals, the coupling should be loosened to within a few degrees of where the oscillations stop.

The Neutralizing Capacity

The primary adjustment of C3 is made to determine the setting at which the amplifying tube refuses to oscillate over the entire frequency range, a capacity that is seldom critical and which permits considerable leeway. A second and more exacting adjustment should be made during transmission of a near-by and powerful station to discover the point within the neutralized area where the incoming signal ceases to induce a howl.

Final Adjustments

In all cases it is desirable to experiment with the values of C4, C5, the grid condenser and grid leak. To facilitate this, Daven mountings have been used by the author for clipping in these parts. Two condenser mountings are necessary for C4 and C5, and a combined condenser-leak mounting for CR. C4 affects the stabilization of the amplifying tube, while the correct values of C5, the grid condenser and resistance for individual tubes, regulate the action of the local regenerative and oscillating circuit. These last values should be adjusted until the detector circuit goes into and out of oscillation over the entire range, smoothly and without howling.

Antenna

A special antenna will seldom be required for the operation of the short-wave set. It is used by the author on his double cage, fifty-five-foot L transmitting antenna.

A CONCLUDING WORD TO THE AMATEUR

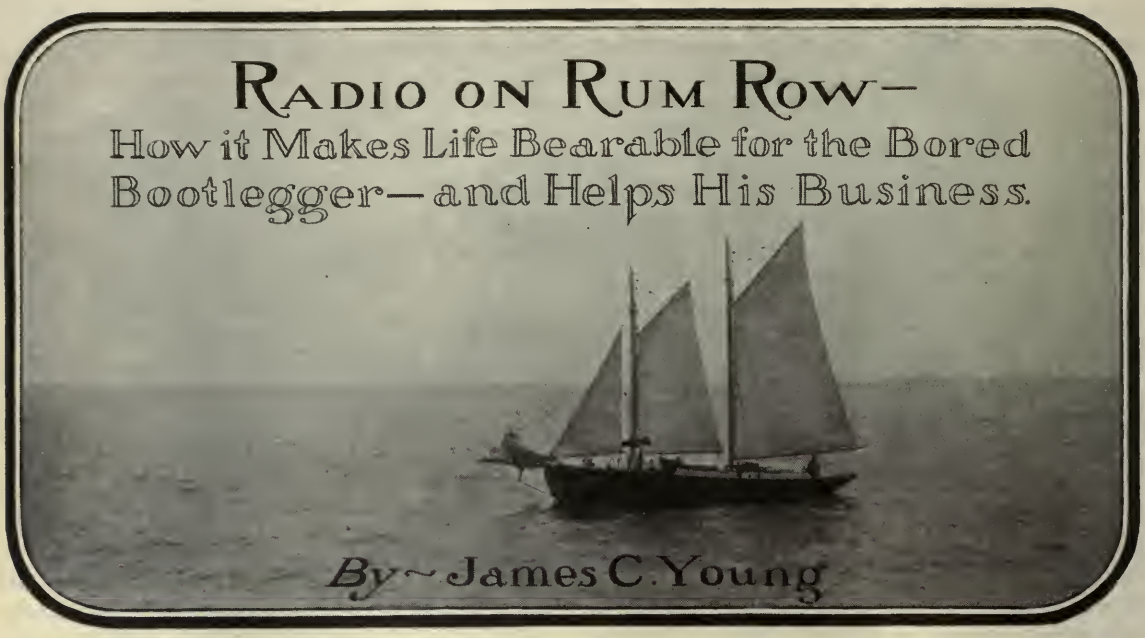
REGARDLESS of the appeal to the experimenter, the transmitting amateur will find the receiver we have described particularly adapted to his own very exacting requirements. Passing over its great sensitivity and perfect wavelength range as being obvious and understood by the relay man, we desire to emphasize in closing the truly remarkable selectivity of this two-tube set. Key-click, excessive ripple, and other disturbances from near-by faulty transmitters are reduced to a most gratifying minimum. At 2PI little difficulty was experienced in copying a DX station through a local 50 watt rectified A. C. C. W. transmitter located less than one thousand feet away, both stations oscillating within four kilocycles of each other.

B–BATTERIES FROM YOUR LAMP SOCKET

CONSTRUCTION details and complete diagrams of an arrangement which will permit the use of 110-volt alternating current to supply the plate potential on any receiver *up to an eight-tube super-heterodyne will be printed in an early number of this magazine. The building of the device is not difficult and it can be made for about $25.*

Radio on Rum Row—

How it Makes Life Bearable for the Bored Bootlegger—and Helps His Business.



By—James C. Young

LONELY, mate? Why, this ship is so lonesome that a man would begin talking to 'imself if it wasn't for the radio."

We were leaning over the rail of a rum runner, as dirty an old tramp as ever slipped out of London on a dark night. Just now she was swinging to forty fathoms of chain off the Long Island shore. With a rainy sky above and a gray sea below, heaving underneath our bow, it was a day to make one think of a stuffed chair and a cheery fire. But this particular rum runner—call her *Augusta*—had been standing up and down Rum Row four months and not a man aboard had stepped on dry land. Add two weeks for the first trip across, with perhaps another month off shore, and yet two weeks more to cross again. Then we get a new conception of what it means to be lonesome.

"Nothing to do at all," said the big man in the blue sweater, standing at our elbow. And the gray eyes in his burned face looked forlorn. "Once Hi was wrecked in the Hindian Ocean and lived a month on some bloomin' crabs, but that was an heasy berth alongside this one. We just lay 'ere, rotting our 'earts. It's no life for a sailor. What they need on these blarsted ships is dummies, not men."

"Why don't you go ashore at night and stay a while. Surely there isn't much danger?"

"Danger enough, mate; not that Hi mind, but the old man wouldn't stand for it. 'E lost one hofficer that way. What do you suppose? The fellow was a drunkard and couldn't stay sober ashore, even when 'e'd been on a rum ship three months. So this blighter gets 'imself locked up and they deports him as a halien who 'ad no right to be in your bloomin' country. And 'e couldn't tell where 'e came from.

"No; the old man wouldn't let me go. And if Hi went the crew would want to go, too. The only thing we can do is listen to the radio and wait for the boats to come out. Hi'll never

What?—No Romance?

The certainties of modern existence have not yet eliminated all the romance from life, as readers of this very interesting article by Mr. Young will agree. The author has had the very unusual experience of visiting the liquor smugglers in their own haunts, "somewhere on the Atlantic" outside the 12-mile limit. Though the business of the hardened crews on these ships is supposedly continuously exciting because of the risk and danger involved, the men, it seems, are actually bored to death. And right there is where radio is helping to lift them out of themselves. You will enjoy reading what broadcasts do for the outcasts.—The Editor.

make another rum cruise. Why, one fellow up for'rard started to knit 'imself a sweater, like 'e'd seen 'is mother do. It was 'orrible the way 'e swore over that sweater. And Hi says that a ship where sailors begin to knit is no bark for me to sail on."

By way of consolation for the *Augusta's* first officer, we suggested reading as a cultural and diverting influence.

"Read?" he repeated, and paused to sink his anchor teeth in a new square of London plug-cut; "why, mate, Hi've read every book in the old man's locker, from one called *Surgery at Sea* to another—well, you could never guess what Hi found in that locker."

"*Romeo and Juliet*," we suggested, at a chance.

"No, no, matey, something worse. It was all about a man who 'ad some strange hideas. 'E was called a—well, now, what did they call him? —Oh, yes, Pilgrim. The book was *Pilgrim's—Pilgrim's——*"

"*Progress*?"

"Right-o, *Pilgrim's Progress*. Well, Pilgrim was an odd one, Hi will say. 'E stopped me from this reading you talk about. The only fun we ever 'ave is the radio."

"So you like it, then?"

The first officer's face broke into its first smile.

"Hi surely do," he said, "and as for the men, we couldn't keep them aboard without it.



© Pathé News

"WHAT'S YOUR ORDER, PLEASE?"

There is more speed than ceremony involved when the bootleggers supply the small boats which come out from shore to lighten the load of the marine merchant. It is apparently as easy to hand a case over the side as it is for the milkman to come up your domestic back steps with his wire basket full of bottles (milk)

RADIO GAMBLING—A NEW THRILL

WHY, every night, they are lined up to get their turn at the 'ead set. Do you know what 'appened on this bloomin' ship? They started gamblin' in the fo'castle, stakin' their turns at the radio when money gave out. Hi found one little tike who 'adn't been able to listen-in for a week, 'aving lost all his chances. So I 'ad to stop that radio gamblin'. We'd 'ave 'ad a mutiny some night when there was a big concert."

"What do the men like best?"

"Oh, anything; mostly the jokes and those songs about 'ome you Hamericans are always singin'. Do you know (and he laid a confidential hand on our arm) Hi 'ave an hidea that this lonesome job makes a man think about 'ome more than he would. Now, as for me, Hi 'ave a good woman and a young one, too, back in Lunnon and sometimes at night Hi get to thinkin' about them mighty 'ard. You know, matey, we just drop our hanchor here and begin to rot. It puts a man in a blue funk, before long. And when these radio singers of yours start to sing about little 'ouses with the bloomin' roses a-twining all over them, a man kind of wishes he 'ad one and didn't 'ave to go rum running."

"Do you get many stations on your set?"

"Oh, yes, most anywhere. You see, we 'as to 'ave a 'igh-powered set; but of course you know I must not talk about that. We 'ave 'eard a lot of stations, dozens of them, I would say. 'Ere, lad, how many stations do you reach?"

His hail brought over to us a young fellow of about twenty-five, the radio operator. He had a coat with brass buttons, a cap of naval cut, and looked like a man who had seen service. Despite the rough-and-tumble life on a rum

runner, he kept a straight back and a smart salute.

"We can hear almost any station within fifteen hundred miles," he said. "Of course we get WJZ and WEAF every night, along with many other stations near by. I don't know what the men would do without our radio. All of the big rum ships carry sets now, partly for the men and partly—well, you understand. Even the schooners are rigging up antennas. Before long the whole fleet will be equipped to receive long distances and many of the ships can send as well. Would you like to see our radio room? It's all right, isn't it, Mr. Jamieson?"

"Oh, sure, lad, lead away."

We went forward, past a bulwark of cases standing breast-high, which several of the crew were handing up from an open hatch for the night's trade. The *Augusta* had sailed with 50,000 cases of Scotch and brandy and still had about one-fifth of her cargo below decks. She was a 5,000 ton tramp steamer, and save for her dirt, not unlike any other tramp. But surely this was the dirtiest ship afloat. Jamieson had the bearing of a real sailor and a sailor of the pure breed will not tolerate dirt aboard his ship. So we wondered—but just then the Captain appeared, and the dirty ship was explained. He had a bleary, rum-soaked face, a heavy, red jowl, with a fringe of gray hair beneath a sou'easter. His clothes matched his face and he bestowed a glance upon us that fell like a blow.



TYING UP ALONGSIDE A RUM SHIP

Perhaps it should be said that us included the writer and another man. By a special dispensation obtained through this other man we had come aboard the *Augusta* about noon of a murky day. She was twelve miles off shore, maybe fifteen, and her Captain had said that he would do us the honor of permitting a visit.

We recalled that excellent rule, never to speak in some places until you are first addressed, and waited for the Captain to have his say. It was brief enough. He nodded, remarked that it was a "Rotten day," and went aft with his glasses to study the shore. Judging from the growing bulwark of cases, customers were expected.

IN THE HEART OF A RUM RUNNER

THE radio man disappeared down a ladder and we followed after, right into the heart of a rum runner. And there, in a little corner of his own, he presided over a magic key and receiving set which kept the *Augusta* in communication with a large part of dry America.

"What's in the air?" asked Jamieson, and the edge on his voice revealed the true radio lover, always expectant of something to stir the spirit.

The radio man—Edwards—did a few tricks with his instruments and looked up. "Somebody speaking at a luncheon," he said, "all about foreign trade and America's part—"

"Aw, blarst that stuff," exclaimed Jamieson, "why do they let 'em do it! Try hanother station, will you, Eddie?"

Eddie tried and presently connected. "Springfield, Mass., sending out a minister's address at some meeting there. Hello, what's that? Oh, he says the dry law must stand and prohibition is an accomplished fact. He wants the President——"

"Stow it, stow it, Eddie," pleaded Jamieson, the barometer of his expectation dropping painfully. Can't you get us a song or two, lad?"

It was evident that we had come at the wrong hour really to enjoy a rum runner's concert. While Eddie searched the ether for a song—and we suspected the first officer of wanting a sentimental song—there was opportunity to take stock of the radio room. Why it should be below decks instead of above was not apparent, except that the *Augusta* had been built long before radio was known and there was no provision for quarters. But seemingly this did not influence the ship set because Edwards said that he could reach practically any desired point in the Eastern or middle States.

"No songs, Mr. Jamieson," he remarked, "but here is another speaker. Wait a minute; he is going to tell a joke."

"Let me hear, please," cut in Jamieson, and deftly took the set. But in another minute he flung it away.

"Your Hamerican jokes are worse than ours

at 'ome," he said, "Hi 'eard that one in the music 'alls when Hi was a boy."

RUM SMUGGLING UP TO DATE

WITH that, the first officer started up the ladder and we reached for the set, just in time to hear the laughter. Edwards obligingly did his best to tune-in something worth while, but the only themes in the air were luncheon speeches and weather reports.

"Maybe you can stay over to-night," suggested Edwards, "when the big stations go into action. There is a concert scheduled at WJZ, with an Italian prima donna on the bill. We have a fine set and you will get a treat."

"We certainly would like to stay. How about the Captain?"

"Well—that's so, but it will not do any harm to ask."

"How long have you been aboard this ship?"

"Oh, I just signed on for this cruise, and it's my last one. I came for the money, forty pounds a month, but it's no fun lying here with nothing to do. Our radio is the only thing that cheers us."

"Do you have a good deal of business to handle, too?"

"Well, I am not supposed to discuss that, although your legal people must know about our radio trade. You see, the big dealers in New York often send us orders by wireless and we have the goods ready for their boats when they come alongside. That saves time and reduces the risk of being seen. It also enables the shore boats to pay for their goods on land, without running the chance of hi-jackers robbing them somewhere on the way out. A lot of money has been lost that way. Why, I remember one poor blighter who came aboard without a cent; they took $10,000 from him less than a mile away."



FASTEST OF ALL THE LIQUOR RUNNERS

Is the steam yacht *Glasgow*, whose trim lines and saucy bow indicate that she could run away from almost any of the liquor patrol vessels now in commission

"Can't the government agents trace your radio connections ashore?"

"That is a hard thing to do," answered Edwards. "Long Island and New Jersey are full of antennas. It would be almost impossible to find all of them. And we do not have to establish connections with such near-by stations. We can take an order from Chicago just as easy as from anywhere else," he wound up with a wink.

"Of course those orders are in code?"

"Oh, yes, everything we send or receive is in code. A thousand sets might receive an order without understanding it. Then we are always interested in the weather reports. Your storm warnings give us a chance to prepare for a big blow. This spring we had weeks of bad weather when the boats could seldom come out. And we were blown all up and down the coast, sometimes dragging our anchor for miles, in order to stay close in shore. It got so bad several times we had to heave the mud-hook and stand out to sea. One schooner was lost altogether and several ships parted their anchor chains."

"Well, your pay is good, any way."

"Yes, the pay is what gets the crews. Fo'-castle hands are drawing twenty pounds a month, when they would be lucky to get six or seven on any other ship. Even then it is hard



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TEN THOUSAND CASES

Are stowed in the hold of this ship. Very few are empty

to sign men for more than one trip. I don't believe the big ships really could keep their men in hand without radio sets and free allowances of rum. Sailors are used to long voyages, but they dislike especially lying idle in one place. Occasionally the men get so anxious for something to do that a few of them land in one of the small rum boats and stay for several days. But since we lost an officer——"

"Yes, the first officer explained that."

"Well, the old man has shut down on shore leave for everybody and we are cooped up here like prisoners."

"Do you have any trouble with the crew?"

The radio man arose before he answered and looked up the ladder. Then he came back and said in a half whisper:

"There is more than one hell ship in the fleet. Most of these skippers are hard customers. They wouldn't take such a command, with a chance of getting into trouble and losing their papers unless they got big pay. And the cargo owners have a difficult time chartering a ship with a captain worth while. Many of these ships are tubs that have been rusting in Liverpool docks for a long time.

"As for crews—well, some of the fellows are the devil's own. Others are not so bad, real seamen who sign for the pay. Once in a while there is trouble. Our skipper carries a gun night and day, especially as he is the man who handles the money. But Mr. Jamieson is worth any three men aboard with his bare hands. They don't talk back to him.

"On one ship they had a mutiny not long ago over the allowance of rum. The men are mighty lonesome and the rum cheers them up. Then they want more and more until they really get ship blues and insist on going ashore. The captain in this case refused and they had a fight that lasted a half day. The officers didn't want to shoot, fearing they would have to begin killing in earnest if a pistol ever cracked. So they went for the men with marlin spikes and the men went for them. It was about a half dozen against twenty, but they stood off that crew and somehow kept them from the liquor until the captain got things in hand."

"Why didn't the other ships send help?"

EVERY MAN FOR HIMSELF ON THE RUM FLEET

"IT IS a case of every man for himself out here," said Edwards. "We were down near the Highlands when this row took place off Montauk Point and I only heard the details second-hand. But other skippers would be afraid to interfere because their own men might start trouble. These fellows get hungry-eyed, watching all the money come over the side, and I would not be surprised if they seized some of it."

"Has that ever happened?"

"They say two ships have been deserted off shore, officers and men splitting up the money aboard. But I don't know. You can hear almost anything out here. Still—I wouldn't doubt it."

"And you think the radio helps to keep crews in good humor?"

"No question about it. Unless there are boats to be loaded we have men down here as long as there is anything to be heard. They are like a crowd of boys, eager for something funny. And they have a fancy for your songs, too. Opera is a little out of their range and speeches are not popular. We have heard so many programs in the last four months that we almost know the regular performers as old friends. Some of them go from one station to another and others appear regularly at a single station. I have heard that most of them are unpaid. Why do they do it?"

"Often they are stage people and need the publicity."

"Well, they certainly get it. I know some of their voices so well that I never shall forget them. Usually we can hear splendidly and I suppose that, having nothing to do, we concentrate on the radio more than people ashore.

"Sailors have a lot of odd tricks. Men who stay on a ship for months are likely to become a bit queer. The captain's boy—mess boy, you know—has a record of all the songs and singers he has heard and the bands and selections played since we first cast anchor off this coast. I don't know what he expects to do with that list, but he spends hours making additions, checking it up and talking to himself about it. You should see some of the spelling —whew!"

"How many ships are there in the rum fleet?"

"Anywhere from seventy-five to a hundred. Some of them only make one cruise and find that it doesn't pay, especially the tramps. A big vessel like this one can easily carry fifty or sixty thousand cases. Unless the owners have connections ashore which assure a ready sale, they lose money through insurance costs, pay for the crew and general upkeep. The schooners, with ten or fifteen thousand cases,

have less expense and sell out in time to make a fine profit. But a big steamship with fifty thousand cases, sold in small lots, must stay here for months to clear her hold.

"That is the trouble with us. We brought too much, struck bad weather, and I guess our shore agents have failed us. Sometimes, when your bootleggers find out that we are heavy laden and anxious to sail they will not buy, but force us into a corner and then get the liquor for almost nothing. One ship sold 10,000 cases at $10 each in order to get away. The steamships which make money are those operated by big companies that begin to unload the moment they arrive. Some of these sail inside of two weeks."

"ALL VISITORS ASHORE"

AHOY, radio room," called a voice down the ladder and we went outside to see Jamieson above. "All 'ands ashore is the captain's order," he said. "You better get started, young fellow."

"Now, that's too bad," remarked Edwards, "I'd hoped you could stay over and share our mess to-night. Then I would have showed you what we could do with our set."

"Maybe the Captain—"

"I'll ask him for you," said Edwards.

But the moment we placed foot on deck it was apparent that that request would be out of order. The Captain was hustling his crew around and the cases were coming up faster. There looked to be at least a thousand on deck, bearing a well known name—White Horse. Our boat awaited and the leader on this expedition stood at a ship's ladder—made of rope—dangling over the side. He nodded and we stayed not on the order of going.

"Next time, come late in the afternoon," whispered Edwards, just as we started over the side. "Then you can stay and hear a concert."

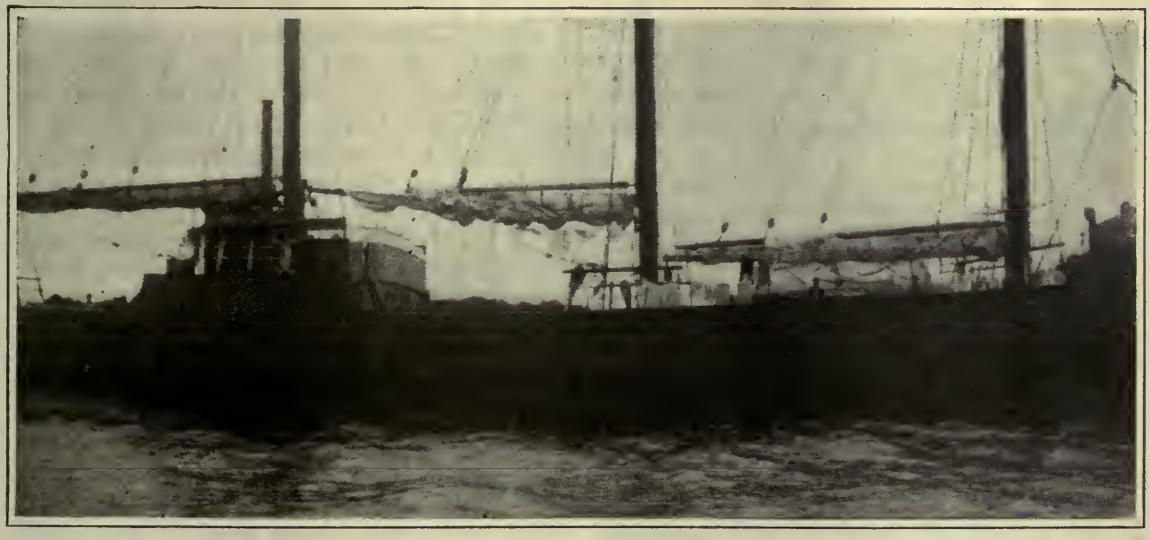
We promised and shook hands. Even the Captain granted us a perfunctory salute. Evening already had fallen and the chill of a wet night laid hold of us. We took a last hasty look around and thought again of the snug radio room and the concert we were about to miss. Also there would be warm food when the ship's bell rang again, and other cheer to comfort the heart.

Against all of these advantages, an open boat awaited just below our heels and the two men in her were saying for a third time, "Come, hurry up."

So we hurried, but paused yet a moment to say our last farewell.

"I am coming ashore soon. And I 'opes by that time to hunderstand better your bloomin' Yankee lingo," said Mr. Jamieson. "You may strike me pink, but I cawn't make out the 'alf of it, mate, and that's the truth. 'Eave away."

The motor sputtered and we fell away from her side on the next wave, into the night, taking every 'eart on the rum runner with us—an unseen cargo.



WASH DAY ON THE RUM FLEET

The S. S. *Rusk*, riding at anchor off Long Island. This is one of the ships Mr. Young boarded on his visit to the forbidden fleet

The Way of the Transgressor

What the Common Deceptions in Radio Advertising and Selling Are—How the Novice May Recognize Radio Misrepresentation or Dishonesty

By WILLIAM P. GREEN

Associate Director, National Vigilance Committee, Associated Advertising Clubs of the World

Radio dealers with more knowledge of what they are pleased to call "sales methods and sales push" than of the actualities of radio, commit many crimes of which they are perhaps, quite ignorant, by the exaggerated claims they make verbally and in their advertising. The radio innocents accept these irresponsible claims and then there is trouble. Mr. Green describes a clever deception in the private sale of "factory built" receivers, "sold at a sacrifice." He is well qualified to write on this subject of deception in advertising, since it is his business as an official of the Associated Advertising Clubs of the World to trace fraudulent and deceptive advertising.—THE EDITOR.

DRIFTING through the classified advertisements of a daily newspaper in any one of a hundred cities in the United States, it would not be at all out of the bounds of possibility to find an advertisement similar to the one reproduced below.

"FOR SALE AT A SACRIFICE—Standard make, three tube set; tubes, A and B batteries, two sets of ear-phones, and non-power loud speaker, all in excellent condition. Call after twelve, 1542 Hudson Boulevard, Apartment 14."

Since you are interested in the purchase of a radio set, you reach the apartment around the middle of the afternoon. It is the usual, attractively furnished home of a person in fairly good circumstances. A middle aged woman answers the bell, and when you inquire if the one who advertised the radio set is in, she bids you enter to be seated a moment while she calls him. You find several minutes on your hands to look around and, of course, you are attracted almost immediately by the radio set on a table in the corner. You step over, lift the cover and observe the interior. It seems to have the appearance of a well manufactured instrument.

As you turn a dial, the door is opened and a middle aged man walks in. He introduces himself as the owner of the set and explains that because of business difficulties, he is under the necessity of leaving the city immediately and, consequently, has offered the set at a sacrifice. His statement that he has had the set and equipment only a few weeks seems to be borne out by their fresh appearance. On the whole, the outfit would seem to be a bargain and after some questioning you agree to take it, provided it works when you return in the evening at a time when local stations are broadcasting. The test in the evening proves satisfactory and by nine o'clock you are on your way home in an automobile with the set and accessories beside you.

Now comes the next day and with it the second act of this radio drama within the apartment. The man to whom you talked yesterday enters the same room, carrying the same type of radio set. His wife follows with several boxes containing tubes and a couple of pairs of ear-phones over her arm, all looking so much like the accessories you purchased yesterday that you easily would have mistaken them for your own. Within fifteen minutes the set is hooked up, and the tubes are in place, with the ear-phones carelessly placed over the back of the chair as though the owner had left them there after listening the night before.

The explanation of this situation is that instead of being under the necessity of leaving the city because of business difficulties, this man and his wife are in the business of selling radio sets and equipment, which they purchase from some fly-by-night manufacturer and sell to the public at a profit. They are following

the practice which, for years, has been a menace in the furniture and music business. Among the trade they are known as "gip" residence dealers. No sooner do they sell a set and equipment to one person than a similar outfit is brought up from the cellar and put up in its place. The appeal of the sacrifice offer, with the added atmosphere of installation within their home, enables these people to do a substantial business.

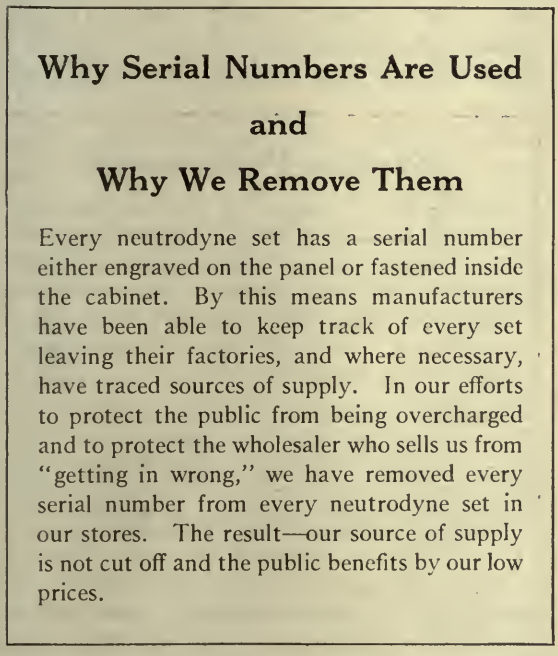
PUBLIC CONFIDENCE IS BEING UNDERMINED BY DECEPTION

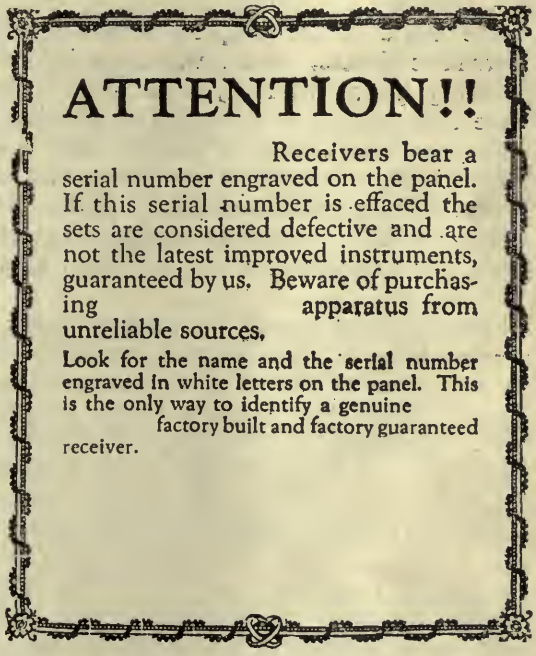
THIS is one example of abuses to be found in radio merchandising and advertising to-day. It is among the more extreme practices of deception, and those which are to follow should not be considered equally flagrant. Of course many honest people have occasion, in emergency situations, to sell their radio sets at a sacrifice. What the consumer public must determine in each instance is whether the offer is bona fide. The fact is that little tricks of deception and misrepresentation, even though many of them do not constitute actual fraud, are undermining the confidence of the public in radio merchandising and, if uncontrolled, eventually will prove a boomerang the effects of which will be felt even by the more reputable manufacturers and retailers.

It is a well known axiom that a counterfeiter always copies something of value. When a new field opens up, and particularly one like radio, which has enjoyed a mushroom-like growth, the faker soon appears on the scene to capitalize the success of legitimate industry. The public suffers, the honest merchant is placed at a disadvantage, and the industry as a whole shows increasing evidences of deceptions that undermine confidence.

We have an excellent example in the manufacture of tubes, for particularly in recent months has there been a marked increase in the number of tubes designated as "201-A" by concerns which are appropriating an identification mark which the public has come to associate with the product of the Radio Corporation of America. The danger is that new customers, unacquainted with radio equipment, who have been told that the "201-A" is what they need, may have the cheaper product foisted on them without knowing it.

Perhaps the next most flagrant deception being practiced on the public is in the sale of parts, or sets manufactured from parts, which are sold to the public under the Neutrodyne





BOTH SIDES

These two pieces of advertising copy, one, that of a retailer, and the other that of a manufacturer, appearing on the same page of the same newspaper, show the bitter fight being waged between the manufacturers of sets and the cut price stores

"Greatest Sale in History"
"Lowest Prices in the City"
"We Undersell the World"
"Our Prices are Lower"
"Price Reductions Hit Bottom"
"Unequalled Radio Bargains"
"Trade With Us—Greatest Savings"

"SOMEBODY'S WRONG"

Seven leading headlines from the advertising of seven radio stores on the same day in the same city. Somebody must be wrong

trade mark. What happens is that a store purchases licensed parts, which go into the building of a Neutrodyne receiver. They take these parts and through the addition of others, perhaps of inferior quality, build a set which is then advertised for sale under the name of the manufacturer of the parts. The danger in this practice is found in the fact that the manufacturers of parts also manufacture sets.

The writer has tested this out many times to see how it works. For instance, companies like Freed-Eisemann and F. A. D. Andrea manufacture Neutrodyne parts and also complete sets. Frequently I have entered a store in response to an advertisement for a Freed-Eisemann set and found that what was on sale was not a factory manufactured instrument, but one which had been built in the store from certain parts manufactured by the Freed-Eisemann Company, which, however, was being sold in the cabinet as a Freed-Eisemann set. This is unfair to the radio novice because, having heard of this or some other particular set, he may be led to believe that he is getting a factory built machine when such is not the case.

MANY ADVERTISEMENTS ARE NOT QUITE HONEST

RECENTLY I undertook to study a cross section of radio advertising by taking the columns of magazines and newspapers appearing within a week's time in order to determine to what extent exaggeration and deception may be prevalent from the standpoint of the consumer public. The result shows certain outstanding characteristics which, in the opinion of the writer, can only eventually thoroughly dissatisfy the public. Most of the statements examined are not such as to constitute a type of misrepresentation or exaggeration which could be prosecuted. They merely lead the purchaser of a set or equipment to expect more than he actually gets, in some cases much more than is even possible from the standpoint of present technical development.

Too many manufacturers of radio sets picture the ideal rather than the actual. Take, for example, a statement such as this:

> When the dial setting for any station has been determined, that station will come in on its own setting any time.

As against this, it is well known that distance reception is most uncertain, depending on the time of day or night, weather conditions and other variable considerations. The purchaser of a set who gets a station fifteen hundred miles distant to-night and cannot bring

Precision Performance

Having once brought in any station and charted the dial positions, that station may be brought in at any time at the same dial settings—any time to-day, to-morrow, or a year from now. The set works like the combination of a safe and operates with equal certainty and precision.

IT CAN'T BE DONE

This type of advertising leads many purchasers of sets to expect more from them than is possible in view of changing weather conditions, differences in the range of daytime and evening reception, and other controlling factors

it in at all to-morrow night wonders why, and well he may, in view of the representations made to him in the advertisements. Over a period of months he must learn that a radio set cannot be operated with the precision of a phonograph, as some manufacturers would lead the public to believe. Another representation that a set offers "perfect mastery of radio" is a bubble bound to burst after the purchaser has endured an evening full of the trials and tribulations which the experienced operator has come to take as a matter of course.

Then we find the advertiser of equipment who endeavors to trace all radio troubles to the fact that the product of some competitor is being used rather than his own. He says, as one dealer did recently, that one hundred per cent. of all automobile trouble is in the ignition,

and that the same is true with a radio set. If the trouble is noise, it's the batteries. Weak volume, blame the batteries again. No distance, likewise blame the batteries. If the unthinking customer responds to this advertisement, buys the particular battery and the noise continues, because it comes from some entirely different source, satisfaction cannot result.

Discontinued sets and equipment frequently are advertised as possessing full current value. For instance, in Chicago, much advertising was recently published of a Radiola model now in the background because of the newer types being manufactured. It was offered with the statement "List Price, $162.50—our price $37.50." At one time this set sold for $162.50, but it does not have such a list price now, and it cannot have anything like that value to the purchaser to-day when compared with more up-to-date sets. Experienced radio buyers who keep closely in touch with developments can hardly be deceived by such reductions; but the constantly increasing number of new buyers are easy prey to misrepresentation, which tends toward the growth of a substantial group in our population who eventually will condemn radio because they will conclude that its products are not marketed with fairness to the public.

It has become a rather common fault to advertise sets at a certain price and in such a way that the reader may well believe that full equipment is included. If he decides to take the set, he places his money on the counter, only to find that an additional outlay is required before his radio is equipped to operate at all. His reaction is likely to be unfavorable to that dealer. We have seen some advertisements which would seem to indicate a deliberate intention on the part of advertisers to list equipment in such a way as to lead the reader to believe that it is included in the price quoted when, however, the price given covers only the set itself.

The public may well inquire when shopping for radio sets in response to advertising whether a set has its weak points as well as those good points which have been emphasized by the manufacturer. Ease of operation and the different steps necessary to bring in stations may be featured, but in doing so some particular adjustment, which actual operation shows to be both critical and more or less unstable, is not mentioned.

WHY ARE SOME DEALERS SO OPTIMISTIC WITH DISTANCE CLAIMS?

CLAIMS of distance reception are all too often based on the exceptional rather than the average. Any one who has operated a standard set for a reasonable period of time knows the folly of exaggerated claims of this sort, and yet many a set has been sold because the purchaser was led to believe that it would receive three thousand miles any time, any where. Such a set, operated in a nest of local stations and which cannot easily reach out and bring in broadcasting from a distance of several thousand miles, cannot be expected to come up to the hopes of the man who has been led to believe that he could bring in any station from any direction and from any distance

Columbia Neutrodyne $140.00

Tubes
Batteries
Loud Speaker
Aerial Equipment
Ear Phones

HOW IT'S DONE

The price quoted is for the set alone although listing accessories in this way might easily lead the reader to believe that they are included

almost at will. To say, as one advertiser did recently, that "there is no limit to the range of this receiving set" is playing with distance in a way that even the most experienced operators with the highest powered sets would hesitate to do; or to say, as another advertiser has done, that a set selling for less than $75 will do anything that any other set will do; or that with the use of a piece of special equipment, programs will come through the air strongly and clearly, not marred by any static and without appreciable effect from electrical storms, warm weather, or of radio weather of any description, may add other names to the list of dissatisfied radio purchasers.

These instances of extreme and exaggerated claims show the necessity for careful buying on the part of the public, and as the public comes to know the pitfalls, it will read radio advertising with an understanding of what to avoid. Honest advertising and merchandising are the only methods that pay in the long run.



GRAHAM MC NAMEE, POLITICAL ANNOUNCER

Whose voice, directly from the floor of the Cleveland Republican national convention has been heard by millions of listeners all over the country who listened to the first party convention ever broadcast by radio

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

The Growing Importance of Short Waves

AS INFORMATION accumulates, the possibilities of short wave transmission seem to mount at an increasing rate. The high-frequency range, from 3000 kilocycles up, was regarded as useless only a few years ago. It was thought suitable for laboratory work such as Hertz, the radio pioneer, had carried out but of no avail when it came to reliable communication over appreciable distances.

Reliable experiment shows this not to be the fact however; some of the most reliable channels in operation over long distances to-day are using frequencies of approximately 3000 kc. and research engineers are continually gathering data to show the feasibility of using even shorter waves. Pittsburgh to Hastings and London—Schenectady to California and England, both short wave channels seem to have attained a remarkable degree of reliability compared to what was to be expected.

With spark wave telegraphy, such short waves would have been of no service at all, for the amount of power which could be sent out in the form of a 100 meter damped wave from a suitable antenna would have been so small as not to reach more than a few miles. There are very important reasons why these high frequencies will do so much more on continuous wave transmission than could be obtained with

the spark transmitter. For a given wavelength a much higher antenna can be used with continuous waves than with spark waves and the amount of power which can be sent off is hundreds of times as great with the continuous waves. The decrement of the spark wave was one of its most important characteristics, so much so that it was not allowed to exceed a certain value, as decreed by law. This decrement could not be kept low using as efficient radiators as are our present short wave antenna.

With a good antenna as much as 10 kilowatts can be radiated at 3000 kc without any trouble at all and possibly much more than this will be possible when we know more about high frequency engineering. Although many experimenters report the short wave channels show less fading than those using waves several times as long, the measurements of Pickard (none better now exist) show this not to be true; apparently the fading phenomenon is about as prevalent in one channel as in the other.

With waves as short as 35 meters, a Paris amateur has succeeded in talking to Algiers; Marconi and others in England have used successfully even shorter than this and we may confidently expect to see this branch of radio of ever increasing importance.

Radio Broadcast's "Covered Wagon"

BEFORE this magazine reaches the hands of its readers, another romantic radio adventure will have begun.

Captain John R. Irwin, the man who received the first C Q D from Jack Binns on the *Republic*, who was wireless operator on that famous air expedition in Walter Wellman's dirigible *America*, who was an officer in the Air Service during the war, and later radio officer of the *Leviathan*—is now on his way across the country in a modern prairie schooner. He is the pilot of RADIO BROADCAST'S "Covered Wagon" and Mobile Laboratory.

He is going to introduce radio to those Americans who heretofore have never known any more of it than could be learned from the perusal of newspapers, those who are not yet convinced that it is the wonderful thing we in the cities have found it to be.

Then, too, he is going to coöperate with radio clubs and power companies throughout the country in an effort to overcome the electrical noises known as "man-made static."

His "Covered Wagon" is an automobile truck with a body like the old prairie schooners. Samples of all the Knock-Out receivers, built in the laboratory of this magazine, will be on board and frequent demonstrations will be made. Captain Irwin will travel from New



PATRICK, CARDINAL HAYES

Catholic Archbishop of New York before the microphone of W E A F. His Eminence is shown holding the red hat which is one of the badges of the high ecclesiastic office to which he has recently been elevated

York to California and thence to Florida. He will make a complete survey of radio in all parts of the country and will give advice to those who are not sufficiently familiar with radio to determine the type of receiver best suited to their needs—and pocket books.

The log of the "Covered Wagon" will be of great value in checking the many important scientific, social, economic, and business problems in which radio plays or may be made to play an important part.

The American Radio Association

FOR several months, we have watched with interest and admiration the effort being made by the American Radio Association to pull the loose ends of radio together. They are making a valiant and praiseworthy effort to enable every listener-in everywhere to get the most out of his receiver.

This organization has picked out a number of ideals extremely difficult of attainment and has been on an up-hill trail from the first moments of its foundation. *But it has done things*—so many things in fact that it now has the hearty endorsement of many of the leading stars in the radio firmament.

Some day, perhaps, the story of Alfred M. Caddell, that able Secretary of the Association, will be told. It will be the story of the successful attaining of an ideal which owes its existence to but one cause—the indefatigable effort to be of service to those vast numbers of radio folk who cannot be of service to themselves.

Veterans' Hospitals Should Have Radio Sets

NO WORK in which radio is a co-partner to-day so deserves commendation as the efforts to make it serve those disabled veterans of the War who are still confined to hospital beds. For most of us the War is becoming mere history, but for many it is yet, and will continue to be, a horrible vivid reality which is sapping their strength and holding them bedridden while the rest of us enjoy the pleasure of our country, preserved by their sacrifices. Could radio, itself practically a child of the War, be utilized in a more worth while work than in relieving as much as possible, the suffering and tedium of the long hours these boys have to bear?

Every normal American knows the answer to that question. Knowing it, why not do, each of us, our share to put radio in the hospitals where these boys pass their seemingly endless days? Why not help S. L. Rothafel in the wonderful work he is doing? If you haven't



YOUNG ENGLISH RADIO CONSTRUCTORS
At work "building their own" at the Plymouth Junior Technical school

done so yet send in your contribution to his Hospital Fund so that those who need Roxie and his Gang more than you do, may have their burdens lightened and days made shorter and brighter as a slight reward for the sacrifices they made for the rest of us.

Radio Inspectors Ought Not to Be Censors

AN INTERESTING phase of radio broadcasting has been called to our attention by an editorial in the Los Angeles *Record* about certain water power rights. The California State Water and Power League is ardent that certain developments be carried out under a public ownership plan. They are opposed, naturally, by private power interests. The relative merits of the two schemes are much in debate, and probably will be so as long as there is water power to be developed. Knowing this no one is nowadays either irritated or deceived by the fallacious arguments put forth by those who take either side of this question.



RADIO FOG SIGNALS

Are now being sent from Ambrose Channel light vessel. So radio supplements the present warnings to navigators which are in the form of light, and sound both submarine and atmospheric. The Light House Service is installing duplicates of this 250-watt continuous wave transmitter on various lightships at important places. The transmitter operates during thick weather and sends on a wavelength of 1000 meters

The editorial in question denounces in unmistakable terms the broadcasting of a speech advocating private ownership, a speech in which it was no doubt conclusively shown that public ownership would involve the public in ruin and debt whereas private ownerhip would bestow upon the same public immeasurable benefits. Using a radio channel for the dispersion of such "misleading information" has thoroughly aroused those interested in public ownership, aroused them to such an extent that the radio inspector has apparently been convinced it was an immoral act, almost sufficiently to warrant the exercise of his censorship power. The Los Angeles attorney who spoke for the private interests is thus painted by his adversaries:

He went to San Francisco and polluted the air with a vicious attack on the Los Angeles municipal power bureau—your power bureau, that is successfully saving you from exploitation by private power profit seekers. He attacked the bond issue, which is about to go before the people. He attacked the Boulder Canyon project as a public ownership enterprise. He attacked the water and power act.

The Commonwealth Club, from which he broadcast is a notorious organization dedicated to service in the vineyards of the ruthless exploiters. It is a pool of economic and political stagnation from which arises a continuous fog of misleading propaganda.

We are asked to give our moral support to the local Federal inspector who threatens to withhold the privilege of the ether from men who present the private interests argument as did the Los Angeles attorney. Well—we doubt very much the power of the Federal inspector to stop the broadcasting of such matter—that



MAJOR EDWARD E. BOWIE

Chief United States Weather Bureau Forecaster. For many years, the Bureau has used radio telegraph agencies to broadcast their forecasts and condition of weather reports, many of which went from N A A signed "Bowie." Now the telephone broadcasting stations are used for the same excellent and helpful purpose

isn't in his province. We suppose the advocates of municipal control would be given the privilege of talking over the ether for presenting their case, and we hazard that their talks might be somewhat more vitriolic than was that of the private interests' representative. One side has as much right to be heard as has the other.

Europe and America Fascinated by the "Deadly Ray"

BY THE time this comes from the press we ought to know how deadly are these rays, by whose mere mention Grindell Matthews has kept the European press agog for nearly a month. He seems to have given the English cold chills by taking his ideas to France, to dispose of it to a French syndicate.

And so far he has shown just exactly nothing! By his mere word he has been able apparently to paralyze the reasoning powers of the editors, statesmen, and militarists. He must be a very smooth talker or else most of his interviewers have been near a nervous breakdown.

An interview with Professor Edouard Branly, inventor of the coherer (which the crystal rectifier displaced) shows the attitude of the true scientist. Never does he say it is impossible but——

As a scientist I must have proofs before I can believe in this new invention. Such proof has not been given and consequently I cannot believe in the ray. As a scientist, if I consider the probability of the existence of the ray I must doubt the claims of the inventor. There is nothing in the present development of science to indicate the perfection of such a ray. Contrary to the popular belief, scientists do not expect such an invention.

To have a ray that will destroy, that will stop a motor, that will kill at a distance, one must have a ray with force in it. No such ray exists. Science has learned how to concentrate rays to a certain extent, but the rays have no great force in them.

Had the Britishers the infliction of Dr. Cook of polar and oil field fame, they would have been better able to cope with the deadly inventor; they would have required him to show them at least a little peep at his deadly weapon before having such a case of nerves as he has apparently been able to produce.

Licensing Broadcast Stations

IN A recent issue we had a few paragraphs under the caption "Outlaw stations to be closed"—it brought a very polite letter from the A. T. and T. Co., telling us we had not adequately presented their case and a rather more forceful letter from a reader who expresses the sentiment that if we "are paid to send out such propaganda for the telephone company, we should at least mark it so that the reader would know it was a paid advertisement." Well—Roosevelt used to say the only man who never made any mistakes was the man who never did anything, and we suppose he meant it to apply to his writing as well as to his political acts.

In the article in question it was stated that licensed stations were not allowed to broadcast for profit, one of the outlaw stations so claiming. It appears that this was in error, as the present form of licenses, some of which were sent to us, contain no such agreement.

The license fees are from $500 to $3,000 depending upon the size of the station. They are paid but once. The fee may be paid in installments if so desired by the licensee. The license forms seem reasonable enough and, at the risk of again being accused of being on the pay roll of the Telephone Company we venture to say that the fee is certainly no more than adequate to cover the various costly developments which the Telephone Company puts at the disposal of the licensee when he is operating one of their equipments.

Other Opinions of the "Squier Code"

SOME months ago we published an article on the Squier System of telegraphic codes and, according to one of our telegraph friends, the lay public was very likely to judge the telegraph companies too severely on the basis of the information there given. He sends us an analysis of the telegraph traffic managers' task showing where the Squier System might prove advantageous and other places where the present system is better.

The real merits of the case can only be appreciated by those having actual traffic knowledge and experience, but the summary of this traffic man's opinion on the question is as follows:

"The point I wish to make in this whole matter is not so much that no saving whatsoever could be had by the substitution of the Squier System but that from practical consideration such wholesale savings as were indicated in RADIO BROADCAST are doubtful of attainment and the saving, if any, would probably be negligible."

Calling Up Your British Relations

ACCORDING to the A. T. and T. officials it may be possible in the not distant future to sit in your own home and talk to a friend on the other side of the Atlantic. If the recommendations of the British Post Office to establish a suitably large radio telephone station are carried out, it will mean that telephone subscribers in our country may talk directly to English subscribers.

We have on this side of the Atlantic plenty of power to talk across with a reasonable degree of reliability in the winter months. For the summer we must still concede the superiority of static; either stations tens and hundreds of times greater than we have at present, or some sort of static eliminator (for which there seems no reasonable hope) must be evolved before our summer time voices can be heard on the other side.

The British Post Office committee which has the matter in hand has just recommended that a 200 kw radio telephone station be erected in England using the same type of apparatus and control as has been worked out and found dependable here. Our radio engineers have been telephoning across the Atlantic for many months, but as there was no transmitting apparatus in England the conversation has been a one way channel only.

The great interference caused by atmospheric conditions is well illustrated by one statement from the engineers who have been doing the work. "The difficulties of the technical problems to be overcome are well indicated by the fact that atmospheric conditions often change so greatly that the amount of power required at one time to give audible speech in England may be 10,000 times as great as that required a few hours before." From this statement, undoubtedly conservative, may be inferred the difference between occasionally getting a message across and establishing commercial communication.

What Radio Can Do for Marriage

HOW it does tickle the vanity of some folk to read their names in the morning newspaper. Avery Hopwood and Miss Rosalie Rolanda plan to be married by radio,



ANOTHER NEW USE FOR RADIO

The Salvation Army in New York collecting funds for their recent Home Service appeal, aided by radio concerts. This photograph was taken in front of the New York Public Library

according to a press dispatch. He will be on board a ship returning from Europe and she will respond from one of New York's studios. In the actor's profession they tie and untie the marriage knot and with such facility and haste that the lack of seriousness at such a performance will not bother the principals at all. We have Radio Golf Balls, a Radio Cafeteria, Radio Pack for all sorts of ills, and many others of similar import so why not a Radio Wedding?

But it is so easy to get married that we think it a useless waste of the ether channel. Untying the marriage knot often proves more difficult than tying it, however, so we suggest that radio be put to work along these lines, where it might be of real assistance. Why not hide a microphone behind the curtain of the room where Percy's wife is to have a clandestine meeting with the man she should have married, Veronica's husband? Some one could watch for the arrival of the hero at the rendezvous, properly tip off the announcer, who would then send out to the world his well known refrain "The next voice you hear will be that of ——-." The station manager who could pull off such an event would, we fear, be voted the "cat's whiskers" or some equally expressive term of approbation by the millions of BCLs who were tuned to his wave.

Subtraction and Legal Wrath Among the Big Five

MANY have remarked on the strange crew of bed-fellows in that offspring of the War, the Radio Corporation of America, and have often said that the natural tendency of such a group was to dissociate instead of to combine. According to testimony of the American Telegraph and Telephone officials, their company has already disposed of all its holdings in the Corporation, so that this member has already separated itself as far as possible from its war-time associates. Certain patent agreements, necessary as a result of the war-time pooling of developments in the interest of the Government, still bind it to a certain extent to the others of the group, but we are given to understand that no profits of the RCA increase the income of the A. T. and T. Co.

We heard recently of a suit brought to collect royalties for the use of a certain patent, being fought by a counter suit to force the patentee to pay back the royalties which had already been paid! But the strangest one of all now comes to light; the Westinghouse Electric and Manufacturing Company in coöperation with Major Armstrong, has started suit against the A. T. and T. Co., the De Forest Radio Telephone and Telegraph Company, the General Electric Company, and certain individuals, among whom is the Secretary of the Navy.

The patent involved is one for "an improvement in method and apparatus for producing sustained electrical oscillations" so evidently is one which may be seriously affected by the recent decision of the oscillating triode in favor of De Forest. If so, more suits loom up in the foreground, for all of which the public pays.

The Radio Drama Needs a New Technique

WE HAVE heard a great deal about the violence done to the sales of popular songs when they are sent out over the radio channels—without a suitable royalty. Now we have the same reaction in the case of plays sent out from the broadcasting studio. And as we read the opinion of Mr. Edward Childs Carpenter, the president of the American Dramatists, we are inclined to believe as he does, an effect the loquacious attorney for the American Society of Composers, Authors and Publishers was quite unable to produce.

Says Mr. Carpenter—"Radio is after all, but hearing the words of a play. A play is written to be performed. Without actors any play is bound to lose its effectiveness. The appeal of any play is in the action and the staging, and no play has really been properly presented nor has the integrity of the author's idea been presented without the complete presentation in a theater, with production, costumes, scenery, music, lights, and the other elements that go to cast the atmospheric spell intended by the playwright. . . . It is not at all impossible that radio will evolve a technique all of its own in the matter of dramatic production."

The Light Socket Receiver

THE receiver which requires no batteries is sure to come, and it is sure to come because there is a tremendous demand for it and because it's possible and because it is sound engineering. What BCL prefers to continue the practice of buying new dry batteries (when he isn't testing them to see if they are any good) instead of connecting the set to an ordinary light socket and using only a switch to start and stop the set?

It seems strange that some one hasn't done it before, but even now, we hail as an advance the set which functions without either A or B batteries. It's comparatively simple to use storage batteries for the filament and plate circuits, mount them in a box fitted with a rectifier in such a manner that whenever the set is being used the batteries are put on charge, thus doing away with the necessity of periodical charging, but this isn't what we have in mind when we speak of a light socket set. A light socket set pure and simple, without any batteries at all—that's the idea. Of course we can't expect that kind of a development to be pushed very hard by the dry cell manufacturers because it will seriously damage their very large business. The inventor of such a set should find it easy enough however to float his scheme (if it is good) because there is certainly a mint of money to be made out of such a device. The device needn't be very high in first cost and its maintenance will be practically nothing. There is already one such set on the market, and we know of another that looks like a winner.

It is comparatively easy and cheap to build an outfit for drawing the plate current from the alternating current mains, but for the filaments, the required investment is quite a bit more. The Radio Corporation apparently controls an idea on a triode explained nearly ten years ago which uses alternating current for the filament. This tube gives much greater amplification than the ordinary kind and functions much better as a detector, yet for some reason not at all clear it is not put into production. Probably it will be developed rapidly enough when the patents on the triode as at present constructed expire, and the Corporation has to meet competition in the triode market.

When this idea was mentioned in these columns before, it called forth a peculiar response from one of those participating in the development policies of the RCA, the main argument of which seemed to be that the general public was well satisfied with the dry cell tube! Of course the public hailed the dry cell tube with delight when they compared it with the older storage battery type, but that doesn't mean they would not prefer to use no batteries at all.



TAKING THE BATTERIES OUT OF THE RADIO SET

Harry W. Houck (left) is holding his invention which is said to do away with A and B batteries. It is a plug which fits into any alternating current light socket. William Dubilier, radio manufacturer, is pointing out to the audience of radio editors the first model of the device. Raymond Francis Yates, of the New York *Herald-Tribune* is standing between Mr. Houck and Mr. Dubilier. Orrin E. Dunlap, Jr., of the New York *Times* is on the extreme right

The dry cell outfit would still meet with much demand for quite some time even though the light socket set were put out at a reasonably low price because there are still localities where power is not available. But for the average city and suburban dweller the light socket set



GENERAL PLUTARCO CALLES

One of the prominent candidates for the Mexican Presidency at the July elections, making an address before the microphone of a Mexico City broadcasting station. In the Mexican system, four microphones are connected in parallel

is sure to come, because it is possible, economical, and people want it.

Are There No More Miracles?

IN ONE of our earliest issues it was pointed out how quickly the American people accustom themselves to new things, with what nonchalance they view a wonderful machine which was perfected only the week before.

A radio novice was permitting his friend, a clergyman, to listen-in with his set and the wife of the clergyman was broadcasting from a distant station. With the same eagerness to show his friend some of the novelties of radio that all of us exhibit when we find some one who knows less about radio than we do, the clergyman (who probably wanted the enthusiast to leave the set alone so he could listen) was made to see the effects of mistuning, interference, and all the other tricks of the receiving set. He found that even though the antenna was disconnected, the currents from the ether were still able to convey to the listener the words of the distant speaker. Seeing that the radio currents which were actuating the receiver must be coming through his body (he had the antenna in one hand and the antenna binding post in the other) he could not repress the statement, "And yet some people say there are no longer any miracles!" "Just body induction," was the matter-of-fact rejoinder of his friend.

Well, we side with the clergyman. A miracle is something we cannot understand, and in spite of the fact that the phenomenon of induction has been known many years it is today as much a miracle as it was to Faraday or the other early workers in this field. We are surrounded by miracles and he who is so devoid of imagination (or so self-satisfied with his supposed wisdom) as not to perceive them operating around him every day is missing much of the interest and stimulus of this age.

Great Minds Still Disagree on Broadcasting Payment

WHO pays? continues to call for much comment and inquiry from the press. The New York *Times* printed interviews recently with many of those most vitally interested in radio, from which the still greatly diversified views on this question may be gleaned.

Herbert Hoover believes that broadcasting will be supported as it is at present and that the stations will be organized into six or seven great national circuits for using economically the finest talent in simultaneous broadcasting.

H. B. Thayer, President of the American Telephone and Telegraph Co., while offering no definite suggestions, did say that he doubted very much the probability of using specially modulated waves, for which specially built sets, to be obtained from the broadcasting company only, would be required. Such scrambled messages are possible, he said, but at the same time he doubted their efficacy in making broadcasting self supporting.

David Sarnoff of the Radio Corporation grasps the idea we put into our very first issue—that the broadcasting station will be endowed as are other great public institutions. Philanthropists have still to be attracted by the possibilities of this scheme, but times and people change and we may expect much. Radio already contributes much to the happiness of mankind, and when this is more appreciated radio will appeal to the givers of gifts as have done libraries and other public institutions.

For the General Electric Company, Martin P. Rice expresses the opinion that the BCL should contribute to the support of broadcasting, either by voluntary contributions, or by the licensing of sets or similar scheme.

Heywood Broun, in one of his typical tirades,

doesn't know who is going to pay the broadcasting artist, but he is perfectly sure some one is going to pay if he has anything to say about it. He says:

> Until radio came along this sort of graft was beginning to diminish. Communities were beginning to realize that it was sheer nerve to ask anybody to speak, or read his poems, or tell a few funny stories without offering a fee, however small, in return. Then radio burst into the world and gall returned in a most noxious form. The broadcasters do not pay. Instead they offer the performer publicity. It is a highly depreciated currency. People who ought to know better yield to the lure.

As for the thousands of letters one is supposed to receive Broun is of the opinion that the artist can neither feed nor clothe himself with them and further that "it must be a fearful nuisance to read them all."

E. C. Mills, for the Society of Composers, Authors, and Publishers, with his usual shrewdness, develops an ambitious plan of forcing the public to pay well for the performances of artists.

China to Have Broadcast Service

REGULAR radio broadcasting has been started in China; *Shu Pao* gets the credit for being the first newspaper in China to put itself in line with its American contemporaries. Four times a day music and educational lectures in Chinese are broadcast.

The Oscillating Tube in a Legal Tangle

MOST radio fans at once associate the regenerative circuit, and the oscillating triode, with the name of Armstrong, but according to Dr. De Forest's attorneys, this should not be. In their words—"by some preliminary litigation and wide publicity given the controversy between Dr. De Forest and Armstrong, the public has been led to believe that Armstrong was the inventor of the so-called feed-back and regenerative circuits. On the other hand De Forest continued his fight and after seven years of continuous litigation has now, by the court of last resort, been given credit to which he is so justly entitled."

The occasion for the announcement of De Forest's attorneys was the recent handing down of a decision in the United States Court of Appeals for the District of Columbia. Contrary to the opinion of the patent office examiners the Court has ruled that De Forest was the inventor of the oscillating triode. This had nothing directly to do with the regenerative patent, which has been adjudicated in Armstrong's favor, but relates to the production of oscillations only. Armstrong entered two patents—one to cover regeneration and one specifically on the production of oscillations. It is the latter which has been decided in De Forest's favor.

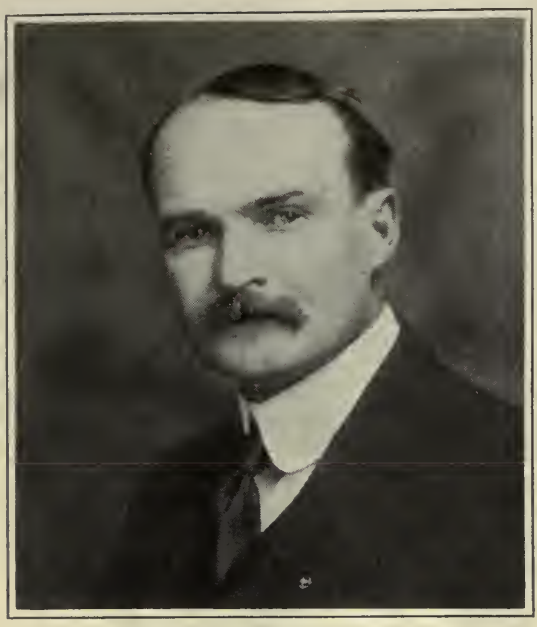
Continuing, De Forest's lawyers say "it is impossible to foretell how far reaching the effect of this opinion is going to be. It is certain that the Radio Corporation of America, which is licensed under the Armstrong rights, and the Westinghouse Company, one of the members of the Radio Corporation, have received a set-back which may have very disastrous results."

It seems that even this decision does not entitle De Forest to sit back and begin to collect royalties, as more litigation still faces him before his alleged priority in this field of invention is finally decided. How many more Courts there are still to be convinced we do not know, but we do know that Armstrong and the Radio Corporation are at present busy collecting data to show the next court they encounter, that De Forest's contentions in the lower court were not sustained by reputable witnesses. Certainly the patent lawyers have reaped a rich harvest from the triode, whatever the real contributors to its development may get.



THE RADIO MOOD—IN CLAY

W. Clark Noble, a sculptor of Washington, D. C., standing beside his recently completed work, "Listening-In"



E. S. MARTIN

Secretary, Editorial Board, Boy Scouts of America

"Ninety-Seven per cent. of the six hundred thousand members of the Boy Scouts of America are interested in radio, which was proved by a questionnaire we recently sent out. This fact is significant to those who are studying the potentiality of the various interests of youth, for radio, more than any other interest, keeps the boy at home. I hail the advent of radio as offering to the youth of America an interest which is at once a challenge to their intelligence, ingenuity, and skill, and a constant source of entertainment of value"

W G Y Too Busy to Test

RADIO is growing so rapidly that those vitally interested must continually strive to keep up with the new things discovered by others and also discover some for themselves. Many of the laws of radiation are still not clear and much experimenting has still to be carried out to ascertain the relative merits of short and long wave transmission. Many other important problems are in the same unsettled state.

If you listen at perhaps three o'clock in the morning you may hear tests of all kinds going on from well known stations. For experiments must be carried on in the off hours when the BCL is in bed or at work. Even with this apportioning of time W G Y is not able to satisfy its needs. The General Electric Company has decided to put up another station, and keep it busy entirely on experimental work. It is expected that $150,000 will be required to erect the station and that it will be put up this summer at some point well away from the main General Electric plant where W G Y is located. Tentative plans call for a very flexible equipment, capable of sending large power at short wavelengths. The station will probably be very popular with the radio research men of Schenectady as there is a tremendous amount of important and fascinating work waiting to be attacked by just such a station.

New Radio Books are Few

OF LATE there has been but little or no activity in the radio field by the book publishers. Apparently the radio book market is saturated. We know stacks of various elementary radio books for which the anticipated demand did not materialize so that they are in dead storage and must be ultimately consigned as waste.

In writing a radio book the author generally tries to explain the underlying principles of radio or to show how to build and make certain sets function. The first idea yields a book that requires study; not mere reading, but real work, for it is not to be expected that a knowledge of scientific principles can be obtained any easier out of school than in it, and surely the students in school find it no easy task to master radio principles. The advantage of so mastering a book on principles is obvious however—anything gained from it is of permanent value and can be applied to any radio problem. On the other hand to read such a book is not as easy, nor to many as interesting, as reading one on how to build a set.

The trouble with the "build your own" type of book is that the information given rapidly becomes out of date, because of the changing art. New types of coils and circuits (the principles of which are the same as before but the arrangement and construction of which are different) are continually coming to the front, so rapidly that it is hardly worth while to invest in such a book. The better type of radio magazine is taking care of this field so well that more books on the subject will probably be failures from the sales standpoint. It is better to get a good book on principles (too hard for mastery at the first reading) and then keep abreast of the advance in constructional developments by reading the better class of radio periodical.

A Powerful New English Station

THE *Daily Mail* tells us that Great Britain is to have the largest and most powerful radio station in the world designed for direct communication with India and Australia.

The work of clearing over a square mile of country where the station is to be located has already begun. Sixteen masts, each 820 feet high, will be distributed over this territory to support the vast span of wires which will form the upper part of the antenna. When we picture this network suspended in the sky we can well sympathize with the small boy who had been taken to see one of the large trans-atlantic stations, and who queried of his all-knowing parent, "Why do they call it wireless, dad?"

Interesting Things Interesting People Say

COLONEL J. F. DILLON (San Francisco; Department of Commerce: Radio Supervisor for the Pacific Coast radio district): "There are more than 500,000 receiving sets in homes, offices, and business houses in California. At least three persons listen-in at each of these receivers, which makes a total of at least a million and a half radio listeners in the state. Four million radio listeners on the Pacific Coast would be a conservative figure."

C. J. WEST (Columbus, Ohio; State Federal Crop Statistician): "One farm in every seventeen in Ohio is equipped with radio. This means that approximately six per cent. or 7,500 rural homes in the state are equipped with radio receivers."

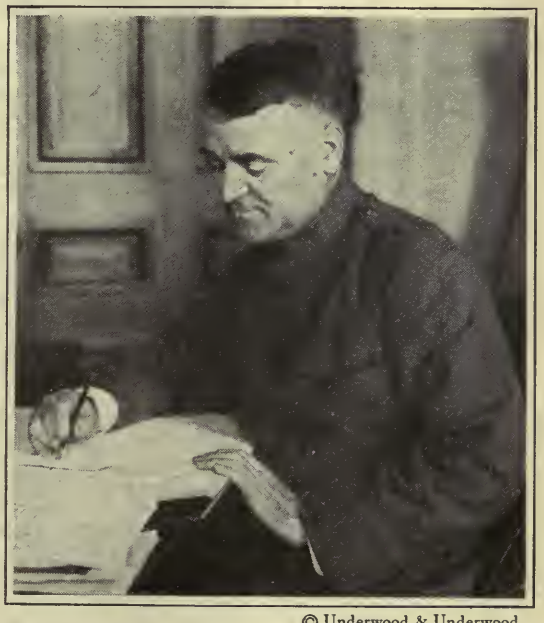
HOXIE NEALE FAIRCHILD (New York City; Director, Home Study Department, Columbia University), speaking of the radio course in Browning which he recently broadcast from WEAF, New York: " . . . People who formerly had turned their noses up at radio promptly turned them down again when they heard of that course. . . . But this experiment proved that a good proportion of the radio audience was willing to listen to literary discussions. Now students are turning radio fans and radio fans are turning students.

"Radio as a mechanical marvel is growing stale. People are beginning to ask: 'Now we have it, what are we going to do with it?' Education is the one great answer to that question, and long distance education means books.

"Here's another suggestion. At present some book stores have lectures, but this fine plan is not practicable for all. But there is hardly a book shop in the country that could not install a radio set and invite people to listen to these courses. And naturally you would have on hand books connected with the topic of the lecture."

S. HUROK (New York City; concert impressario, and manager of Pavlowa): "To-day, radio entertains thousands of people who never have been reached by concerts or the gramophone. People who own radio sets look up the programs to see what is being broadcast. They read that the aria from "La Bohème" will be sung that night from a certain station. They become interested and ask questions. "What is 'La Bohème'?" They look it up and learn that it is an opera. They want to read the libretto. They become interested in the soloists and inquire about them. In this way, an interest in music is created which is beneficial to concerts, because all these listeners are prospective attendants.

"Of course, radio is not yet perfect, but the experiments now being performed will remedy the minor defects which exist to-day. Some of the transmission is poor, and I believe that the piano goes over the ether with less fidelity than any other musical instrument. Vocal selections are in most cases the best. . . . In the long run, I feel that music will benefit directly from radio."



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JOHN T. AXTON
Chief of Chaplains, United States Army

"The degree of cheer and comfort which radio is giving to the disabled veterans in our hospitals, can hardly be realized by those who are well and whole"



THE ROBERTS THREE–TUBE KNOCK-OUT RECEIVER
Designed and incorporated in a cabinet of his own design by Mr. J. E. Roberts, of Cleveland, Ohio. The set cost exactly $51.90 to build

Building a Knock-Out Three-Tube Roberts Set

Suggesting Improvements in Design of the Roberts Two-Tube Knock-Out Receiver—A Selective, Sensitive, Dependable, Non-Radiating Set—The Parts Cost $50 and are Standard

By J. E. ROBERTS

THE article appearing in the April issue of RADIO BROADCAST, entitled "A Knock-out Two-tube Set" was of particular interest, in that it apparently described an ideal receiving set of its class which offered specifically three outstanding advantages——

Economy and performance of a two-tube reflex, with a tube for detector, instead of a crystal.

Selectivity and DX range of a regenerative set with two stages of amplification, without the vice of radiation.

Ease of control, stability, and other virtues of a neutrodyne, without the complication or multiplicity of tubes.

Any of these advantages alone is well worth trying for, so the result was that a set was hooked up, temporarily, on a base consisting of the end of a soap box, with a "false" panel, of wood, to carry the condensers—exactly in accordance in every detail, with the description and diagrams in the April issue, and the product though rather short on good looks, produced results much in excess of those promised, either specifically or by inference.

It was apparent that this hook-up was much too efficient to be allowed to remain in temporary shape, and as it seemed possible to put it on a panel in a compact and workmanlike manner, with a possible further improvement

due to perfect connections, proper spacing of instruments, etc., the set was rebuilt on a 7″ x 18″ panel, and laid out to fit a cabinet, 7″ x 18″ x 8″ inside dimensions, and this hook-up was completed some weeks in advance of the panel layout shown in the May issue of RADIO BROADCAST.

In this second hook-up several changes were made which promised more efficient or simpler operation, and while some of them did not show material advantages, the rest of them were apparently improvements and were incorporated in the set as it now stands.

THE CHANGES MADE IN THE ORIGINAL DESIGN

FIRST, the A or primary coil was found to have a very satisfactory effect if it were arranged so that the coupling with its partner (Coil S-1) could be easily varied—in other words, if a variable coupler was made of these two coils—and this was done, by mounting Coil S-1 directly on its variable condenser, and then varying the coupling by mounting Coil A on a bracket which would allow it to rotate through an arc of about 20 degrees in the same plane as Coil S-1. Details of this mounting are shown in Fig. 3. The results obtained were particularly noticeable when it was desired to make a selection between two stations operating at the same time on a wavelength nearly the same—with a difference of 10 to 20 meters, for example.

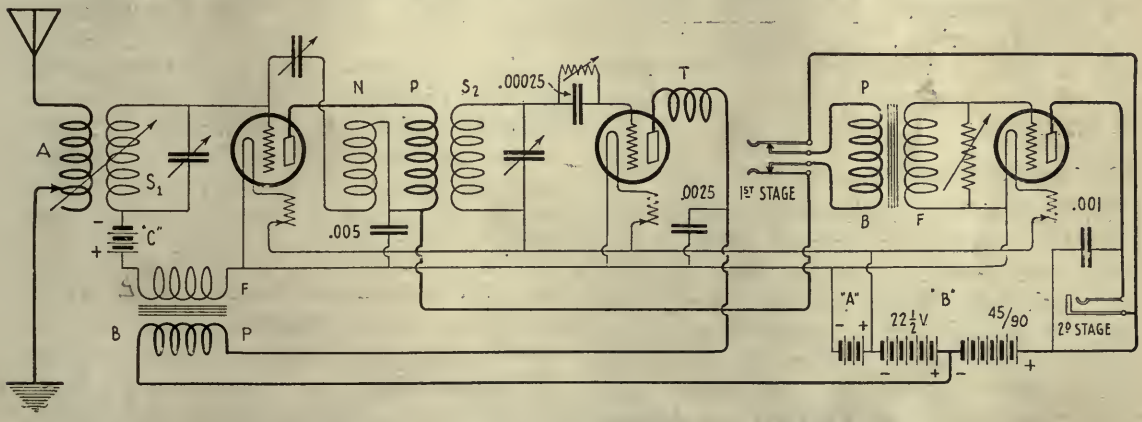
Second, the neutralizing condenser C was replaced (as suggested) by a two-plate variable condenser—this was mounted on the panel, and while there is no necessity for frequent variation of this capacity, yet it often aids in improving reception—furnishing just the little variation that is necessary to make it "just right." The grid wire, spaghetti, and brass tube combination are efficient, but they are inconvenient to reach and adjust, particularly if the set is enclosed in a cabinet.

Third, the fixed grid leak shown on the detector tube was replaced by a Cutler-Hammer variable leak, and the control brought through to the panel—a fixed grid leak was not satisfactory, owing to the difficulty of getting just the right resistance—and while the variable leak needed no attention after the right adjustment was found, it was certainly possible to get just the proper resistance more easily and to change it in the case of a change of tube in the detector socket.

Fourth, Coils N and P, and S-2 were mounted directly on the back of the condenser controlling that circuit, coils N and P being $\frac{1}{2}$″ from the back condenser plate, coil S-2 on the same center post, $\frac{3}{4}$″ from N and P, and centered with them. Coil T was then centered $\frac{1}{4}$″ from S-2 and arranged to rotate through an arc of about 30 degrees in the same plane, and the control carried out through the panel for convenient adjustment—as in Fig. 2.

Fifth, a Frost single-circuit switch was hooked in the common wire carrying the — B and + A current as a matter of convenience and possible economy in battery current.

In addition to these direct changes from the original specifications, several little details were noted that were of advantage. As will be noted from the photographs, Univernier dials are used in connection with the two tuning condensers, the condensers themselves having no vernier plates. This type of dial is an ab-



CIRCUIT DIAGRAM OF THE ROBERTS TWO-TUBE RECEIVER

With an additional stage of audio-frequency added. Note the variable grid leaks in the grid return of the detector tube and across the secondary of the second audio transformer

solute necessity on the second condenser, since even with the reduction of 12 to 1 obtained by this dial, the difference between good and poor reception is a matter of a very few degrees—with an ordinary dial, this condenser would be most critical, but with the vernier dial it is not critical—merely *accurate*.

The dial in the primary circuit tuning coil S-1 need not be a vernier, as the adjustment in this circuit is much less fine, but the advantage of having two dials alike is found in logging stations. In the set in question, these two dials run approximately together, making the simplest sort of tuning—for if a station is brought in on 80 on the first dial, the best reception will be found by locating the second dial between 78 and 82. W B Z comes in on 60–60, W W J on 155–156, W O O on 138–140, W H A M on 41–45—and it can also be noted that there is a direct relation between dial settings and wavelength, so that a dial can be set approximately for any station not logged, if the wavelength is known, and the variation of a few degrees either way, will bring that station in—if it's on the air.

Tickler coil T—specifications called for 20 turns. Later, this was changed to 18; in the set described, both 20 and 18 turns were tried and later reduced to 15 turns—which, *in this set*, gives the best results.

CONSTRUCTION EXPERIENCES WITH THE SET

IN WINDING these spider-web coils, whether on home-made or purchased forms, it has been found that better results were obtained, and much less trouble, by using the proper gauge of *enameled* wire, rather than silk or cotton-covered. These spider-web forms are liable to have a sharp edge, and in threading the wire down into place, this edge cuts through the insulation of silk or cotton, resulting in two or more turns being shorted. The enamel is much tougher, does not scrape off or "open up" on sharp turns—and in addition takes less space, and looks better, and *doesn't absorb moisture*.

Tubes were mounted on brackets made of $\frac{1}{4}$", No. 18 "half hard" brass, and long enough to allow a little spring—this prevents microphonic noises from the tubes, and also insures safety for the tubes when the set is moved—this particular set being intended to be a portable set.

It has been compared in operation to a number of other sets and has been operated in several instances with the same conditions of antenna, ground, location etc., and in every case has shown its value. This two-tube set, consisting of 1 stage of RF, detector, and 1 stage of AF (reflexed) was fully the equal of a two-tube reflex set in volume, clarity and distance — the reflex consisting of 1 stage of RF, crystal detector, 1 stage AF (reflexed) and one stage of straight AF.

In this case, this set operated on the same tubes, batteries, antenna, ground, and loudspeaker as the reflex and in the same location.

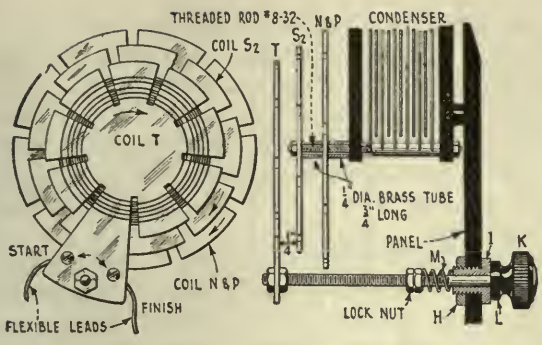
It was then decided to experiment with the addition of another stage of audio frequency to this set—making it a three-tube set, and incorporating one stage of RF, one detector, one stage of reflexed AF and one stage of straight AF. Fig. 1 illustrates the hook-up, and the photographs show the general construction details and layout, as well as general appearance of the completed set, in and out of its cabinet.

THE SET COMPLETE WEIGHS TWENTY-TWO POUNDS

THE entire set is mounted on a 7" x 18" rubber panel, and included in a cabinet, 19" long, 10" deep and 11" high, which cabinet also includes three dry cells in parallel, for the A battery, a 3-cell C battery block, and

The Roberts Set—Dressed Up

If there has been one receiver which has called forth general approbation and enthusiasm from our readers it was the Knock-Out One-Tube Set. But soon after that had jumped into such general popularity, along came Mr. Walter Van B. Roberts with his two-tube receiver which has all the advantages, and more, that one could ask from a set using two tubes. The great number of enthusiastic readers who built up the Roberts Set, which was described in this magazine for April and May, lost precious little time in writing us the excellent results they got from the outfit. All of them praised its sensitiveness and selectivity. And among these enthusiasts was Mr. J. E. Roberts, of Cleveland, who put the set together, plus another stage of audio according to his own ideas—which, by the way, are excellent ones.—THE EDITOR



DETAILS OF THE COIL MOUNTING

Of coils N and P, S-2, and T. H, I, K, L, and M, are nut bushing, knob, lock-nut and spring of standard switch assembly. J is $\frac{8}{32}$ threaded brass rod, whose length varies with the distance of the coil S-2 from the panel. A lever 3" long can be used in place of knob K

two blocks ($22\frac{1}{2}$ v. each) of B battery, with room enough for two more blocks —making 90 volts. The completed set, with everything ready for the pushing of the battery switch, weighs about 22 pounds, and is very distinctly portable, being no larger or heavier than the well known Gladstone bag—and not so heavy as many of those bags, when filled.

The three-tube set is nothing more nor less than the two-tube set as originally built, right up to the output jack. A two-circuit jack was substituted for the single circuit jack on the original set, and the second stage of amplification, which is the regular second stage standard hook-up in every way but one, was connected in the standard way to the terminals of the two-circuit jack, as shown in Fig. 1. The only exception to the regulation AF hook-up is the inclusion of a *grid-leak*, across the *secondary* terminals of the *second* transformer. Almost as good a result can be obtained by shunting a .002 mfd. fixed condenser across these terminals, but a variable grid leak is to be preferred.

The location of a grid leak in this position is of very great advantage in preventing distortion, particularly on strong signals.

WHAT THE SET WILL DO

THE resulting set is most satisfactory in every way—it is compact, and easily handled and portable in the strictest sense—it uses three tubes, and gives the equivalent of four and five in volume—it is easily tuned, and a station once logged, can be returned to again and again, quickly and easily—it is stable; once tuned-in it can be forgotten till the end of the program—it is selective, as it will bring in out-of-town stations through powerful locals, even when the wavelengths differ less than 20 meters. Two tubes are all that is necessary for loudspeaker results from stations up to several hundred miles, consistently, further, on occasions; three tubes will bring in anything up to 1500 miles on the horn and many of the smaller powered stations in the same radius on the phones.

Following is a copy of the log-book of this set for three days (or nights):

May 1st	WGY	380 m	Primary	4	Cond's	81–87
	WBZ	475	"	4	"	60–60
	KYW	536	"	5	"	170–168
	WOO	509	"	5	"	138–140
	WIP	509	"	5	"	138–140
	WHN	360	"	3	"	62–62
May 2nd	8AJ	Amateur	"	4	"	21–13
	8BOP	"	"	4	"	21–13
	WDAP	390	"	4	"	70–67
	WHAS	400	"	4	"	86–85
	WSB	429	"	4	"	110–108
	WDAF	411	"	4	"	95–91
	WOS	441	"	4	"	110–114
	WGN	370	"	4	"	75–73
	WDAR	395	"	4	"	86–81
	WJZ	455	"	5	"	114–119
	WGR	319	"	4	"	52–50
	WLAG	417	"	4	"	100–98
	WLS	345	"	4	"	65–61
	WOQ	360	"	4	"	65–65
	WHB	411	"	4	"	93–93
May 3rd	WHAM	283	"	4	"	45–41
	WWJ	517	"	4	"	155–156
	KFKX	341	"	4	"	61–61
	WCX	517	"	4	"	155–156
	WSAI	309	"	4	"	48–45
	WCAE	462	"	5	"	120–120

In all cases noted, this reception was ample for the phones on two tubes—in about half the cases, it was sufficient for loud speaker reception. On three tubes, they were all amply loud for comfortable reception with but one exception (WLAG) which was poor on this occasion. In all cases excepting WGY, WDAP WGN and WOQ, reception was through local broadcasting.

PARTS REQUIRED

FOLLOWING is a list of parts used in the three-tube set illustrated, at local prices. This list shows that the three-tube set can be built out of reasonably good material complete for less than $50.00, exclusive only of the cabinet and phones (or loud speaker units).

It is to be noted that this entire description refers to several sets. One of them was temporary, another, a complete two-tube set on a panel and a complete three-tube set, on a panel and in a cabinet, which were operated with the results as outlined, on two, and later, three

WD-12 tubes. Trial was made on the two-tube set, of a pair of boot-leg tubes of the 201-A type with results less satisfactory than those produced by the WD-12's. The two-tube set was also tried with two 201-A Radiotrons, with a 6-volt storage battery on the filament, and 90 volts on the plate of the first tube. The results were but very little better than the results produced by the WD-12's.

PARTS REQUIRED

2	23 plate RVC variable condensers	$ 4.00
2	Univernier Dials	2.50
3	Fada sockets	2.25
3	Rheostats	1.50
5	Spiderweb coil forms	.50
	Wire (enameled) for coils	.50
1	Cutler-Hammer grid leak	1.50
1	Double circuit jack	.75
1	Single circuit jack	.50
1	Jefferson Transformer 6:1	3.50
1	Jefferson Transformer 3:1	2.50
1	Frost Battery switch	.25
1	Inductance switch for primary taps	.75
2	Switch levers (for coupling control)	.75
1	2 plate condenser variable	1.00
1	Dial for same	.25
3	Micadons (.00025, .0025, .005 mfd.)	1.15
1	Bradleyohm	2.00
1	Phone plug	.50
	Flexible connections	.40
	Panel 7 x 18	1.35
	Miscellaneous—bus bar binding posts, bolts, etc.	1.00
		$29.40
3	W D-12 tubes	15.00
3	Dry-cells (Burgess)	1.50
3	blocks B battery	6.00
		$51.90

The latter tubes seem to vary in characteristics, as it took some shifting of tubes to get the three tubes sorted out for their best operation. It was found that one tube was decidedly below average as a reflex operator, but functioned perfectly as a detector, and vice-versa with the second tube, while the third will do anything, anywhere. The set is easy to control, simple to tune, and it *does not radiate*.



BEHIND THE PANEL

From the under side, showing the spring-brass brackets holding the tube shelf and three rheostats. The neutralizing condenser is in the center. The tickler coil is on the left and the two audio transformers are one on either side of the rheostats

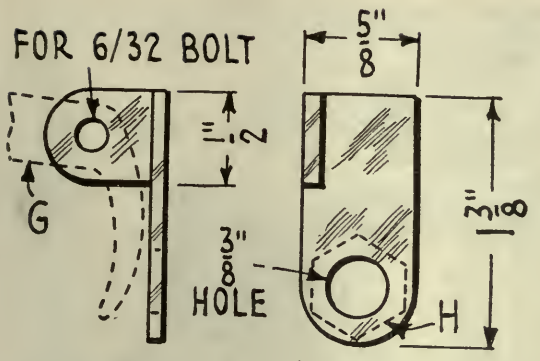
This particular set is operating about three miles from the center of Cleveland, Ohio—within a mile of WHK, two miles and a half from WJAX and less than 5 miles from WTAM. It operates on a 75-foot single wire antenna, with a 40-foot lead-in, down the brick side-wall of an apartment house, surrounded on three sides by 550-volt trolley lines, and on the fourth side by a 2200-volt power cable—with transformers less than 500 yards away. It is within three miles of WTK, a most pervasive ship-to-shore spark station operating on 600 meters, and apparently in the center of the largest collection of radiating sets with dial-twisting operators in the whole United States—it will get away from everything but the shock excitation of WTK's spark. Nothing can eliminate that.

HINTS ON BUILDING THE SET

IN THE building of these three sets several little kinks have been discovered that may aid in construction of duplicate receivers of this type.

The forms for the spider-web coils are not easy to make, for the best material is hard to handle with the usual tools. They are more or less difficult to find in the regular radio stores, for some unknown reason, but they have been found in the five and ten cent stores in three cities, and are probably carried by all of the stores of that class that carry radio parts. Three types of these forms have been found: one is made of what appears to be a soft cardboard, much like a double-thick stiff blotter. It is wise to avoid this sort of material—another is made of a $\frac{3}{32}$" (thick) red vulcanized fibre, and is very good, but the best, if they can be found, are the ones made of $\frac{1}{16}$" (thick) hard rubber. The size that is best, and which is amply large for the windings specified, has a $1\frac{3}{4}$" center, 4" outside diameter, and fifteen slots.

It makes no difference in winding



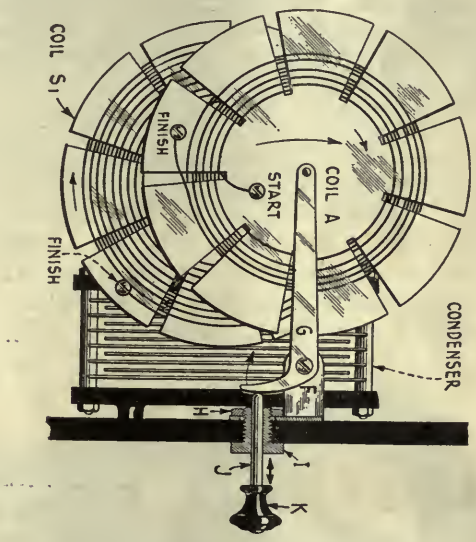
DETAILS OF THE BRACKET F

As shown incorporated in the drawing below. The lever G is #18 gauge brass. Its other dimensions will vary with the location of center of coil S-1

these coils whether they are wound clockwise, or counter-clockwise, *but, whichever direction you choose, wind all of them the same way.* It is a very good scheme to wind them clockwise, leaving the inner terminal wire protruding from the face of the form (the face being the side toward you), and wind in a clockwise direction till the required number of turns are placed, and then bring the outside terminal wire through to the face of the form. Make a terminal out of a $\frac{1}{4}''$-$\frac{6}{32}$ brass bolt and nut and locate same for the beginning of the coil, about $\frac{1}{4}''$ inside of the windings, soldering the end of the wire in the screw slot—duplicate the process for the outside end of the wire, locating the bolt about $\frac{1}{4}''$ outside of the windings on one of the spokes of the form. Then mark the coil, on the face, with an arrow pointing in the direction of the windings, and when assembling the coils, see that all the arrows are on the same relative side of the coils and all pointing in the same direction.

In the double coil, (N and P) it is well to bring the *outside* terminal of N, and the *inside* terminal of P, to a common terminal bolt, inside the winding circle, and locate the terminal bolts for the *inside* terminal of N and the *outside* terminal of P, outside the winding circle, on two adjacent spokes of the form, and *mark them.*

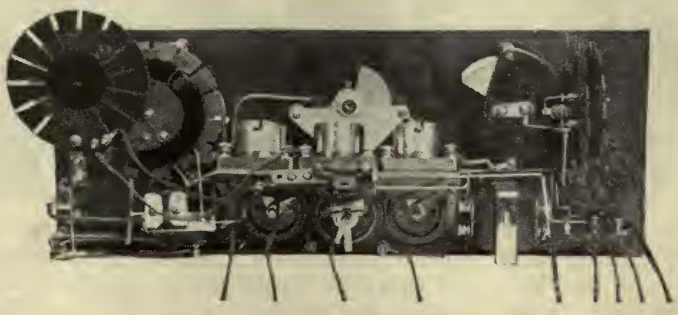
The wiring diagram should be followed carefully, in every case, but most particularly in the wiring of the filament lead. Do not run this wire to or through rheostats or resistances of any kind—use either square bus bar, or No. 14 hard copper wire, and run direct from the – A terminal binding post to the – terminal of the filament on the tube sockets (on standard sockets, the – post is the one nearest to the grid terminal—often both terminals are only marked with an F without + and – markings), and then carry it on, if consistent, to meet the other – A connections (on the two-tube set these connections are to the F terminal on the secondary of the transformer, one side of the .005 condenser, one side of the .0025 condenser, and the grid return of the detector tube—the three-tube set has another one—to the second transformer.) The rheostats, whether you use one or three resistances, if you use them, and the battery switch should all go in the line carrying the A – and B – currents.



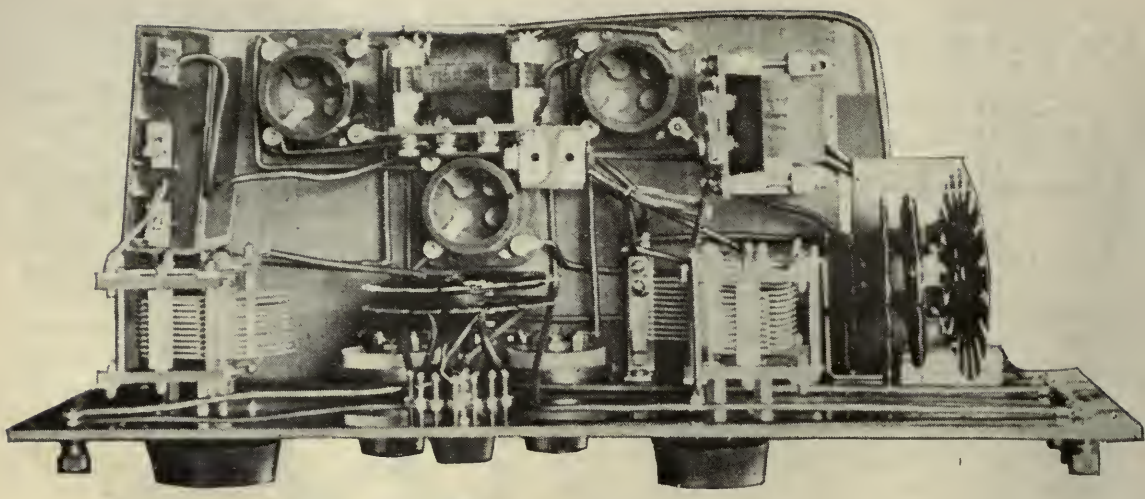
DETAIL OF THE MOUNTING

And coupling of coils A and S-1. H, I, J, and K are nut, bushing, shaft and knob of standard switch lever assembly. J is coated with solder and filed to a sliding fit in bushing I

In the set described, using two (and three) WD-12 tubes, $22\frac{1}{2}$ volts of B battery seemed to



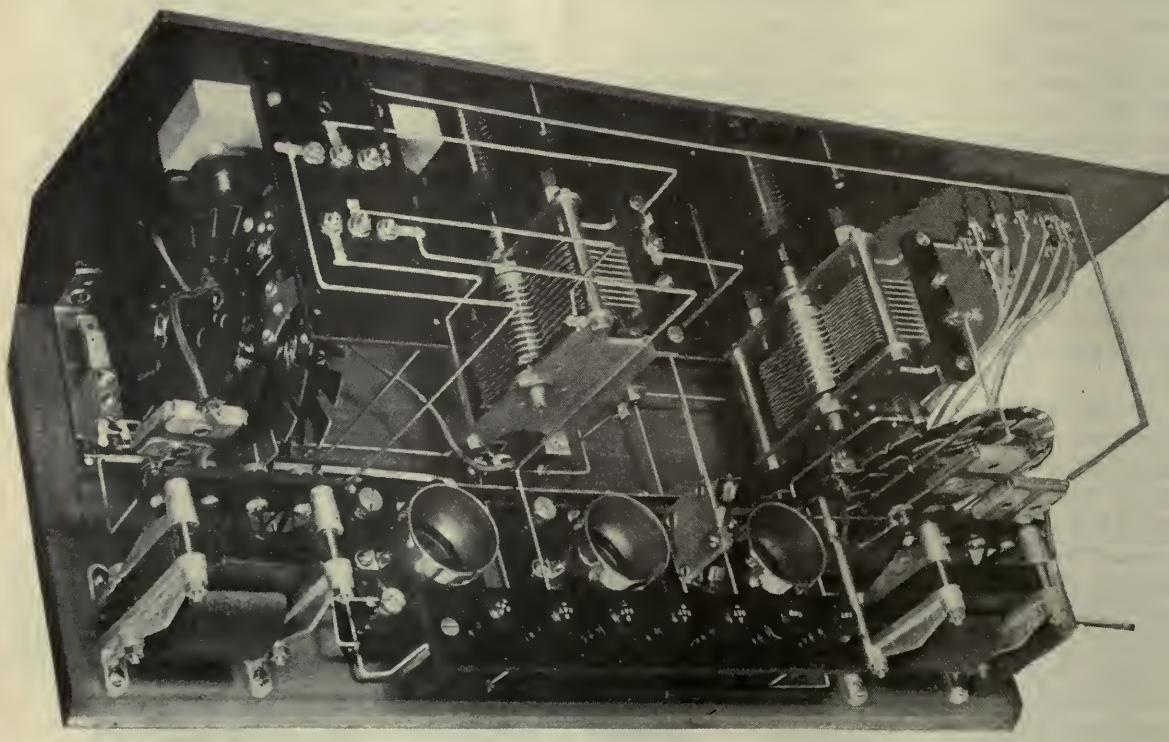
BACK VIEW OF THE RECEIVER



ALTERING THE DESIGN

Several of these three-tube sets have been built in Radio Broadcast's Laboratory and the illustration above shows very plainly that it is not absolutely essential to follow the lay-out suggested by the author

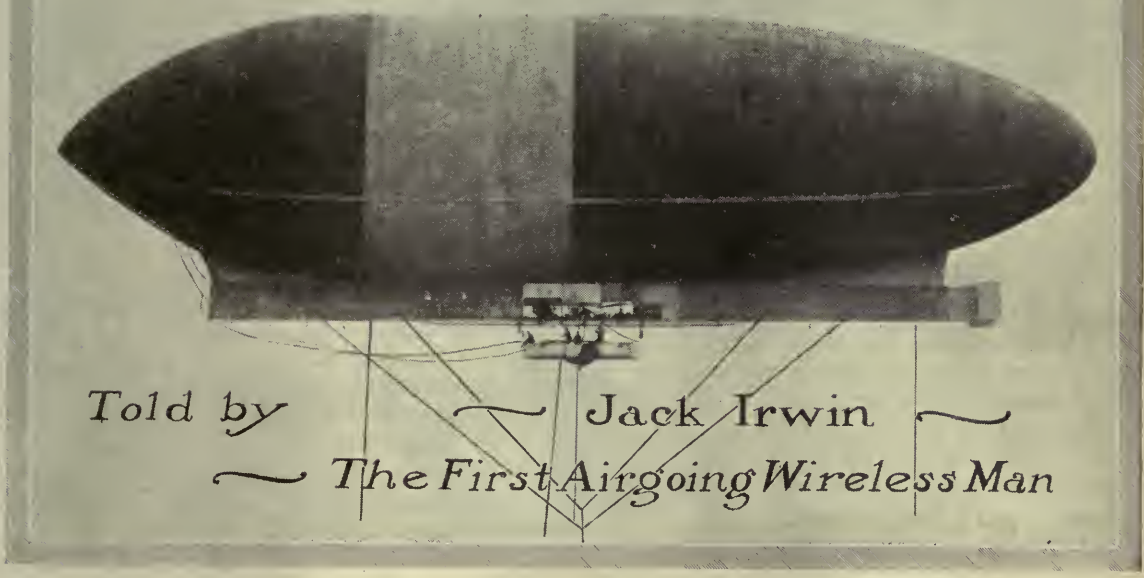
be correct for the plate voltage on the second tube, and both the two-tube and three-tube sets have given splendid results with 45 volts of B on the first (and third) tube. When 201-A tubes were used in the two-tube set, 90 volts were applied to the plate of the first tube and 22½ volts on the second tube and the results were only slightly better than 45 volts on the WD-12.



THIS FINE LAY-OUT

Was built under the direction of Radio Broadcast by Schneider and Horneij, of New York. The design and workmanship is exceptionally clean cut and workmanlike

When the "America" Put Out to Sea
Fog—Wind—Disaster—and—Rescue.



Told by — Jack Irwin —
— The First Airgoing Wireless Man

ON JULY 14, 1919, those two admirable Lieutenants, Alcock and Brown began their airplane trip from St. John's, Newfoundland, which ended with their successful arrival at Clifden, Ireland. On October 10th, 1910, a much bulkier airship and a more numerous crew started to cross the same stretch of ocean, but they were nine years ahead of the progress of invention and failed in their attempt to reach the other shores. This story is particularly interesting at this time because of the "round the world" airplane flights being staged by the U. S. Army Air Service, and others.

"I have often before been approached to write about this eventful voyage of the *America*," writes Mr. Irwin to the Editor, "but have refrained, believing that the story would make more interesting reading later."

IN THE spring of 1910 I received what, at that period in the history of radio, was the strangest assignment a wireless operator ever had. I had returned to New York after a trip to England as radio operator on the old American Liner *St. Louis*. The Marconi Wireless Telegraph Company of America was then a small organization and I was one of the four sea-going operators in its employ (there were only fifteen operators in the company's entire service). To be in charge of one of the four ship stations the company controlled was considered, in those days, a good job. I was contented with my lot and satisfied with what life offered—a fine ship, good fellows for shipmates, and a pleasant run.

It was then customary, in that small family-like organization, for ship operators to report after each voyage direct to the Chief Engineer of the company, Mr. Frederick M. Sammis. He occupied a similar position to Poo Bah—that extraordinary and versatile character in Gilbert and Sullivan's "Mikado." He acted in almost every capacity. Without any other

thought in mind, except, perhaps, the usual operator's genius for smelling a salary advance, I entered Mr. Sammis' office and made the customary report. It was then I received the jolt he had prepared for me. He nonchalantly inquired whether I was prepared for a transfer to another ship, and as though it was an every-day duty with him, in a few words tendered me the job of operator on the airship *America*, then being constructed at Atlantic City. Whether I jumped at this offer or not I cannot remember now, but I found myself in the course of a day or two in Atlantic City, duly signed on as a member of the crew of a dirigible and committed to make the first attempt to cross the Atlantic by air line.

ASSIGNED TO AN AIRSHIP IN 1910

MY CONTRACT with Mr. Walter Wellman, who commanded the expedition, called for my services not only as a wireless man, but as a general aide, and the months intervening between June, when I joined the crew, and October 15th, when we sailed, found me handling many jobs and assimilating a knowledge of aëronautics. There was also born in me a love for the flying game that has persisted to this day. One of the jobs nearly cost me my trip when the valve on the hydrogen plant, which I was tending, came off in my hand and filled my shoe with a boiling sulphuric solution. I was weeks in a hospital and my substitute had already been selected, but fortunately many delays in the sailing date intervened, with the result that I was able to hobble down to the ship and sail with the originally selected crew.

The *America* was what is known as a non-rigid type of dirigible, cigar shaped. She was 228 feet long and 52 feet in diameter at the central or thickest part. This great gas reservoir was made of cotton, silk and rubber and beautifully tailored, all seams being wide lapped, sewn and gummed, and extra strips cemented over to cover the stitches and prevent leakage of hydrogen. The huge envelope contained when fully inflated, 345,000 cubic feet of hydrogen gas. This lifted a load of 28,000 pounds.



JACK IRWIN

Who tells his story of the first wireless voyage in the air when Walter Wellman's *America* set out to conquer the Atlantic in October, 1910

Under the balloon or gas envelope was built a huge steel frame, enclosed with varnished linen, and attached to the balloon by eighty steel cables fastened to what is known as the "relingue," or, in other words, a belt sewn to the balloon about ten feet below its equator and extending its full length. This frame was fashioned of the best steel tubing and wires, strung as a bridge, the whole being 156 feet long, 8 feet wide at the top, V shaped, and at the bottom of the V there was a staunch steel cylinder two feet in diameter, divided into ten compartments, with a capacity of 1,500 gallons of gasoline. Along the top of this cylinder ran a thin boardwalk $2\frac{1}{2}$ feet wide, forming the floor or deck of the car. Celluloid windows were placed at intervals in the linen sides of the car enclosures; and about the engine rooms, amidships, steel screenings replaced the linen. Non-inflammable paint was employed to minimize fire risks. In this car were the crew's quarters, engine rooms, dynamo, and control or navigating bridge.

THE EQUIPMENT OF THIS PIONEER SHIP

SHE was engined with two motors, one a Lorraine-Dietrich engine driving, at 500 revolutions per minute, a pair of propellers each 12 feet long. The other engine was an E. N. V. 8-cylinder motor, driving twin propellers $10\frac{1}{2}$ feet in length at 750 R. P. M. We also had a small gas engine to operate air pumps for the balloonettes. This small engine acted as a donkey engine for cranking the big engines.

Slung under the central portion of the car was the lifeboat. This lifeboat was then the last word in boat-building. It was built of sewn, laminated mahogany—27 feet long, 6 feet wide, with a depth of $3\frac{1}{2}$ feet amidships. Each end was decked over and made into a water-tight compartment by simply battening down a circular hatch in each deck. Amidships was a spacious cockpit in the center of which was a self-baling device and in the forward end a cubby-hole for the wireless apparatus.

Below the lifeboat, made fast to the long steel car fore and aft, swung the equilibrator, designed to equalize our altitude. This device



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THE CREW

Of the *America*, photographed near the hangar at Atlantic City, where the ship was built. Left to right, Melvin Vaniman, constructor, and chief engineer; Murray Simon, navigator; Walter Wellman, head of the expedition; Fred Aubert and Louis Loud, assistant engineers. Wireless operator Irwin burned his foot in an explosion of hydrogen and was not in the photograph

also served for our radio ground connection and provided storage for our reserve gasoline supply. This equilibrator consisted of a great many steel cylindrical tanks, concave and convex at either end, threaded like cotton spools on a 340 foot ½-inch steel cable.

The radio apparatus, designed by Mr. Sammis, was considered the ultimate in equipment in those days, but how I have laughed since, and yet marveled at its simple efficiency. Those who read this will also smile at the description of the set, nevertheless, pause and consider that this was the first time that the radio engineers of that day had been called upon to equip an airship of any kind. We had nothing to guide us—no precedent to follow. There were innumerable problems to solve, the greatest being the elimination of fire hazard by sparking in the rigging adjacent to the gas container. Hydrogen gas, when combined with a certain mixture of air is a mighty explosive, as I was to learn in the subsequent *Akron* expedition. Other problems to overcome were limitations in weight and size. Like radio arrangements on any ship in those days, the wireless accommodation was given the least consideration at the time of drawing the ship's plans. Radio was indeed an experiment. The events of the voyage changed this attitude.

THE FIRST AIRSHIP RADIO SET

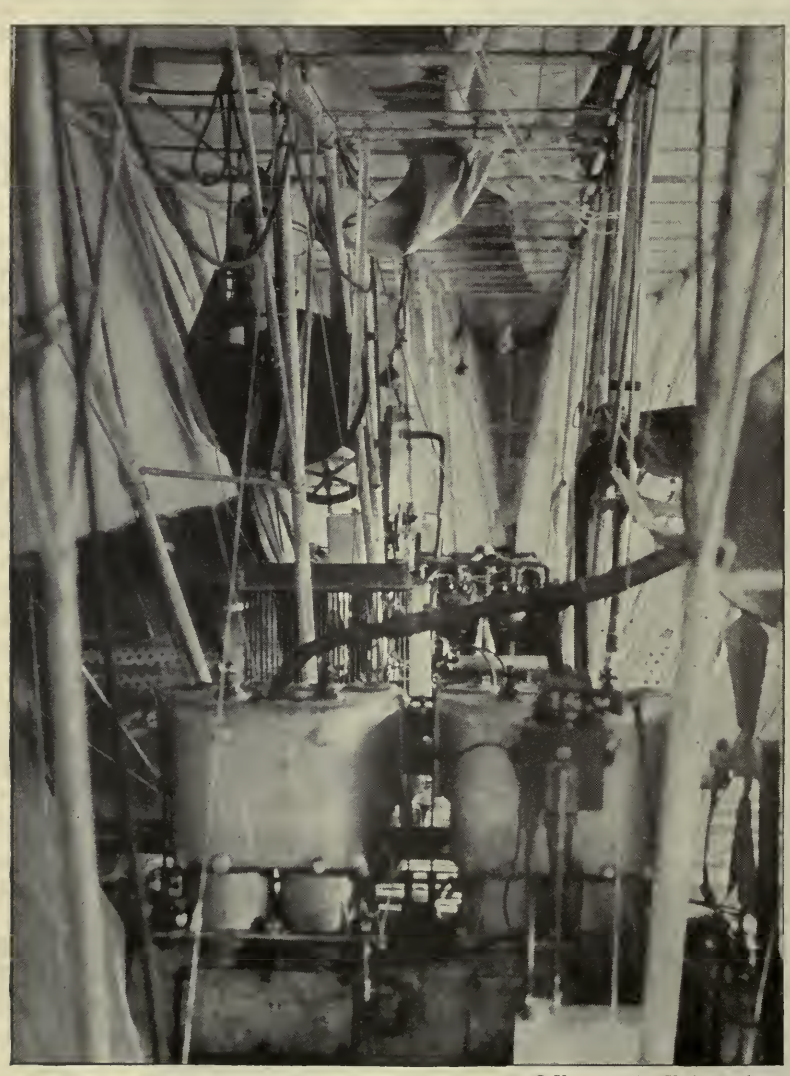
BECAUSE we had absolutely to eliminate fire hazards the transmitter was of the inductively coupled spark type and constructed to provide exceptionally loose coupling. A specially built induction coil was installed inside a square cabinet about 12 by 12 inches by 18 inches high. This cabinet was hinged six inches from the top. In the lower part with the induction coil the condensers and spark gap were installed. The leads from the spark gap and the condenser were taken to the primary of the oscillation transformer, consisting of a few turns of heavy wire wound round the inside of the lower portion of the cabinet. The secondary of the oscillation transformer was wound round the hinged lid of this transmitter cabinet, and variation of the coupling was obtained by the raising or lowering of the lid. One lead of this secondary was taken to the car of the airship and made fast to the tank, making the entire metal and wiring of the great car the antenna. The other lead from the secondary of the oscillation transformer was made fast to the equilibrator which was used as a ground when trailing on the sea, and as a counterpoise when suspended out of the water, care having been taken to insulate it from the car to which it was anchored. In series with the ground connection we inserted a small air-gap to indicate antenna radiation as we possessed no reliable radio-frequency meters in those days!

Theoretically, in arranging the coupling of the transmitter it was necessary to give careful attention to the fact that the dragging equilibrator, which formed part of the open oscillating circuit, would be continually varying in length, dependent upon the lifting power of the hydrogen in different degrees of temperature,

thus causing a corresponding variation in its natural period. A very loose coupling was finally determined upon in order to nullify as far as possible the effect of the open oscillatory circuit upon the closed. We later had to cast aside all these fine theories for a more simple expedient.

In actual tests on the ground it was found the original induction coil was not very efficient and a standard Marconi 10-inch coil was added to the set, the original being retained as a spare. A battery of Leyden jars was also provided for a condenser. Tests proved that this assembly was capable of transmitting a distance of from 50 to 75 miles in daylight without difficulty, and as we planned to keep to the steamer lanes across the Atlantic this was considered satisfactory.

The actual power used was approximately 250 watts. The energy was obtained from a small storage battery of 24 volts, which, in turn, was charged by a small dynamo belted to one of the main engines. This outfit also supplied current for a few electric lights in various parts of the ship.



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ENGINE ROOM

Of the ship, looking aft. The crew had very little space for promenades

OUR RECEIVER—SIMPLICITY ITSELF

THE receiving apparatus was simplicity itself and consisted of a single circuit containing a variable inductance, a variable condenser and a specially built magnetic detector. These were arranged on the baseboard of the wireless cupboard and connected with flexible leads. As I have previously remarked, we hoped to stay on the transatlantic steamer tracks. Distance reception and selectivity were of secondary consideration. As ship and shore stations in those days worked on the wavelength which gave them the greatest efficiency (this was before the London Convention and U. S. Radio Laws), a receiver broad in its tuning was desirable.

With this equipment installed, the *America* was finally ready for the hop-off. The start had been scheduled for August or early September and trial trips had been planned, but due to annoying delays the ship was not ready for the air until October. Since it was so late in the year, the proposed trial flights were abandoned.

OCTOBER FIFTEENTH—4 A. M., FOG, AND THE START

ON THE morning of October 15, 1910, I was awakened about 4 o'clock and told to go aboard. There was not a breath of wind. A dense fog dripped down over everything. The crew of the ship consisted of Messrs.

Walter Wellman, commanding; Melvin Vaniman, chief engineer; Louis Loud and Fred Aubert, assistant engineers; Murray Simon, navigator; and the writer. With the help of a few hundred police and firemen we proceeded to launch the largest non-rigid airship ever constructed. At 8 A. M. all was in readiness and the crew climbed aboard. The last to embark was our mascot, a pretty foundling kitten that had been a pet around the hangar. The crew had jokingly told visitors that the kitten was going along with us and just as the word to "let go" was passed, somebody in the crowd threw the kitten into the lifeboat where I had taken my station. Up we went and the cat was one of us! Kitty, at first, appeared scared and raised an awful "holler," but he (yes, it was a Tom!) soon settled down. In the long days and longer nights that followed, I will admit I was grateful for that kitten's affectionate company. It was always to be found cuddled up to me in the wireless corner of the boat.

We did not start our motors immediately, but preferred to be towed out through the narrow entrance called The Inlet, at Atlantic City. Reaching the open water our tug cast off our line and we started our engines. We were flying at an altitude of only 200 feet, with a portion of the equilibrator trailing on the surface of the ocean. This low altitude was due to the heavy cargo we carried and the fact that the morning was cold and wet. The moisture of the fog contracted the hydrogen with a consequent loss of lifting capacity.

During the first hour of the flight I was busy making various adjustments. Listening in, I could hear "Bobby" Miller, at the old United Wireless station "AX," on Young's Pier at Atlantic City calling "W," the call letter assigned to the *America*. The signals dissipated any doubts I may have had regarding the receiver.

For months we had discussed the possibility of sparking in the rigging and the risk of burning a hole in the fabric of the balloon, so when the moment came to "sit" on the key of the transmitter, I think I can be pardoned for my nervousness. I am sure I have experienced the moment that a suicide passes through when he is about to pull the trigger. Stationing the crew in different parts of the ship to report any sparking, I threw in the sending switch and answered Miller's repeated calls. I shall never forget my expansive satisfaction when he came back and told me my signals



THE CAT AND THE ENGINEER

The homeless Atlantic City cat which unwittingly acted as mascot on the voyage, being comforted by chief engineer Vaniman

were clear and strong. I had opened the coupling of the transmitter for a minimum radiation; therefore, with only a few miles separating us from the nearest station, I had established radio communication, for the first time, between a ship of the air and the earth, but I had plenty of power in reserve and knew that we had reliable communication within certain limitations. Mr. Wellman, during the time I had been engaged in these preliminary tests, had been sitting at my elbow, anxiously waiting the result, but as he afterwards wrote in his book describing the trip, he could tell by the pleased grin on my face that we had succeeded in establishing communication.

FIRST SENSATIONS IN THE AIR—NONE

BY REFERENCE to my log, I find that communication was established with AX at 10.30 A. M. and that at 11.05 A. M. I had sent eight messages to Miller. At 12.30 P. M. I made an entry of receiving two messages from AX, while at 1.30 P. M.. there was this notation in the log, "Received one message and sent two to Atlantic City. Everything going fine, sensation very fine, all happy." Thus was the first airship traffic conducted, and it had soon developed into the ordinary routine. I had been very busy, these hours, without time to reflect upon my strange surroundings or give thought to the unusual experience of flying.

I have spent hundreds of hours in the air since and been asked innumerable times what my first sensations were, but I can truthfully say I cannot recall them, if I had any. My only anxiety was regarding the success of the installation of wireless; once that was assured I felt nothing but elation. While I was busy at the radio key, successfully maintaining constant touch with Atlantic City, things were not going so smoothly with the engineering department of the ship.

After several hours in the air the dense fog in which we started condensed upon the huge surface of the dirigible, adding a great weight to an already overloaded ship. Instead of steadily rising, as the heat of the sun increased and expanded the gas, we slowly descended and lost altitude. We were compelled to jettison some of the cargo. Due, also, to the lack of trial flights, the engines required tuning and we proceeded very slowly during the morning of the first day. Several times during that morning either one or the other of the engines had to be stopped, caused by sand in the bearings. Our hangar at Atlantic City was in a most exposed spot where every wind that blew brought clouds of sand. However we continued to make progress.

At 3.30 P. M. on that first day, I received my last message direct from Atlantic City. At that time I find that a notation in the log states that I was no longer able to hear him, because his signals were weak. The motors made a fearful noise. The only means I had of deadening the sound of those big engines was the slight protection provided by the cotton battens, I had fashioned. From then until 8 P. M., with the exception of intermittent motor trouble, the voyage was uneventful. At that time, still in a dense fog, we almost ran into a large sailing ship. So close did we pass that we could see the crew running round the decks. Later we passed very close to a large steamer, which we eventually learned was the *Coamo*. From time to time I tried to get into communication with various shore stations, without success. It is quite possible that some of them answered me, but the engines killed anything but the very strongest signals.

AN ENGINE GONE BAD

DURING the night, our best engine had to be stopped, permanently out of commission. It appears that the bearings of the propellers had broken, causing one of them to wabble alarmingly. Up to this time there had been no wind at all, but now it began to freshen up a bit which drove us eastward, but in a northerly leeway. The fog still persisted and we were compelled to jettison some fuel to prevent descending into the sea. Another danger which became apparent when night fell was the stream of sparks from the exhaust. We were afraid that they would cause an explosion and Wellman wanted to stop the remaining engine. Vaniman, however, talked him out of this, explaining that we had been running all day and that, if we stopped the engine we would undoubtedly drift over Long Island. Furthermore, the balloon by this time was so saturated with water from the condensed fog that we ran little risk of fire. So, through all that night we proceeded under one engine. The engine that had gone back on us was the one to which the dynamo was belted and that meant that we would be unable to charge our battery. With this in mind, I began to hoard the "juice" and used the wireless only when positive that there was something to use it for. As subsequent events proved, it was well I did.

At 5.05 A. M. on the 16th, my log shows that the engines had stopped and that I was listening to all stations talking about us and calling W. I heard the Sagaponack (Long Island) station inform Siasconset that we were 60 miles South of Scotland Light at 6.50 P. M. the previous night when we had been sighted by a steamer and reported by radio. All this time the wind was steadily increasing but was in our favor and we made such good time that we decided to allow our remaining engine to cool off. I waited until Siasconset station was very strong before I attempted to communicate. At 10.35 A. M. I established communication with SC (Siasconset, Nantucket Island) sending him several messages. We were very close to that island during the day, so close, indeed, and so strong our signals, that I afterwards learned that the boys at the stations ran outdoors to try to sight us.

Our expedition had been financed by several newspapers and Mr. Wellman, a newspaperman himself, commenced to file voluminous messages to them. I sent the short ones, but as they became lengthier I protested that the batteries were running down and that we should conserve our power in case we needed help. He promptly agreed with me.

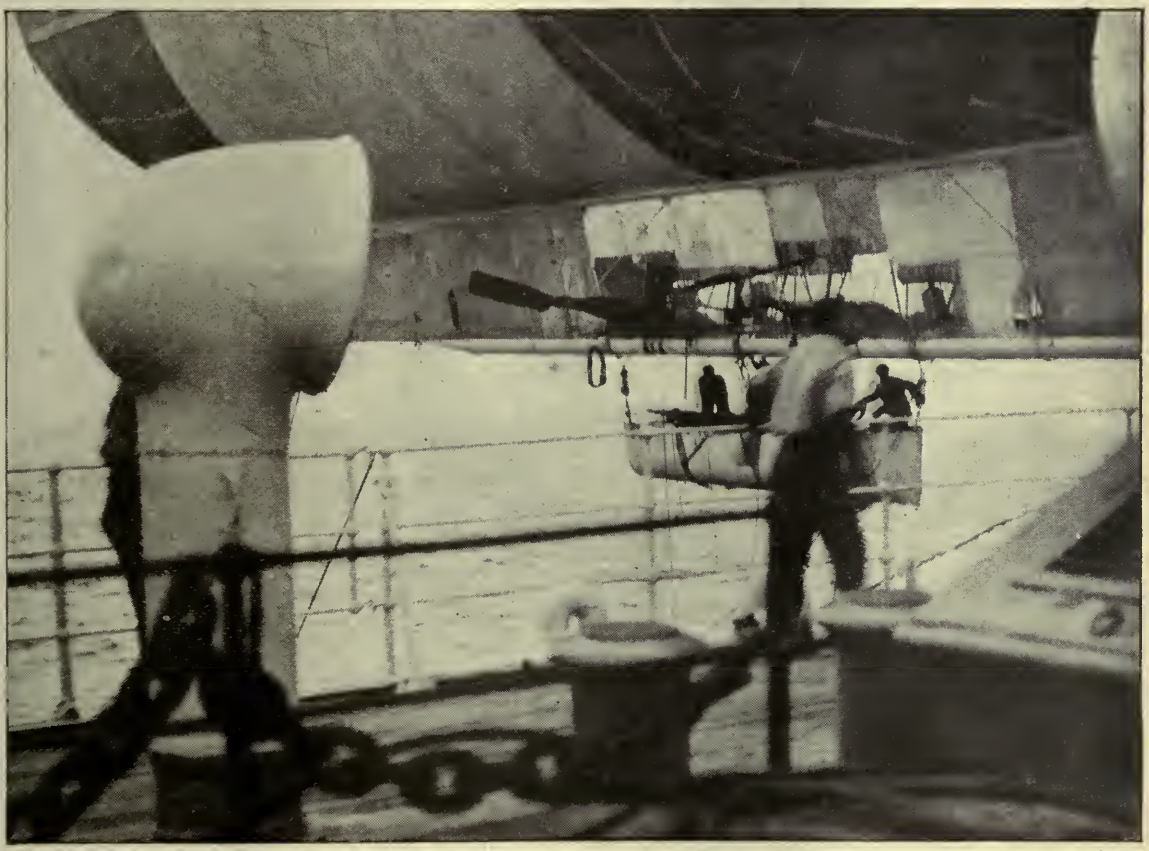
The wind now increased to a gale and began to bear us southeast. When night fell we

again experienced trouble in remaining in the air. We were compelled constantly to throw supplies overboard.

C Q D

THAT night I attempted to obtain assistance, calling C Q D, which at that time was the signal of distress. Our engines were now useless. The voyage had failed and our one concern was to get away with our lives. I early realized that there was no hope of assistance while we were in the air and that we would have to take to the lifeboat. However, with the sea then running and the gale blowing, we simply had to stay in the air. Engineers Loud and Aubert commenced to take the large motor apart and throw it overboard, to lighten the ship. At daybreak on Monday, the third day out, I find I made a note reading, "7 A. M. All ready during the night to leave in the boat, but the breeze too strong for launching. Listened-in and heard the S.S. *Main* (German) very strong. Now hear Cape Sable sending a message to some ship for us. Copy it. It is from the *New York Times* and is about the weather."

At 7.20 that morning our navigator took his first sight for position and made us in Longitude 65.51 West. This was 210 miles east of Nantucket. We were steadily drifting south in a beautiful sunny morning. The warmth of the sun took us upward, indeed, so fast did we rise that we had to let some of our gas out to steady our ascent. It was about this time that I received the greatest scare of my life. Mr. Vaniman in pulling the valve cords to release the hydrogen, pulled on the wrong control and we came down in such a rush that it looked as though we were to be emptied into the sea. Mr. Wellman and myself were in the lifeboat, which, slung as it was under the car, would be the first thing to hit the sea. Without a word we made for the ladder leading to the car above. It was then I forgot about



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"AIRSHIP OFF THE PORT BOW, SIR"

This remarkable photograph was taken from the deck of the rescuing ship *Trent*, which picked up the six men in the open ocean. The crew of the airship can be seen preparing to release the clutches which held their special lifeboat

my injured foot. I went up that ladder like a monkey but when I had reached the car above, I found the excitement was over, we had bounced off our equilibrator which had acted as a bumper on the sea. We made a series of long bounces much like a bouncing tennis ball. Mr. Wellman, who had in the meantime got caught in the manhole in the bottom of the car, with his head and shoulders above and held fast under the car by his projecting hunting knife (we each carried one), was not so happy. He did not know that the danger had passed. He called for assistance to extricate him and Loud and myself, laughingly, released him. I was laughing through reaction after the previous terrifying moments, but Mr. Wellman in a story he wrote after our return to New York, said "Irwin laughed in the face of death." Thus are heroes made!

From that time on, we drifted in a southeasterly direction. From my log I find that I listened in all day and into the evening. The last note made in the air in the radio log reads: "7 P. M. Hear wireless stations working from Cape Sable to the Southern States." In that early day, that meant that I heard just about every station in North America.

The following, taken from my log, tells the remainder of the story:

"October 18th, 1910. Notes made after arrival on board the Royal Mail S. S. *Trent*, made from memory and the log of the *Trent's* wireless operator.

"Remained on watch until 3 A. M., 18th, listening to various stations working, static very bad. Unable to read Cape Cod but hear him working. I turned in at 3 A. M., but was awakened about an hour later by calls of a ship in sight. Descended into the lifeboat and called C Q D. Nothing doing. Then got an electric torch and commenced calling in Morse lamp fashion. Was eventually answered by the *Trent* and signalled him that we were in trouble and required help. Also conveyed to him that we were equipped with wireless. The *Trent's* operator was awakened, and he called us."



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"HEAVY ON THE STA'BOARD OAR"

The staunch lifeboat of the *America* being pulled toward the rescue ship which was summoned by wireless. This was the first time in aeronautical or marine history that wireless had been used in this spectacular way. Thus ended the Wellman air voyage across the Atlantic after three days of struggle against great odds. Operator Irwin is wearing the straw hat and seated on the starboard side of the boat

WHEN WIRELESS STEPPED IN TO RESCUE

AS I had my head phones on all this time, I answered him and instant radio communication was established. I am indebted to Mr. Louis Ginsberg (the *Trent's* operator) for copies of the following messages which were copied and sent by him; I did not do so, merely reading out his messages to Mr. Wellman as he sent them.

To the *America*—Do you want our assistance?
To the *Trent*—Yes. Come at once, in distress, we are drifting, not under control.
To the *America*—What do you want us to do?
To the *Trent*—Come ahead full speed, but keep astern, we have a heavy tail dragging.
To the *America*—O.K. Am standing by wireless in case of trouble.
To the *Trent*—You will pick us up at daybreak, you will be better able to see us then.
To the *America*—O. K.
To the *Trent*—Come in close and put your bow under us, we will drop you a line but do not stop your ship as you will capsize us.
To the *America*—O. K.
To the *Trent*—Who are you and where bound?
To the *America*—S. S. *Trent* bound for New York.
To the *Trent*—Have one of your boats ready to launch, as we will probably capsize when we launch our boat.
To the *America*—O. K. boat manned.
To the *Trent*—We are going to launch the boat, stand by to pick us up.

Wireless communication then ceased. I cut

MARCONI WIRELESS TELEGRAPH CO. OF AMERICA

Airship: America — STATION PROCES-VERBAL — Oct 18 1910 — 6084

TIME	REMARKS	INITIALS
	To RNR. Who are you and where bound?	
	To W. S/S Trent for New York.	
	To RNR. Have one of your boats ready to launch as we will probably capsize when we launch our boat.	
	To W. OK boat manned.	
	To W. Are we gaining on you?	
	To RNR. Yes, we are getting ready to launch.	
	To W. Shall we stop for you?	
	To RNR. Dont stop we will drop a sea anchor and try and check our ship.	
	To RNR. We have a motor going above me. Cant hear your signals now. Will say when I can. Airship ready to bring her down lower.	
	To W. We are going full speed waiting for your orders.	
	To RNR. We are going to launch boat stand by to pick us up. Wireless then closed.	

I then cut aerial and earth wires put watertight doors on the opening of the wireless cupboard & stood by. The boat was successfully launched, a most dangerous operation. We were going 15 knots an hour with the boat swinging beam on to the sea and behind the ton and half trailer composed of heavy tanks of gasolene.

At the signal let o both clutches holding the boat were jerked. They acted beautifully, the boat fell into water, launched gunwale under, then righted the equilibrator (trailer) hit Mr. Loud (1st Asst. Engineer) & myself and stove a small hole in the wireless compartment of the boat but did not injure either of us or impair the stability of our boat.

The greatest danger of the whole eventful three days now occurred. The Trent was following full speed right in our wake and she bore right down on our lifeboat for a few seconds which seemed hours. It appeared we were to be cut in two. I prepared to jump overboard and swim clear of the propellers of the big ship, but fortunately at the instant I thought to do so the Trent cleared us and we grazed along her sides.

After two or three attempts to row to the ship with two small oars we waited, wallowing in a heavy sea, for the ship to come about. This she did and ranged at slow speed alongside us. Lines were thrown but although we hung on the speed was too great for us to hold on and again we were left astern. Once more this manoeuvre was executed and we got near enough to the liner to row the boat close enough to catch a line.

We came alongside and climbed aboard by a rope ladder.

All wireless gear saved.

J. R. Irwin, Operator.

THE LOG OF THE AIRSHIP "AMERICA"

A photograph of the last page of the log, which every radio operator must keep as a record of the transactions of the station. The call letters of the stations are in the left-hand column. R N R is the call of the English ship *Trent*, which rescued the *America's* crew of six. W was the call used by the airship. This is the first time this highly interesting document has been printed

the antenna and ground wires, put the watertight doors on the wireless cupboard, and stood by. The boat was successfully launched, a most hazardous operation. We were drifting fifteen miles an hour, with the boat swinging beam on to the sea and behind us the ton-and-a-half trailer. At the signal to "let go" both clutches holding the boat to the car were jerked. The boat fell into the water, lurched gunwale under, then righted. The trailing equilabrator hit us, stove a hole in the boat above the water line, and bruised Loud and myself. The *Trent*, ploughing along at 16 knots, almost ran us down. We fell astern and waited for the steamer to come about and pick us up. After considerable maneuvering she came alongside, and with her derricks, lifted the lifeboat aboard. Thus was I able to save the entire wireless equipment.

The *America*, with the weight of the lifeboat and crew released from it, shot up in the air several thousand feet and soon drifted out of sight. Before leaving her we opened the gas valves so that, eventually she would come down on the sea and not cause damage by landing or dragging over a city. We never heard of her again.

Nobody but those who have experienced it, can imagine the feeling we had upon arriving on the *Trent*. We were overwhelmed with kindness. Two days later we arrived in New York where we found that our attempt to reach Europe in an airship had attracted extraordinary interest. We had occupied the front pages of the press of the world for several days. We failed, but in later years I had the gratification of knowing that other Americans accomplished what we had attempted and that the N C 4 "delivered the goods." One thing we had done. We had demonstrated that communication by radio from airships to the ground was easily accomplished and presented no great difficulties. While these pages were being written the press published the news that the *Shenandoah*, giant navy dirigible, had had one of her six engines removed in order to make a place for an additional radio equipment that would be powerful enough to reach shore from any position. This is, indeed, a tribute to the efficacy of radio in the air.



CAPTAIN JACK IRWIN

Preparing a "Knock-Out" receiver in RADIO BROADCAST's laboratory for the RADIO BROADCAST COVERED WAGON, in which he is engaging in another radio adventure, as interesting in its way as the voyage of the *America* which he describes in this article. The Wagon will visit cities and towns everywhere throughout the country, spreading the gospel of radio, and has already started on its way West. Arthur H. Lynch, editor of this magazine, is in the center and John B. Brennan, technical assistant, is at the extreme right

Solving the Problems of the Neutrodyne

One of Professor Hazeltine's Aides Discusses the Set—How to Neutralize Stray and Over-All Capacity in Two- and Three-Stage Radio-Frequency Sets—A Radio Club of America Paper

By J. F. DREYER, Jr.
Engineer, Hazeltine Research Corporation

A YEAR ago Professor Hazeltine described before the Radio Club of America his method of tuned radio-frequency amplification. The objectionable and uncontrollable regeneration caused by the capacity which couples the grid and plate circuits of the vacuum tubes had previously stood in the way of a successful amplifier of this type. The receiver employing this method, which he called the Neutrodyne, removed this obstacle by neutralizing the objectionable coupling due to this capacity. Since that time the Neutrodyne receiver has become very popular; and many amateurs have constructed their own receivers, though often with much difficulty in completely attaining the results of which a factory built Neutrodyne is capable. It is the purpose of the writer to describe the different problems which have presented themselves and to explain how these problems were solved.

In order to form a basis for further discussion, it is necessary again to explain the fundamental theory of capacity coupling neutralization. Fig. 1 illustrates a vacuum-tube amplifier whose grid and plate circuits are both tuned to the desired frequency. A passing radio wave causes a minute current to flow through the grid circuit C_1L_1. This circuit being tuned to the wave frequency, and thus having a high impedance, builds up an appreciable voltage which is impressed on the grid of the vacuum tube. By the relay action of the tube a similar current flows in the plate circuit. As this circuit is also tuned to the wave frequency, it builds up a still higher voltage which is passed on to the next tube. Without neutralization, regeneration takes place due to the capacity coupling the grid and plate circuits. That is, the voltage built up in the plate circuit of the tube causes a current to flow through this capacity C^1, which reinforces that already present in the grid circuit due to the passing wave. This may be sufficient to cause self-sustained oscillations which, unless very carefully controlled, completely destroy the value of this form of amplification.

HOW THE HAZELTINE PRINCIPLE IS APPLIED

THE Hazeltine circuit as embodied in the Neutrodyne receiver eliminates this effect in the following way: A third coil, L_3 is coupled closely to L_2 as shown, so that one end (the other end being grounded) varies in potential in exactly opposite phase to that of the plate end of L_2. A small condenser, Cn is then connected between this end of L_3 and the grid of the tube. If C^1, Cn, L_2, and L_3 are properly related, the following action occurs: a current still flows through the plate-grid capacity, C^1 due to the voltage built up in L_2, but this current no longer enters the circuit C_1L_1 for the reason that the combination CnL_3 demands exactly the same current. This current therefore, instead of flowing down through C_1L_1 passes back harmlessly through CnL_3 to its source at the plate of the tube.

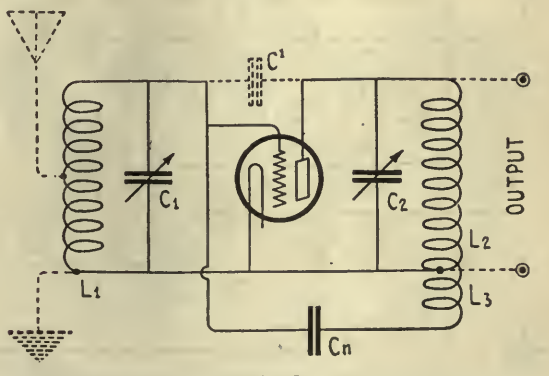


FIG. 1
Circuit diagram illustrating the neutrodyne principle

The conventional Neutrodyne receiver employs this circuit in a slightly modified form. There are usually four or five tubes employed, two radio-frequency amplifiers, detector, and two audio-frequency amplifiers. Or perhaps one audio tube is omitted and a radio tube used in place of it by the usual reflex method. The circuit of a five-tube receiver is illustrated in Fig. 2. Three separate rheostats are provided, one for controlling the filament temperature of the radio-frequency tubes, one for the detector and one for the audio frequency. The radio-frequency rheostat provides a volume control for cutting down the strength of the signal, which is advisable when the user is located near one of the more powerful broadcasting stations. The other two rheostats are used in the ordinary way.

The two radio-frequency amplifiers (employing the Neutrodyne principle) are different from the one illustrated in Fig. 1 in that instead of tuning the plate circuit, a secondary coil closely coupled to the primary or plate coil is tuned. This allows a step-up ratio to be employed which gives greater amplification and selectivity. Also if the two coils are connected properly—that is, with plate of one at the opposite polarity to grid of the succeeding tube, then a portion of the secondary coil may be used in place of a third or neutralizing coil. Referring to Fig. 2, the neutralizing condenser Cn is connected from the grid of tube No. 1 to a tap on the secondary of the transformer unit B. The neutralizing condenser for the second tube is connected in a similar manner from the grid of that tube to a tap on the secondary of the unit C. The correct location of these taps depends on the value and range of the neutralizing condensers used—that is, if the tap on coil B is moved up so as to include twice as many turns between it and the ground potential end of the secondary coil, then the capacity required at Cn will be only one half (approximately) as large as before. In this connection it should be pointed out that many receivers constructed from parts but which are not provided with a proper panel shield are very difficult to balance due to their inherent capacities. Referring again to Fig. 2, any capacity between adjacent grids tends to neutralize the tube capacity even more effectively than does capacity at Cn. This capacity will always be appreciable because the fixed plates of the variable condensers C1, C2, and C3 are connected directly to the grids of the tubes and therefore present large surfaces which act as the electrodes of condensers connected between them. As mentioned above, it is possible for these capacities to more than neutralize the tube capacities. If this is so, it is impossible, of course, to obtain a balance by a further addition of capacity at Cn. This condition may be eliminated by adding capacity at C^1 or better still by minimizing the inherent capacities by shielding. A grounded metal shield properly mounted on the panel cuts down the external field of the condensers sufficiently to make a balance possible.

ADJUSTING THE NEUTRALIZING CAPACITY

THE actual adjustment of the capacity Cn is accomplished as follows: A strong signal either from a near-by broadcasting station or from a local oscillator is impressed on the antenna coil. The condensers C1, C2, and C3 are then tuned to this signal with the filaments of

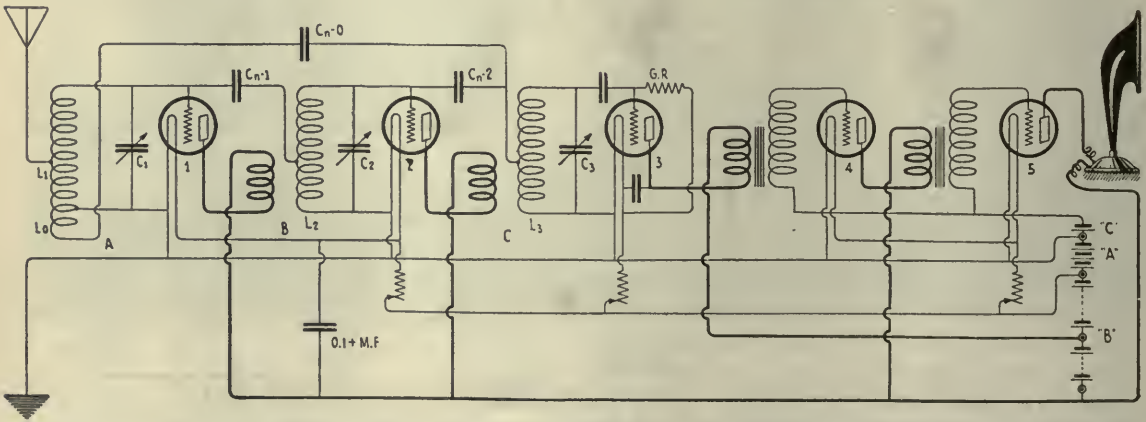


FIG. 2

Circuit of a five-tube Neutrodyne, showing the method of neutralizing the over-all capacity

all tubes lighted. At this time the receiver will probably oscillate. The filament of tube No. 1 is then extinguished, usually by placing a piece of paper under one of the filament prongs. The dials can then be retuned for maximum signal. This signal is present only because of the coupling between circuits A and B introduced by the grid-plate capacity in the tubes. If now the neutralizing condenser Cn is increased, the signal will grow weaker and weaker and finally will disappear entirely. If the capacity is still further increased, the signal will again become stronger. The circuit is then said to be over-neutralized. An over-neutralized receiver will oscillate when all tubes are operating.

If the tube capacity is exactly balanced while the filament is not lighted and still cold, no signal will be transmitted through the succeeding tubes. The explanation of this is as follows: Referring to Fig. 2, the voltage present in circuit A causes a current to flow through the grid-plate capacity of tube No. 1, but at the same time another current flows through the neutralizing condenser Cn-1. These currents in passing through the primary and tapped portion of the secondary of circuit B, respectively, produce equal and opposite magnetic fields in circuit B which cancel out and produce no resultant voltage.

A third neutralizing condenser is sometimes used for the purpose of neutralizing the very small capacity existing between circuits A and C. This will be discussed in detail later. It should be noted in Fig. 2 that primaries of the audio-frequency transformers are reversed relative to the secondaries in a manner similar to that employed in the radio-frequency circuits. This very often prevents "singing or howling" at audio frequency. It might even be worth while for the purpose of improving the quality of reproduction to completely neutralize the audio-frequency tube capacities. This could be done by the introduction of very small capacities between adjacent grids.

For Those Who Have Built Their Own and for Those Who Haven't

This paper on the Neutrodyne receiver will have an appeal. As Mr. Dreyer, who is an assistant to Professor Hazeltine, the inventor of the Neutrodyne, says, "In one short year the Neutrodyne has sprung into very great general popularity." The many owners and operators of Neutrodyne sets should read this with great interest because it treats of kinks of operation and experiment with this type of receiver which have not appeared anywhere else. Those who have heard a great deal about the receiver and are a bit hazy on just how it works can easily bolster up their weak technical points by reading this paper.—THE EDITOR

HOW TO PREVENT REGENERATION

IT IS necessary in a Neutrodyne more than merely to neutralize the tube capacities. In the conventional type which employs three sharply tuned circuits it is necessary to remove all couplings that may exist between these circuits except mutually conductive or one-way coupling of the tubes. In fact if in any way radio-frequency energy may be transferred from one circuit to a preceding one, regeneration will usually occur. This is always undesirable since it has the effect of sharpening the tuning to too great an extent and thus ruining the quality of reproduction. The capacity couplings due to the tubes may be neutralized by the method already described. The other couplings which should be eliminated are:

(1) inductive coupling between adjacent stages (coils L1-L2, L2-L3); (2) couplings from the second to the first stage due to the impedance of the leads to the B battery; (3) coupling from the third to the first and second stages due to improper connection of the telephone condenser; (4) coupling introduced by a common C battery or due to improper connection of grid returns; (5) coupling between stages introduced by inductive loops in the wiring; (6) coupling between first and last stages due to inherent capacity between high-potential surfaces of these stages.

The first of these, inductive coupling between coils of the different stages, may be eliminated by properly placing the coils. As is well

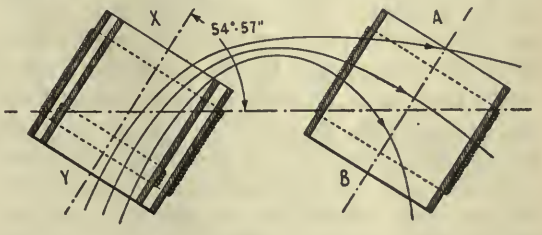


FIG. 3

How the angles of the coils used in the Neutrodyne receiver may be used to give zero magnetic coupling

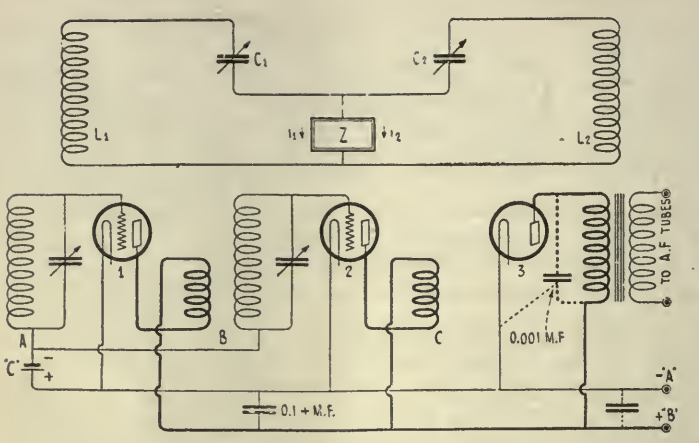


FIG. 4
How coupling other than that due to tube capacity may be eliminated

known, three coils may be placed mutually at right angles, so that the magnetic flux of any one has no resultant linkage with the turns of the others. A neater and more symmetrical arrangement was devised by Professor Hazeltine. He discovered mathematically that any number of coils might be placed on a common line of centers and if their axes were inclined at an angle of 54.7 degrees to this line of centers, no magnetic coupling would exist. That this is physically possible is rather hard to visualize at first. In Fig. 3 two coils are shown inclined at the theoretically correct angle. Magnetic flux of coil XY will pass through coil AB roughly as shown. Some of this flux, as represented by the middle line, passes through coil AB in a direction perpendicular to the axis of that coil and therefore does not link with the turns at all. Other portions of this magnetic flux will link with turns on AB. Some of it passes up and some down through the coil. There are, therefore, flux linkage in both senses. It seems reasonable that if the coils are set at some such angle as this, zero coupling may be obtained. This is true, but the angle varies slightly from the theoretically correct one, due to conditions not being ideal. The most conspicuous reason for variation is the fact that the leads which carry the coil current to the condenser form a single turn in an entirely different plane from the turns on the coil itself. The exact angle may be determined in any given receiver whose coils are first set approximately correctly as follows: the neutralizing condensers are first adjusted for a high broadcast frequency in the manner previously described. The settings of the two neutralizing condensers Cn-1 and Cn-2, Fig. 2, are then noted and the process repeated at a low broadcast frequency. The settings will be in general different. This is due to the fact that, if inductive coupling is present between adjacent coils, the neutralizing condenser counteracts this as well as the coupling due to the tube capacities. This neutralization will be exact for only one frequency, because with varying frequency the coupling effect due to the mutual inductance between coils varies at a different rate than the negative coupling effect due to the capacity Cn. If the settings are different, the coil angles are shifted a slight amount and the process repeated. When the neutralization is correct at both high and low frequency ends of the scale, the coil angle is correct. It has been found to vary by this method from 54 to 58° in different receivers.

INTER-CIRCUIT COUPLING IS OBJECTIONABLE

OBJECTIONABLE coupling between circuits due to the use of a common C battery has proven very troublesome, but not unavoidable if proper precautions are taken. The coupling introduced by the battery is analogous to that introduced in the theoretical circuit shown at the top of Fig. 4 by the impedance Z. Here the current of circuit CL1 flows through the impedance Z which is common to circuit C2L2. It is evident that the current of one circuit will induce a voltage in the other, or it may be stated that if any portion of the current of one circuit flows through an impedance in common with any portion of the current of another, then these circuits will be coupled. The lower portion of Fig. 4 illustrates several ways in which this sort of coupling may be introduced (batteries, rheostats, and non-essential wiring are omitted to avoid confusing the figure) The plate circuits of tubes 1 and 2 carry radio-frequency currents which, like all other electric currents, must flow in closed paths. Let us trace the probable path of the radio-frequency current produced by tube No. 1. Starting at the plate it passes through the primary of unit B and thence to the B battery, through the battery, and back to the filament, where the electron stream completes the circuit to the plate. If it does take this path, the batteries and, more important, the leads to the batteries,

form an impedance through which a similar current from tube No. 2 must also flow. This common impedance introduces coupling. A large condenser placed as shown between the + B and the −A leads has the effect of by-passing these currents and preventing their passage along common leads. To be effective, this condenser should be of at least 0.1 microfarad capacity. Also it should be carefully placed at the point which provides the minimum of common wiring for the currents in the separate circuits. It would be less effective if placed at the right, as shown by the dotted connections.

The detector plate circuit also carries radio-frequency current for which a reasonably low impedance path must be provided. If this path is not provided the signal will be considerably weakened. In regenerative circuits it is common practice to shunt the high impedances of the telephones or audio-frequency transformers by a condenser of about 0.001 microfarad capacity. This must also be done in the Neutrodyne, but care must be taken to connect this condenser from the plate of the detector *directly to its filament.* Otherwise if connected as shown alternatively in Fig. 4, a large radio-frequency current must pass through the B battery in order to complete its circuit. This might readily cause trouble.

PREVENTING COUPLING PREVENTS OSCILLATION

COUPLING sufficient to cause oscillation has been found when either a C battery or a common filament rheostat has been used to introduce a negative bias on the grids of the radio-frequency tubes. (See Fig. 4.) This is analogous to the coupling introduced by the common B battery, since the currents which pass through the grid filament capacities for the first two tubes must return to their starting points by way of this rheostat or C battery. If such a device is used, it should be by-passed with a large condenser which is located in the most desirable place, namely the one which provides the least common wiring for the different currents. It has not been found necessary to use a bias on the radio-frequency tubes and therefore the grid returns are usually connected directly to the negative filaments of the separate tubes as illustrated in Fig. 2.

Inductive loops in the low potential wiring cause a great deal of trouble and are present in a great many "home-made" receivers. If, for instance, the negative and positive battery leads are far apart, a loop closed at the ends by the filaments of the tubes is formed. This loop has mutual inductance to all coils in the receiver and provides a path for the feed-back of energy which is often sufficient to cause oscillation. The remedy for this is obvious and simple. All wires which carry the B or A battery currents should be bunched together and thus minimize the area of possible loops.

It was found in certain receivers that after all other possible sources of coupling had been eliminated that energy was fed back through the extremely small capacity usually present between circuits C and A. This capacity may be eliminated by shielding, but because this is expensive, several types of receivers have been equipped with a third arrangement which serves to neutralize this last form of coupling. The effect of this coupling capacity is only noticeable in receivers having very low resistance circuits and having therefore very high amplification. It is accentuated by the presence in the neighborhood of the receiver of a piece of ungrounded metal such as a long piano hinge on the cabinet. Also, if the antenna is connected

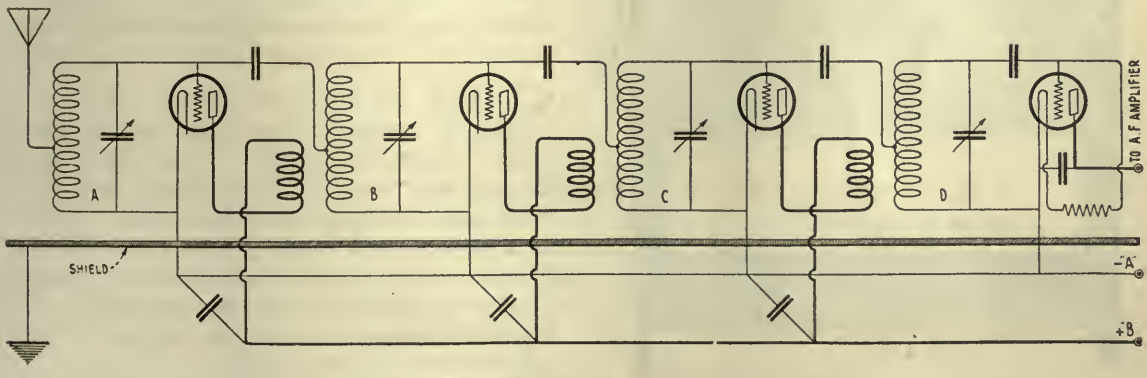


FIG. 5
How the "segregated shielding" is used in a three-stage (radio-frequency) Neutrodyne

in such a way that it passes behind the receiver close to the last circuit, the effective capacity between the first and last circuits is increased. The antenna lead may be shielded with a grounded metal tube or Belden braid, and the metal hinge may also be grounded. If these precautions fail to remove the trouble, complete shielding or neutralization must be resorted to. Neutralization of over-all capacity may be accomplished with the arrangement of Fig. 2 already referred to. When adjusted, the action is as follows: a very small current passes through the space from the high potential parts of circuit C to circuit A. However, another larger current flows through the third neutralizing condenser Cn-O. This current, in passing through the extra coil Lo which is coupled closely to L1, produces a magnetic effect in circuit A exactly equal and opposite to that produced by the first current in flowing through L1. The net regenerative effect is then zero. It is interesting to note the relative size of the coils and capacities involved in this action. In a certain receiver L1, L2, and L3 are of 65 turns each. A tap on L3 used for two neutralizing condensers is located 8 turns distant from the grounded side of that coil. Lo has but one turn. The neutralizing condenser Cn-O is of the usual form and when adjusted has a capacity of about 10 micro-microfarads.



FIG. 6
An experimental three-stage Neutrodyne

The adjustment of this third neutralizing condenser is accomplished by first encouraging the receiver to oscillate. This is done by tuning the circuits to the highest possible frequency and by adjusting the plate and filament voltages to produce the greatest amplification. If the receiver oscillates under these conditions, the condenser Cn-O is increased until oscillation ceases. If increased too far oscillation will again commence. The correct setting of this over-all condenser is, of course, at the center of the range of non-oscillation. If no oscillation or regeneration is noticeable when these steps are taken, over-all neutralization is unnecessary and may be omitted.

Another cause of unsatisfactory operation on the part of Neutrodyne receivers is that introduced by local conditions. High impedance ground leads may be the cause of oscillation for reasons which are not very clear. The trouble may usually be eliminated by replacing the long lead with a short one to the nearest piping system, such as the radiator or water pipe. If the A battery is located at some distance from the receiver and is wired to it with long leads, trouble again may occur. This form of oscillation trouble usually appears over only a limited frequency range and is probably due to an action which occurs at the natural period of the ground or battery system.

THREE-STAGE NEUTRODYNE RECEIVERS AND THEIR PROBLEMS

SO FAR, all discussion has been limited to the two-stage receiver. Successful three-stage Neutrodyne receivers have been constructed and when finally adjusted give very great amplification and selectivity. One of these constructed by H. W. Dreyer and the writer and used with a ten-foot indoor antenna compared favorably with the performance of a good two-stage receiver when used with an outdoor antenna 75 feet long.

The problems which arose in the construction of this receiver were of the same nature as

those previously discussed. They are, however, more difficult to solve, and the stray coupling had to be eliminated to an even greater degree than was necessary with the two-stage. Fig. 5 illustrates schematically some of these problems.

It should be noted that three separate by-pass condensers are used to prevent B battery coupling. The most troublesome coupling, however, was found to be that due to over-all capacity. This becomes of more and more importance as the amplification increases. When four tuned circuits are used, it becomes too cumbersome to effect a neutralization of all capacity couplings between circuits. Since to eliminate them would require six adjustments, it was decided to shield out as much as possible of these capacities and neutralize the remaining tube capacity by the Hazeltine method. The shielding of a copper lined cabinet proved ineffective, due probably to eddy currents set up in the shield. These currents caused coupling between first and last stages in a manner similar to that caused by inductive loops in the wiring.

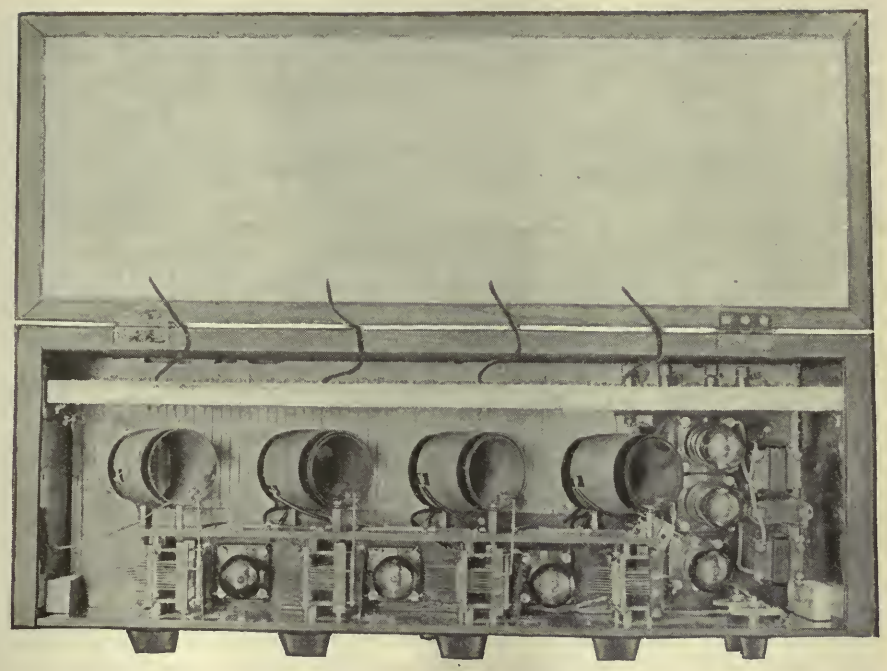


FIG. 7

Top view of a three-stage (radio-frequency) Neutrodyne. Note the wire shielding in the bottom of the cabinet

Shielding in the form of a cabinet lined with copper wire grids did prove effective. Care was taken to see that no closed loops were formed in this shielding. Also it was necessary to segregate it into four insulated portions adjacent to the four coil systems. These four sections were grounded at the low-potential points of the individual coil systems. Of course, no attempt was made to shield the magnetic fields, but these are not harmful if the coils are at the proper angle.

In the short year that the Neutrodyne circuit has been before the public it has met with very great popular approval. In the coming year improvements will undoubtedly be made, but probably not of a radical nature. Greater amplification may be expected by more careful construction and by the use of more shielding.

A. J. HAYNES has written an interesting and informative article about the super-heterodyne and why high frequencies should be used in the intermediate-frequency amplifier, a subject which has received very little attention. The article will help any experimenter who is building a super-heterodyne and will aid and interest those who already own a receiver of this type; it will be printed in an early number.

The Listeners' Point of View

Conducted by Jennie Irene Mix

Are Women Undesirable—Over the Radio?

AFTER having written for the June number of this department a nice little comment regarding women announcers, and one such announcer in particular, came the discovery, when this same number was published, of a letter in the department, "What Our Readers Write Us," denouncing all women announcers because, the voice of a woman when she cannot be seen "is very undesirable, and to many, both men and women, displeasing."

The man responsible for this opinion bases it on his experience with the sales of phonograph records. Various manufacturers lost several thousands of dollars, he tells us, before they learned that the public will not pay money to listen to the talking record of a woman's voice.

This is interesting. And when one stops to consider the matter it is impossible to recall a phonograph record of a monologue by a woman. Yet some of the highest paid women in vaudeville are the women heard only in monologues.

Does this mean that when a woman is speaking she may be fascinating as long as she remains in sight, and becomes displeasing the moment she cannot be seen although she may go right on talking just as delightfully as the moment before? That is exactly what it means provided the experience of the phonograph men is all the evidence needed to prove so radical a statement. But is it logical to draw final conclusions regarding so important a matter from but one medium of experiment? It scarcely seems so.

In its fundamentals the question is one for the psychologists to deal with. Perhaps, now that the radio is bringing women daily before the microphone, psychologists will delve into this subject and, if their conclusions agree with that of the phonograph dealers, we shall then know the cause for this strange difference in the effect produced—in the opinion of some—between the voices of men and women when the speakers are invisible.

It would be interesting to know how the radio public feels about this matter. Let us, for instance, take station WOR at Newark. Many women speakers have been presented from this station, women of notable achievement in various avenues of activity, with the majority drawn from the dramatic profession.

Surely, if a woman's voice is both displeasing and undesirable over the microphone, WOR must have received complaints along this line from many of those who regularly tune-in on this station. Any report from there would be something of a test because no other station in the country has presented so many women in speeches and monologues as has WOR.

Then there is WGY at Schenectady, where scarcely a week passes without the presentation of a radio drama with women in the cast. Do the unseen audiences experience a feeling of repulsion every time Rosaline Greene or Lola Summers, Marie Prott, Charlotte Paulos, Mildred Stanyon, Gemma Votties, or others among the women in this dramatic company, speak? If this were true, then WGY would have received so many objections to presenting women before the microphone that plays employing both men and women would long since have been discontinued. Which would mean the discontinuance of all their drama programs, for no one of any sensibility could listen to a radio play given entirely by men.

We are willing to grant that were the profession of broadcast announcing to be equally divided between men and women the honors would without question go to the men. But this



ETHYL HAYDEN

This young lyric soprano, favorite among large numbers of concertgoers, recently gave pleasure to many thousands of unseen listeners when she sang the rôle of Marguerite in the concert performance of "Faust," given at Mankato, Minn., and broadcast through WLAG

does not prove that all men are successful as announcers and all women unsuccessful.

Women, as a rule, when they speak over the microphone, are apt to make one of two mistakes. They either speak in a patronizing tone or they are precise to a point of exasperation. With the latter, it is as if they stopped to cross every T and dot every I. The effect in either case is disagreeable. And, so far as the present writer's experience goes, women radio speakers are lacking in humor. On the other hand, men are inclined to be preachy. Here is a choice of two evils, one as bad as the other. But there are some men heard via radio to whom it is joy unalloyed to listen.

There are a few announcers in this country—all men—who are beyond criticism. They are consequently an unfailing pleasure to hear, from their first greeting to their final, "good night." They know just how far to carry familiarity in their speech—a trait that is the final test of an announcer's adaptability to his position. The men who are continually "jollying" their listeners, trying themselves to be entertainers, become extremely tiresome. A little of this sort of thing may be agreeable and effective, but more than a little becomes a surfeit. This is not an individual opinion, but one that has been expressed by large numbers of people.

If Mr. Henry Ford ever loses his job as a maker of automobiles he could undoubtedly get a position as announcer without half trying. This was proved when, at the close of the recent automobile race at Indianapolis, he was lured to the microphone by the genial Mr. Kaney who, for five hours, had himself been at the microphohone announcing the progress of the race which was broadcast by WDAP and WGN, Chicago.

Although Mr. Ford had been busy for many hours in his capacity as referee, his voice came through the air as fresh and vigorous as if



—Apeda, New York

PAUL SPECHT'S FAMOUS ALAMAC ORCHESTRA

Just as you sometimes "cannot see the forest for the trees," so you sometimes cannot see a jazz orchestra for the instruments. There are eleven men in this Alamac orchestra, and, without including those manipulated by the man at the drum, there are about two dozen instruments in the picture. To the drummer can easily be credited half a dozen more. An average of three instruments, let us say, to a man. But while some are accountable for only one instrument, others handle two—three—four—or five. Yet when you hear them via radio, which it is your privilege to do twice a week through station W J Z, the orchestra plays with a smoothness which gives no indication that any of the men change from one instrument to another during a performance

fatigue were something unknown to him. It was a perfectly poised, finely modulated, clear cut voice that would have held the attention even had the speaker been unknown. And Mr. Ford said in a few seconds as much as some radio speakers would have taken five minutes to say, and without saying it as well, at that.

But, according to our phonograph authority, if the most famous woman living had been at that race and had been persuaded by Mr. Kaney to speak over the microphone, all who heard her would have found the experience displeasing.

How do you feel about this question, my readers?

Program Director—Musician—Woman

WHATEVER may be said as a generalization regarding women announcers, Mrs. Eleanor Poehler, director and chief announcer at station WLAG, has been sufficiently successful in her work to bring her many assurances of commendation from radio fans, near and far.

Mrs. Poehler is a musician of broad education and experience. Left a widow a year after her marriage, she turned her attention to the cultivation of her voice, having the good fortune to study with the internationally known teacher, Mme. Schoen-Rene, who was then a resident of Minneapolis. There followed a period of study in Europe. Upon her return to this country Mrs. Poehler was occupied with concertizing and teaching. Then came another period of study abroad, this time chiefly in England. The breaking out of the War forced a return home.

"I have carried on ever since," said Mrs. Poehler when asked to tell further details of her career. "When the position of program director at WLAG was offered me, I was given but twelve hours to reach a decision. I have been glad ever since that I had so little time to consider the matter, because I took a flying leap in the dark and have loved the work better than anything else I have ever done. I am still singing and expect to continue doing so for a number of years to come. I have lost my fairness, am trying to keep away from fatness, but cannot possibly avoid fortyness."

Mrs. Poehler has for many years taken active interest in musical educational work in Minnesota and the Dakotas. It was she who first made a special study of radio voices, and through tests proved that many voices of good quality that are too small of volume for the public concert stage, are admirably adapted for radio performance because of the increased volume made possible through amplification. She has created several popular radio stars in the Northwest since she took over WLAG. Any one listening in regularly to her programs can readily see that she is not carrying on her radio work simply for the purpose of "giving the public what it wants," but rather with the idea of affording the radio public opportunities to hear a sufficient amount of good music to gratify those who already appreciate it, and to create a taste for it among those who, hitherto, have listened to little but trash.



—Mishkin, New York

FREDA BENNECHE

Born in New York, the daughter of Edward Benneche who, for years, was president of the Arion Society and prominent in other musical circles, Miss Benneche, coloratura soprano, came naturally by her musical gifts. She was recently heard by radio through station WOR

Good Programs from Here and There

THE last concert for the season given by the Mendelssohn Glee Club of Albany, with Mary Jordan, contralto, as assisting soloist, and broadcast through station WGY,



© Underwood & Underwood

WILLIAM VAN HOOGSTRATEN

Joint conductor with Willem Mengelberg of the New York Philharmonic orchestra which was frequently heard by radio audiences during the last season through station WEAF. Mr. Hoogstraten is this summer chief conductor of the concerts being given by the Philharmonic orchestra every night at the Lewisohn Stadium, the College of the City of New York

provided an agreeable evening for listeners-in. The Russel Sage College Glee Club heard through WHAZ was another excellent feature. The Girls' Glee Club of the Davenport, Iowa, High Schools and the combined quartets from the Junior High Schools of the same city were enjoyed through WOC. And the Advanced Elementary School Orchestras of St. Louis, heard through KSD, gave a public concert sufficiently well-done to hold the attention throughout the entire performance.

A Radio Singer Advances

HERE'S wishing Miss O'Brien of Kansas City the best of success in her future musical work!

Miss O'Brien, who has a brilliant full soprano voice, far superior to the majority of voices heard over the radio, has frequently sung at station WHB, Kansas City. Not long ago she gave her farewell program preceded by the announcement that she was going East to study with the view of furthering her career. Her singing seems to justify her ambition to develop her work to the fullest possible extent. Every venture to become a widely known professional in the musical world these days when competition is so keen, is a big risk, and that is why one admires those who make the venture when, as in the case of this young soprano heard by radio, there is sufficient natural gift to justify ambition.

So—again—here's wishing Miss O'Brien of Kansas City the best of success!

What Are the Elite Radio Orchestras?

HOW many orchestras heard regularly over the radio make it a custom to give occasional programs composed wholly of standard musical works? By standard musical works is meant works that have been accepted by the musical world as worthy of performance on orchestral programs constantly given through the regular concert channels. This eliminates all jazz and the ephemeral popular music that is here to-day and gone to-morrow.

Note that the question is not how many orchestras heard over the radio always give



—Zintsmaster, Minneapolis

MRS. ELEANOR POEHLER

Director and Chief Announcer of station WLAG, St. Paul—Minneapolis

programs of standard works, but—how many even occasionally give such programs?

The conductor of this department greatly desires full statistics regarding this matter. She at present has but a very small number of such orchestras on her list.

Who will help make this list complete by sending in the name or names of any radio orchestras known to be in this class? Individual credit for all such information will be duly given in this department.

The Girl Scouts at Chicago

ALTHOUGH it is not unusual for some broadcast stations to put on programs given wholly by girl scouts, the first time, so far as can be learned, that the camp song, "Innisfree," was heard by radio was during the recent annual National Convention of Girl Scouts held at Chicago when this song, which was the official song of the convention, was broadcast from station WDAP, now WGN. The singer was Elsa Clement, Field Captain and Captain of Troop 26, Toledo Girl Scouts.



—Livingston

ELSA CLEMENT

Who, during the National Convention of Girl Scouts in Chicago, broadcast the official song of the convention from station W D A P (now W G N)

From reports that came in later, girl scouts all over the country listened with delight to this song which they all love, although it is far from being either ragtime or jazztime. The poem by William B. Yeats has become a classic while he is still living. It was set to music by an Englishman and is the official song of the English Girl Guides. Do you recall the poem? It begins:

I will arise and go now
And go to Innisfree
And a small cabin build there
Of clay and wattles made.
Nine bean rows will I have there
A hive for the honey bee
And live alone in the bee-loud glade.

And the last stanza, what an appeal it makes to many city-bound folks at this time of year!

I will arise and go now
For always, night and day,
I hear lake water lapping
With low sounds by the shore.
While I stand on the roadway
Or on the pavements gray,
I hear it in the deep heart's core.

A mile distant from Camp Andree Clark, Briarcliff Manor, N. Y., the largest national girl scouts' camp in the country, there is a log cabin where different groups of girls are sent, from time to time, to live the primitive life, without even cooking utensils or beds, being dependent wholly on their own efforts to get along. It is called "Innisfree," and the girls not only enjoy the cabin and seek the privilege of staying there, but they like its name because they like the poem and song.

Such is the romantic atmosphere surrounding the song that went out over the air to thousands of listeners from station WDAP in the great city of Chicago where the atmosphere is so alien to that pictured in "Innisfree."

Good Radio Music from Mankato, Minn.

NOT long ago, upon tuning-in this station, WLAG, came the announcement that a concert performance of "Faust" was about to be broadcast from Mankato, Minn. That settled it, so far as one listener was concerned. The evening would be spent enjoying this performance. The fact that it was given at Mankato meant that it would be well worth the hearing. For Mankato is one of the most musical towns in the entire country, a place where every artist, even the greatest, is happy to get a chance to appear. At the end of each season Mankato can show you a list of musical attractions presented that would make a similar list in many a good sized city seem indifferent in both quantity and quality.

During that performance of "Faust" there came to the listener, many hundreds of miles distant, a voice singing the rôle of Marguerite that held the attention throughout the evening, a voice of lovely quality and used with skill. It was later learned that the singer was no other than Ethyl Hayden, one of the foremost among the young lyric sopranos of the day.

When the radio can carry a voice many hundreds of miles with such fidelity that its quality and manner of production are unmistakable, it is a wonder that any manager stands in his own light by not permitting his artists to be heard, occasionally at least, through this medium. Hearing that singing by Ethyl Hayden was more convincing as proof of the quality of her work than would have been the perusal of a whole book of press notices about her.

Others in this cast who were heard to excellent advantage were Agnes Snyder in the double rôle of Siebel and Martha; Louis Klebba as Faust; Rollin Pease, Mephistopheles, and Glen Shoemaker as Valentine. The choruses were carried off with telling effect by the Women's Glee Club and the Orpheus Club of Mankato, while the orchestra was a combination of the Mankato Festival orchestra and members of the Minneapolis Symphony. The entire production was directed by Mrs. H. A. Patterson with a vitality and flexibility that aroused unstinted admiration.

This performance was part of a spring festival given at Mankato, and to WLAG should go a vote of appreciation from radio fans for making possible an opportunity to hear it.



—White, New York

WADE HINSHAW

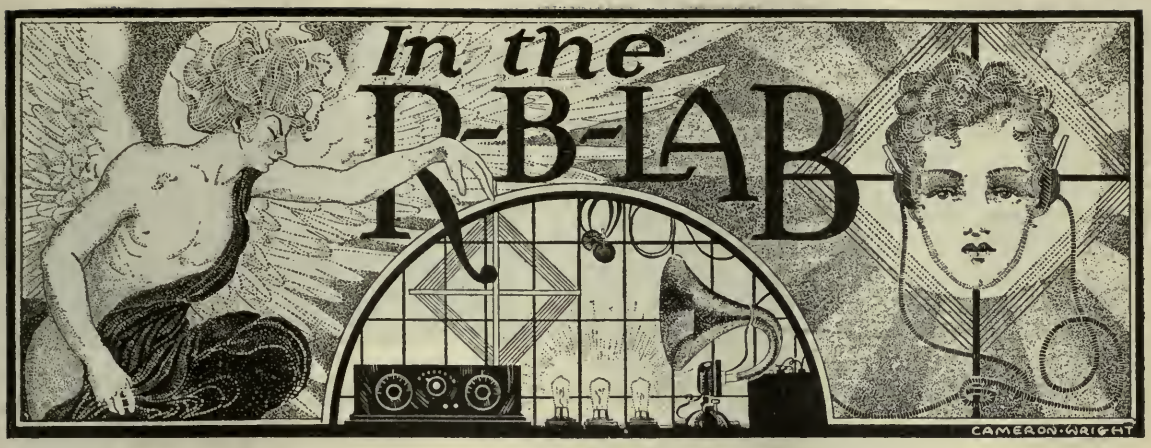
This is the man who led the "Radio Sing" at station WJZ. He was not so very long ago a grand opera singer, but during the last few seasons he has devoted his time to presenting the classic comedies of Mozart in tabloid form throughout the country with great success. Mr. Hinshaw's achievements in this line have done much to further the cause of Mozart among many who hitherto seldom had an opportunity to hear operatic music

Excellent Polish National Music from WGY

IT WILL be a long time before some of us who heard it, will forget the singing of Chopin's "Hymn to Polish Song," by the two Polish societies, the Kalina Glee Club and the Liberty Bell Chorus of Amsterdam, N. Y., and broadcast from Station WGY at Schenectady. It brought to a close a program composed, with but one or two exceptions, of Polish music sung by Polish singers in the vernacular. The way in which they interpreted this music was proof that, no matter how long they may have lived in this country, even if born here, the spirit of the land of their fathers animates them.

The fact that the program was not interrupted by a speech totally foreign to the subject of music added immeasurably to its enjoyment. Abominable custom—that of injecting speeches into the programs of radio concerts!

MANY interesting talks are heard over the radio, but more often they are only partially heard, because they are almost always too long. Many listeners tune-out before the end is reached. When it seems as if the talk had continued for at least half an hour, the watch will show that it has been going on but fifteen minutes. Which proves that it should have stopped at the end of ten minutes.



HOW TO REBUILD A RADAK C-3 INTO A REFLEX RECEIVER

FIGURES 1, 2, 3, and 4 tell the story of how the Radak and similar regenerative receivers can be made over into a more efficient and desirable reflex set plus one stage of external audio amplification. The Radak C-3 is a single-circuit receiver manufactured by the Clapp-Eastham Company, designed to cover wavelengths between two hundred and two thousand meters, and includes a two step audio-frequency amplifier. It is an excellent receiver of its type. Radio progress and the appreciation of the interference caused by single-circuit regenerators have relegated it with antiquated and ostracized apparatus.

The Radak C-3 (as well as other receivers of this type but of different manufacture) are mechanically characterized by three predominant parts, a tuning coil, a rotating tickler and a variable condenser (plus, of course, two stages of audio-amplification). In the case of the Radak, there are two variable condensers, one for short waves and one for long waves. Single-circuit receivers, and how to recognize them, have been discussed at greater length in "The Truth About Trick Circuits" appearing in the March, 1924, issue of RADIO BROADCAST.

Sets of this type can be salvaged and made over into very efficient non-radiating reflex receivers at a cost that is nominal compared with the expense of totally new equipment.

THE ADDITIONAL PARTS

THE following extras are required for the reconstruction of the Radak and similar receivers:

Radio-Frequency Transformers, T1 and T2, at $3.00	$6.00
One variable condenser, .00035 mfd. (17 plate)	4.00
One Celerundum Crystal Detector	1.25

Full details concerning the various possibilities for the radio transformers T1 and T2 will be found in "The R. B. Lab" for the current and last three issues of RADIO BROADCAST, as well as in articles, "A Knock-Out One-Tube Receiver" and a "Knock-Out Four-Tube Receiver" appearing respectively in the April and June numbers.

What the Lab Offers You This Month

—How to rebuild your single-circuit Radak receiver into a reflex set.
—Variations in building the "Knock-Out" four-tube receiver, using Sickles coils for the inductances and Daven resistors.
—Some recommeded resistances for use in resistance-coupled audio amplifier circuits.
—Installing a reconnected A battery rectifier for charging B batteries.
—How to make very efficient home-made inductances.
—Suggestions for adding to the home laboratory.

PREPARING THE RADAK

THE first step in this rejuvenation is the dismantling of the tuning inductance, fixed condensers, and the complete unwiring of the tuning elements.

All connections are removed from the detector jack, and likewise from the binding-posts excepting plus B and plus and minus A. The first amplifying transformer is completely disconnected and the four leads permitted to hang freely.

The grid and plate connections to tube number two are removed, as well as the connection to the prong marked A of the middle jack (the left hand jack in Fig. 1). The original detector socket and detector jack are not used on the finished reflex set, tube number one being plugged in the middle socket and controlled by the middle jack (originally the first step jack).

The tuning coil is removed by unscrewing the two screws above and below the tickler dial, and the set screw on the shaft *behind* the panel. Clip the leads to the taps close to the panel. The circular fixed condenser is also demounted by removing the holding screws through the panel, which, on rebuilding the set, are used to hold the celerundum fixed crystal detector.

The front of the panel is left unaltered, the vernier dials and all controls, excepting the inductance switch and the detector rheostat, being used in the reconstructed receiver.



FIG. 2

The Radak C-3. All controls excepting the inductance switch, the detector jack and the detector rheostat are used in the completed reflex

REBUILDING

THE first task in reconstructing is to mount condenser C1 and transformer T1 in place of the dethroned tickler and tuner. As the vernier dial is fitted for an eighth inch shaft, it will be necessary to file or turn down the usual one quarter inch shaft on the condenser. This is easily accomplished using a flat file with the aid of a vise. File the shaft square, then hexagonal and finally round. This will

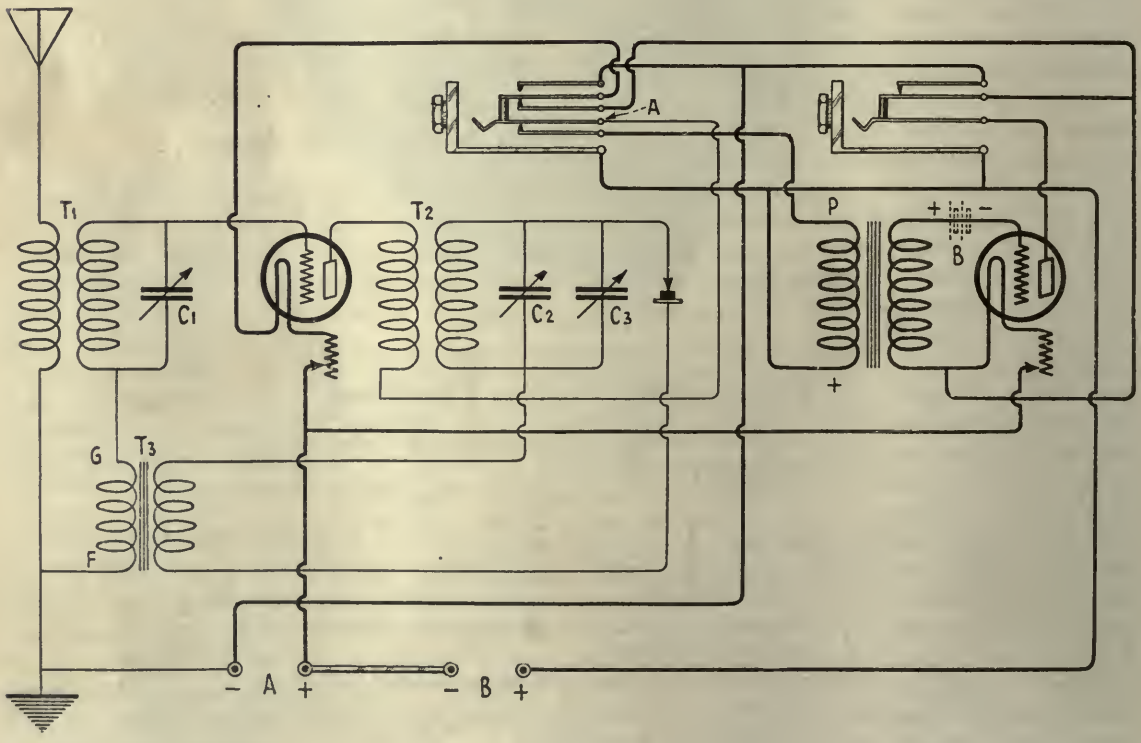


FIG. 1

The circuit for the rebuilt Radak. The reflex is a great improvement over the former single-circuit regenerator

generally achieve the desired reduction. It is probable that the shaft will also have to be shortened by about three quarters of an inch.

The condenser is then mounted on a $4\frac{1}{4}''$ by $3''$ piece of $\frac{3}{8}''$ wood by means of the usual screws. A $\frac{3}{4}''$ hole should be allowed for the shaft, through which the collar of the knob and dial may pass. A half inch slot is sawed from the outer edge to the center hole to permit the entrance of a screw-driver for tightening the set-screw. The condenser may now be mounted by means of the original screws passing through the panel, and T1 fastened to it with brackets. Fig. 3 illustrates this arrangement very clearly.

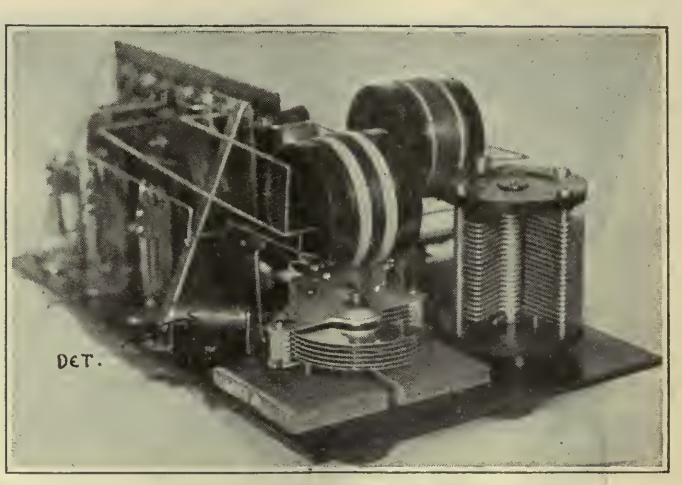


FIG. 3
Mounting the detector and condenser C1 without boring new holes

T2 is mounted on the small condenser, marked "low wave," which capacity is shunted, as a vernier, across the large 43 plate affair, C2.

The crystal detector is secured to the panel, as before mentioned, by means of the screws which originally provided the terminals to the circular fixed condenser. The middle screw is brought through the panel and tightened "blind" merely to hide the hole.

HOOKING UP THE "NEW" SET

THE circuit is shown in Fig. 1, and our old readers will recognize it as the justly famous single-tube reflex receiver plus one stage of external audio-frequency amplification.

Only two points in the wiring should bother the experimenter—the connections to the first amplifying transformer, T3, and those to the external amplifier. Even these obstacles are more imaginary than real.

If the secondary leads from T3 are examined, one will be found on the surface of the winding and the other a half inch or so nearer to the core. The inner wire is the filament connection (F) and the outer should be led to the grid (G).

To complete the plate circuit to the first tube, it is merely necessary to run the plate to the primary of T2, and from T2 to point A of the middle jack. The plus B battery is already wired from the binding-post to the jack, as well as are the filament connections for automatic control.

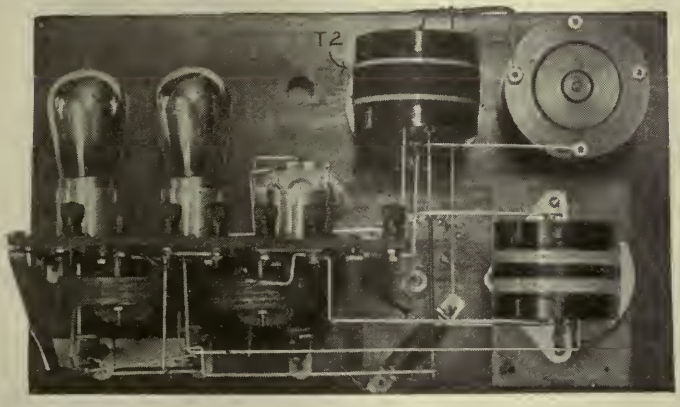


FIG. 4
Rear view of the rebuilt Radak. The detector jack, rheostat, and socket are not used

OPERATION

THE operation of the completed receiver is quite simple, and is that happy characteristic of the single-tube reflex. Almost all tuning is accomplished with C1 (the lower left dial), and C2 merely used to increase selectivity. The vernier, C3 will rarely if ever be touched.

As there is no bias whatever on the amplifying tube, such as is generally secured across a rheostat in the negative filament lead, it is probable that the amplifier will distort appreciably. This may be remedied by including a bias (C) battery, of three to six volts, in the grid circuit, negative to the grid. In the receiver described, the C battery is most conveniently placed as suggested by the dotted lines at B.

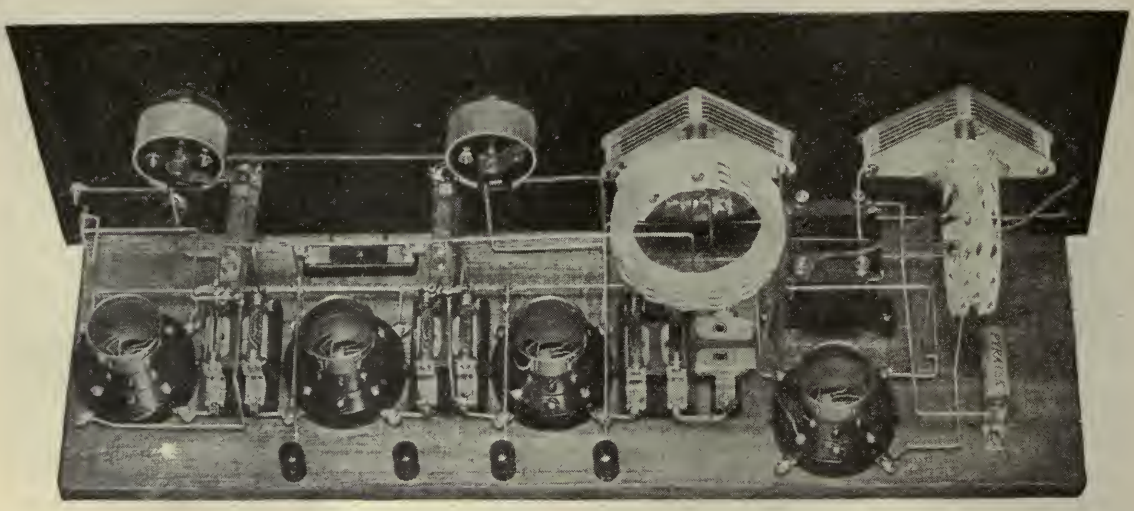


FIG. 5

Behind the scenes. Reflex and three stages of resistance-coupled amplification. The compactness and neatness are facilitated by the "Resisto-Couplers" between the sockets

The rebuilt Radak will give excellent loudspeaker volume on all local and many distant stations. The single tube alone will actuate the loudspeaker on locals. The set is quite selective, does not radiate or oscillate, and is very stable and easily operated.

ANOTHER FOUR-TUBE KNOCK-OUT

A SUBSEQUENT model of the receiver described by Zeh Bouck in the June RADIO BROADCAST is shown in photograph 5. This later design differs in several ways from the original receiver, and represents improvements that will appeal to our many readers who have followed the "knock-out" series.

The panel layout has been altered slightly, the rheostats being raised one inch above the center of the panel. This balances the arrangement, and adds subtly to the aristocratic simplicity of the receiver.

The Sickles "Diamond Weave Transformer Coils" have been substituted for the rewound neutroformer type inductances. The Sickles coils are easily mounted on any type variable

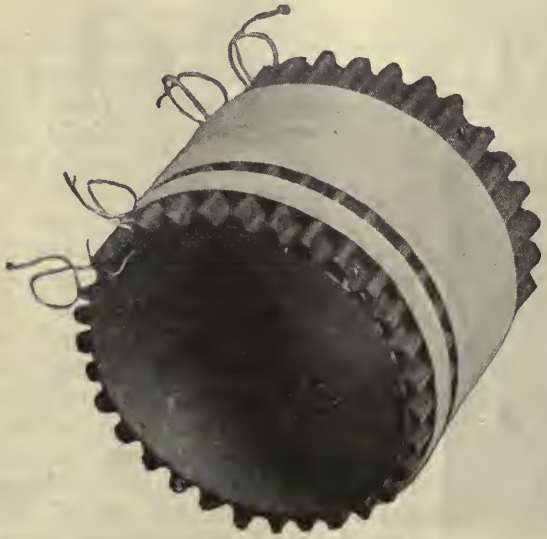


FIG. 7

A highly efficient form of inductance

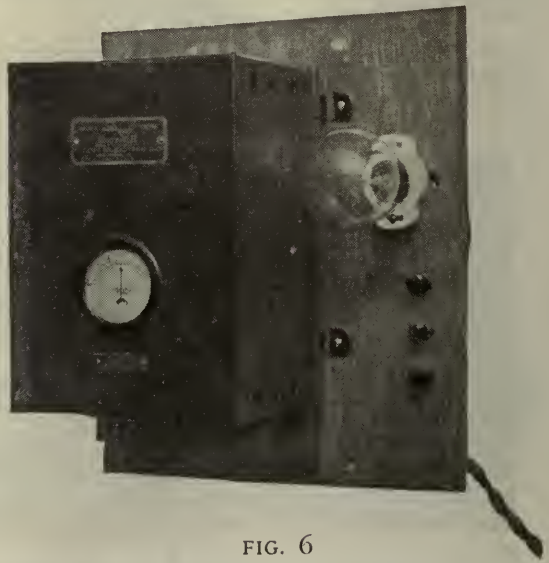


FIG. 6

The A battery rectifier permanently mounted on the station wall, and wired for charging both A and B batteries

condenser. In most cases this is best accomplished by removing one of the machine screws from the condenser end plate (generally a six thirty-two) and substituting a longer and headless screw which will take the threaded support on the coil.

The very compact construction of the set is made possible by the use of "Resisto-Couplers" (Daven Radio Company), in the three-stage resistance-coupled amplifier. The Resisto-Coupler clips the coupling resistance, grid leak, and isolating condenser into a small unit which fits nicely between the tubes and under the jacks. A five inch base-board was used.

The circuit is identical with that described in Mr. Bouck's original article, except that the .00025 mfd. stabilizing condenser is more effective between the grids of the first two amplifying tubes (not counting the reflex tube), rather than between grids one and three.

OTHER COUPLING RESISTANCES

SINCE the article on resistance-coupled audio amplification, by G. Y. Allen, in the May RADIO BROADCAST, several manufacturers have appreciated the possibilities of this system, and several new resistors, suitable for coupling resistances, have been placed on the market. Any of the following are now easily obtainable and are equally efficient:

The Bradley-Ohm.
The Daven Resistors (fitting the Resisto-Coupler).
The Lavite.
The Ward-Leonard non-inductive resistances.

AN A BATTERY RECTIFIER PERMANENTLY INSTALLED FOR CHARGING B BATTERIES

THE vibrating rectifier described in the B battery charging article in last month's RADIO BROADCAST is shown permanently and conveniently mounted in photograph 6. This makes a very business-like installation. The rectifier, lamp, and terminals are mounted as a single unit, and wired to the battery and to the station switch-board from which the rectifier is controlled. Binding-posts are also provided for connection to batteries other than the cells permanently wired. Three posts are provided, one positive, for

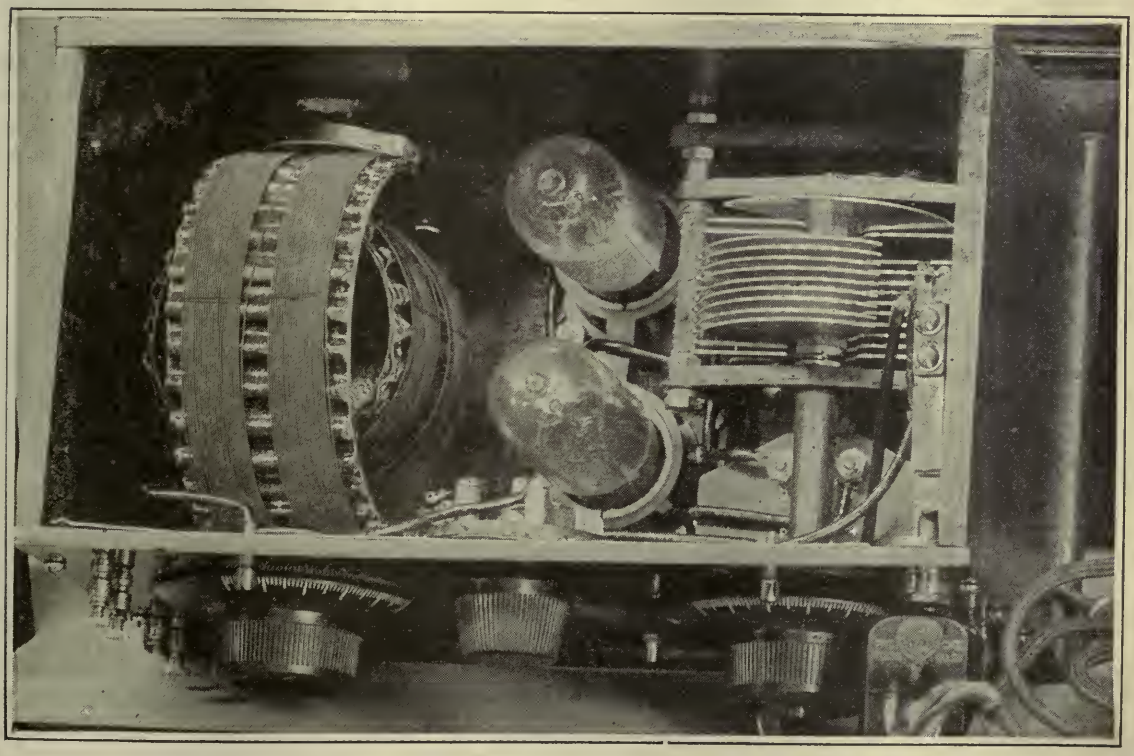


FIG. 8
A receiver built by Mr. Brown, using his corrugated pasteboard inductances

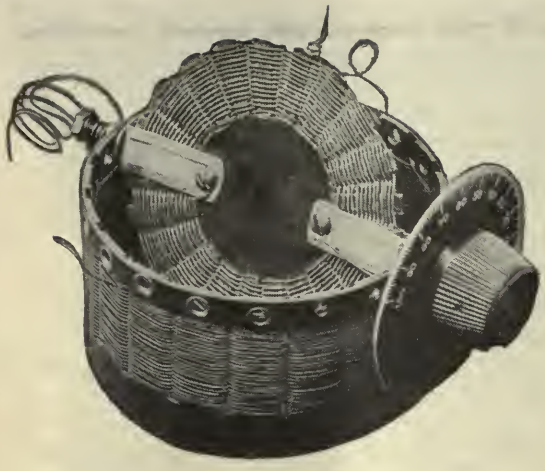


FIG. 9

A spider-web variocoupler. Unusual, and perhaps a little more efficient than the ordinary

both A and B batteries, and two negatives, one for A and the other for B. The use of a common plus post, which runs to the ammeter on the front of the rectifier, makes it possible to employ this meter in both A and B battery circuits.

HOME MADE ULTRA EFFICIENT INDUCTANCES

PHOTOGRAPHS 7, 8, and 9 show the highly efficient inductances made by one of our readers, Mr. C. H. Brown. Theoretically, the most efficient inductance would probably be a coil of self-supporting bare wire wound on air. The dielectric losses and distributed capacity of this coil would be reduced to a minimum. However, such inductances are hardly practical, and the nearest approach to this theoretic ideal is found in honeycombs, spider-webs, and the coils wound by Mr. Brown.

The winding form in Fig. 7 was made from the common corrugated pasteboard used in packing photographs and for making heavy pasteboard boxes. A strip of the material, cut to the desired width, is merely bent backward into a tube, and fastened with glue or eyelets.

Fig. 9 shows a spider-web variocoupler that will appeal to our less conventional readers. The form on which the primary is wound was originally a strip of ordinary cardboard (or fiber may be used), about three and a half inches high and sixteen inches long. Slots are cut to three quarters of an inch from the lower side, leaving half inch segments with a quarter of an inch between them. The form is then bent and permanently made into a circular tube. The finished form must have an odd number of slots and segments. After the wire is wound, the top of the coil is encircled with a strip of cardboard made fast with glue, or eyelets as Mr. Brown has done. The secondary of the coupler is an ordinary spider-web.

BUILDING YOUR OWN LAB

THIS month's suggestion is a handy little device that only recently found its way to our own work-bench. Photograph 10 shows the Nestor "Bend-Rite"—a genuine aid to the art of neat wiring. It is a wrench arrangement that may be used for bending large and small bus-bar wire, and for making eye holes to pass both number six and number eight screws. It is in this last operation that the "Bend-Rite" shows its true worth, and the behind the panel neatness of the receiver shown in Fig. 5 pays tribute to this handy device.

The "Bend-Rite" is made to be permanently screwed to the work-bench or table, but the experimenter will probably find it more convenient to clamp the tool in a vise, and shelve it when not in use.



FIG. 10

The "Bend-Rite" arrangement. This little wrench device may also be used for making excellent tail-washers from short lengths of bus-bar wire

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM MAY 17 TO JUNE 13 INCLUSIVE

CALL LETTERS	LOCATION	KILOCYCLES	WAVE-LENGTH	POWER (Watts)
KFPO	Denver, Colo.	1300	231	500
KFPT	Salt Lake City, Utah	833	360	500
KFQA	St. Louis, Mo.	1150	261	50
KFQD	Anchorage, Alaska	1070	280	100
KFQE	Colorado Springs, Colo.	1340	224	5
KFQF	Minneapolis, Minn.	1340	224	10
KFQG	Los Angeles, Calif.	1330	226	100
KFQH	Hillsbourgh, Calif.	1300	231	50
KFQI	Culver City, Calif.	1280	234	100
KFQJ	Oklahoma City, Okla.	1270	236	50
KFQK	Fayette, Mo.	1270	236	10
KFQL	Muskogee, Okla.	1190	252	20
WCAY	Milwaukee, Wis.	1130	266	250
WDBI	St. Petersburg, Fla.	1330	226	10
WDBO	Winter Park, Fla.	1250	240	50
WDBP	Superior, Wis.	1150	261	50
WDBQ	Salem, N. J.	1280	234	10
WDBR	Boston, Mass.	1170	256	100
WDBS	Dayton, Ohio	1060	283	5
WDBT	Hattiesburg, Miss.	1270	236	10
WDBU	Skowhegan, Maine	1160	258	10
WDBV	Fort Wayne, Ind.	1160	258	100
WDBW	Columbia, Tenn.	1120	268	20
WEBH	Chicago, Ill.	810	370	1000
WFBW	Cincinnati, Ohio	970	309	750
WJAB	Lincoln, Neb.	1310	229	100
WJAZ	Chicago, Ill.	1120	268	20
WKBF	Cranston, R. I.	1050	286	500
WLBL	Stevens Point, Wis.	1080	278	500
WMAZ	Macon, Ga.	1150	261	100
WQJ	Chicago, Ill.	670	448	500
WSAU	Chesham, N. H.	1310	229	10
WSAV	Houston, Texas	833	360	100

LIST OF BROADCASTING STATIONS DELETED MAY 1 TO MAY 30

CALL	LOCATION	CALL	LOCATION
KDZQ	Denver, Colo.	WGN	Chicago, Ill.
KFCH	Billings, Mont.	WHAP	Decatur, Ill.
KFDR	York, Nebr.	WIAU	Le Mars, Iowa
KFLP	Cedar Rapids, Iowa	WMAP	Easton, Pa.
KFLY	Fargo, N. Dak.	WOAD	Sigourney, Iowa
KZN	Salt Lake City, Utah	WPAP	Winchester, Ky.
WBBE	Syracuse, N. Y.	WSAX	Chicago, Ill.
WBL	Anthony, Kans.	WTAH	Belvidere, Ill.

MEXICAN BROADCASTING STATIONS

CALL LETTERS	LOCATION	KILOCYCLES	WAVELENGTH	POWER (Watts)
CYB	Mexico City	545 to 857	350 to 550	
CYL	Mexico City	545 to 857	350 to 550	
CYR	Mazatlan	545 to 857	350 to 550	250
CYX	Mexico City	545 to 857	350 to 550	

TOTALS

Number of U. S. broadcasting stations	601
Number of Canadian broadcasting stations	44
Number of Cuban broadcasting stations	34
Number of Mexican broadcasting stations	4

The D X Con



MRS. EVA L. RHODES

Who won the first prize for ready-made receivers in RADIO BROADCAST'S third distance receiving contest. She received a MuRad MA-15, six-tube radio frequency set



O. B. EVANS

Of Mount Pleasant, Michigan, whose one-tube Michigan Midget receiver, appearing in the photograph together with its owner and his dog gained second place in the contest with a distance of 84,620 miles. His prize was a Fada neutrodyne receiver, model "160"

MEET the winners of RADIO BROADCAST'S third annual distance contest. Last month, we announced their names and the prizes they received, but the scarcity of available space in the magazine made it necessary to hold over their photographs until this number. These are the six fortunate ones out of a very large group of contestants who brought all their dial twisting cunning to win the six prizes, three for home-built receivers, and three for ready made sets, in the contest recently closed.



M. F. WINNE

Of Webster Groves, Missouri, second prize winner in the home-built receiver group. His home-made neutrodyne brought in a total distance of 115,088 miles. The photograph of Mr. Winne's set showed one of the neatest and best built we have seen

Those who entered the contest and were not successful and those who did not enter it and have since wished they had, and those who are interested in distance reception anyhow all doubtless would like to know what sort of receiver did win out in the two groups.

THE RECEIVERS THEY USED

MRS. EVA L. RHODES, of Utica, New York, who logged a distance of 85,510 miles used a Paragon RA-10 receiver with a DA-2 detector-amplifier unit of the same manufacture and a 10-R radio-frequency amplifier. The other equipment included a Fibretone loud speaker, and a Malone-Lemmon Control-o-Meter.

O. B. Evans, of Mount Pleasant, Michigan, who came in second in the manufactured set group, used a Michigan Midget one-tube receiver. He used Brandes receivers, and his antenna was an inverted L type 102 feet long which was alternated with an indoor cage antenna containing 61 feet of No. 14 wire.

Alex. B. Nicol, of Bogota, New Jersey, who won third place with his Atwater-Kent No. 10 Radiodyne, logged a total distance of 68,520 miles. He used an 80-foot single wire antenna, 25 feet high, Western Electric phones, and Atwater-Kent loud speaker.

test Winners

HOME-MADE WINNERS

DR. W. C. WOLVERTON, of Linton, North Dakota, who won the first place in the home-built set group, used an assembled neutrodyne receiver to gain his mileage of 121,535. He used the following parts:

Freed-Eisemann neutroformers and neutrodons
WorkRite non-microphonic sockets
All-American audio transformers
Dubilier micadons
Star Rheostats
Standard Two-Circuit jacks
Freshman .006 mfd, fixed condenser (mica).
Baldwin and Brandes phones
Murdock multiple plug
Baldwin loud speaker, with Weston plug
additional audio amplifier unit using 2 Air-Way audio transformers



KENNETH DANIELSON

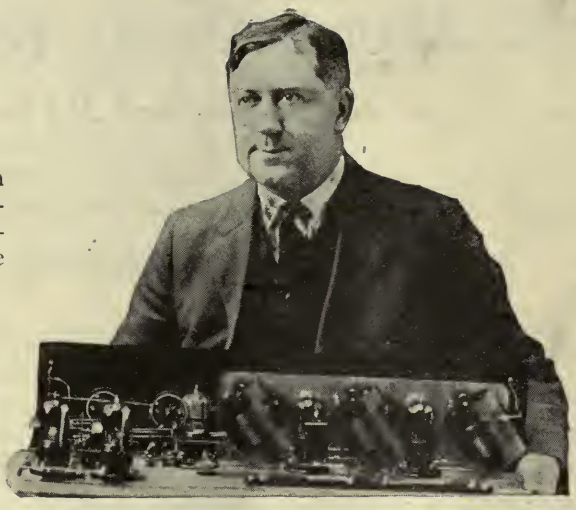
Of Thermopolis, Wyoming came in a good third for the receivers in his class with a distance of 135,190 miles. His receiver was also a home-assembled neutrodyne which was built from Freed-Eisemann parts

M. F. Winne, of Webster Groves, Missouri, won second place in the homebuilt receiver class with his distance of 115,088 miles. His home-built neutrodyne is an exceptionally well made one. Besides home made neutrodyne parts, he used Carter .04 mfd. fixed condenser; Carter rheostats; Federal audio transformer; Royal sockets; Ezytoon dials; Western Electric phones.

His antenna is a single wire, 90 feet long, stretched from a window of his house to a tree, 45 feet from the ground and free from all obstructions. His location is apparently an excellent one for receiving.

Kenneth Danielson, of Thermopolis, Wyoming, whose total distance of 135,190 miles won him third place, used a neutrodyne receiver which he assembled from Freed-Eisemann parts. Most of his reception is done on Baldwin phones, although he uses a Magnavox R-2 loud speaker on strong signals. His antenna is a single wire 65 feet long, 35 feet above ground.

Mr. Winne got the parts for a Roberts two-tube knock-out with one stage of audio, and Mr. Danielson the parts for a Roberts set as his prize.



DR. W. C. WOLVERTON

Of Linton, North Dakota, whose home-built neutrodyne receiver won first place in that class with a logged distance of 121,535 miles. The set is excellently assembled and neatly wired. His prize was a complete set of parts for a Haynes super-heterodyne

CONCLUSIONS

THE neutrodyne receivers seem to have it by acclamation in the home-built receiver class, for every one of the winners in that group used such a receiver. Some of them were built entirely by the constructor, and others used some manufactured parts. The winners in the other group also depended on radio-frequency amplification, very largely. Mrs. Rhodes attained success using a radio frequency unit ahead of her regular receiver.



ALEX B. NICOL

Of Bogota, New Jersey came out third among the contestants with ready-made receivers. He logged 68,520 miles with an Atwater-Kent No. 10 Radiodyne, and received a Sonochorde loud speaker as a prize

The letters which came in with the contest entries were almost unanimous in their condemnation of the single-circuit regenerative receiver, and almost all reported continuous interference from this type of set. It is distinctly worth noting that excellent distance was attained by these contest entrants all of whom used non-radiating types of sets.

In later issues, we shall publish photographs and brief descriptions of some of the very excellent sets which were entered in the contest.

A Word About Radio Broadcast's Knock-Out Receivers

How They Came to be Featured so Strongly—How to Tell Which of Them Will Best Suit Your Needs

By ARTHUR H. LYNCH

WE FEEL perfectly justified in stating that no group of radio receivers, with the possible exception of the neutrodyne and the superheterodyne has achieved anything like the success and favor among the radio public that our own Knock-Out series has received. And so we tell some of the story.

From the first numbers of RADIO BROADCAST, its editors have been of the opinion that whistling receivers were a menace not alone to good reception but to the entire radio industry. Many of you, who have followed our activities will remember that hardly a number appeared that did not contain some reference to this nuisance.

Many reputable manufacturers did not agree with us in our stand, and some of them went so far as to tell us that unless we ceased our criticism of the receivers on which they were making their living they would discontinue advertising with us. This magazine, like most others, depends to a great extent on advertising revenue for its life. We held a council of war and decided to stand by our guns and unless we could tell the truth, not half-truths, we would discontinue publisning in the radio field. Some advertisers did pull away from us and we lost their business, but we gained something far more valuable—the confidence of our readers. Other advertisers began to believe our doctrine and realized that in the long run the family that could afford an expensive receiver would not buy it if the entertainment it would provide could be and would be subject to the whims of other families in the neighborhood operating interfering receivers. Then, too, we had the parts manufacturer and the retail dealer to contend with. Contention it was, because neither would agree that a policy that would reduce sales, even temporarily, was a good policy to pursue.

HUMAN NATURE, BLOOPERS; THE GOLDEN RULE

"THERE isn't any problem to it," said the manager of one radio store. "Human nature is human nature, and just as long as the cheapest receiver that brings in long distance is one of your so-called "bloopers" the public is going to buy it. The golden rule days have not yet arrived. And from a purely business standpoint, it is necessary for me to sell these receivers to stay in business, because if I didn't someone else would, and the money is just as good to me as to any one else."

Eminent radio experts and many self-appointed radio engineers went to a lot of trouble to advocate the continuance of the sale of receivers that could and did radiate. Their arguments have appeared in the radio sections of many newspapers as well as in some of the radio monthlies.

One of the simplest methods to show the menace of radiating receivers was to have every listener in this country attempt to listen for the same broadcasting station at the same time. By coöperating with *The Wireless World & Radio Review* and British Broadcasting Company in London, and the broadcasting stations here, we were able to carry on our transatlantic tests last November. American broadcasting stations kept silence while listeners throughout our country endeavored to pick up signals from England. The reports from all who took part in these tests show that the greatest drawback was the interference caused by radiating receivers.

THEN CAME THE CAUSTIC EDITORIALS

RADIO editors in all sections of the country began writing highly vitriolic editorials condemning the bloopers. What could be offered as a substitute? What type of receiver would be as easy to operate, as selective, and as economical? There was but one such receiver that we knew of (excepting,

of course, the commercial type neutrodynes, reflexes and other non-radiators) that would fill the bill for those who rolled their own. We had tried every receiving gadget we could lay hands on, but the search was fruitless until we happened to get into the laboratory of a small radio company in New York. Here we found the single-tube reflex which was described in our November number, and because it was so far superior to any single tube receiver we had ever seen, we called it a "Knock-Out." It was from this receiver that the Knock-Out series developed.

There is little need, therefore, further to expand the merits of the Knock-Out one-tube reflex. It is, we believe, the best all-round single-tube receiver ever made. It is cheap, easy to assemble, and is easy to operate and it does not cause interference.

OVER-ENTHUSIASTIC CLAIMS

IN PRESENTING new developments in receiver design to our readers we have always attempted to use moderation in making claims for their performance. Sometimes this modesty on our part has caused easily impressed construction enthusiasts to build inferior receivers described in other publications for which glowing and frequently very optimistic claims were made. The result has been that many of those arrangements which have been heralded from the housetops as wonderful have been discarded for more reliable circuits that have appeared in our pages. The following unsolicited letters, which are but two among hundreds, indicate quite clearly how this system of conservatism is working out.

In the November number of RADIO BROADCAST, which we accidentally ran across a short time ago, "young son" and I read Mr. Harkness' article describing the "knock-out" one-tube reflex. Now we had built a number of sets, some good, some bad and others indifferent. Particularly did we expect great things of a one-tube reflex that was widely heralded last summer, only to be disappointed by its working in our hands.

However, the "knock-out" looked good to us and we proceeded to build it, and let it be said that as a result of our first night with it we were tickled pink. On K S D with our Western Electric loud speaker it filled the house. In rapid succession then came W O O, W M C, W O A W, W F A A, W D A P, W C A E, W O C, and W E A F. It was Sunday night and hearing W O C announce organ music, we adjusted the dials to tune-in more clearly and then, after listening to an organ selection that came booming in, judge of our surprise on hearing W E A F announce the Skinner organ program instead. The "knock-out has now a permanent place in our cabinet alongside a much more expensive and pretentious set.

JOHN N. MCCAUGHAN, M. D.,
St. Louis, Mo.

Three rousing cheers for RADIO BROADCAST and the Roberts reflex set. First we had the Harkness, which was a dandy set for local broadcasts, and now we have the Roberts that is fine for local and excellent for distance too.

Our problem here is to get by our four 500-watt stations operating simultaneously on 276, 360, 395, and 469 meters and get KPO at Frisco and KGO at Oakland on 423 and 312 meters respectively, and taking into consideration also that a set good for 1000 miles east of the Rockies will do well to cover half that distance on the Pacific slope. My receiver will do this, and in addition, gives me more volume on the locals than the Harkness with an extra stage of audio. . . . The idea of seeing a hookup through to the bitter end is an excellent one, and a relief from the galaxy of new hookups constantly appearing elsewhere.

G. L. KING,
Los Angeles, Cal.

HOW THE RECEIVER DEVELOPED

THERE are many who desire volume enough for loud speaker operation at all times and for them we have built up the two- and three-tube sets.

In designing these receivers, we have always endeavored to prevent our search for really satisfactory results from running away with our sense of duty to our readers in the matter of expense involved. For this reason the design of the Knock-Out two-tube and Knock-Out three-tube sets was made with a view to keeping the cost to the builder down as low as was consistent with good operation. Then, too, it was necessary to include in the design only such units as a builder could reasonably expect to find in the small dealer's shop or could be made at home with comparative ease.

But, despite these efforts improvements came more rapidly than we bargained for, and where the builder can afford a set employing two or more tubes we feel that it is better for him to use the system described by Walter Van B. Roberts in our April and May numbers or by J. E. Roberts in this number.

Our tests on the Roberts receiver indicate that it is almost as far superior to the single-tube reflex as that receiver was above other single-tube arrangements. For selectivity, economy of operation, ease of adjustment, etc., we know of no other receiver—tube for tube—that compares with it.

That does not mean that the builder of a receiver of the older type should junk it if it is operating satisfactorily. If you are one of those builders who builds a set for the entertainment received from broadcasting and your present receiver gives satisfaction, keep it.

The Vacuum Tube as an Amplifier

Explaining the Action of the Tube in Radio- and Audio-Frequency Circuits—The Advantages of Amplification at Radio Frequencies

WHAT MAKES THE WHEELS GO 'ROUND: VI

By WALTER Van B. ROBERTS

For those who have wondered just "how and why" the vacuum tube works in radio- and audio-frequency amplification, here is a clear and concise answer to their perhaps unasked questions. Mr. Roberts discusses regeneration, inductive, or tickler feed-back, and the relation that the size of tubes and their elements bears to this phenomena. As the other articles in this series, this article may be read as an entity in itself, although it fits in with the others in the group.—The Editor

WHEN radio waves of the frequency for which the antenna circuit is tuned are coming in, the high-frequency currents flowing in the coil produce high-frequency variations of the grid potential which in turn produce high-frequency currents (of considerably greater energy) in the plate circuit. If we could "feed back" some of this high frequency energy to the antenna circuit it might help the radio waves in their job of maintaining the high frequency current in the antenna circuit. This can be done in several ways. A very common method is shown in Fig. 24. To make the circuit conform to actual practice, the grid leak and condenser system of detection is shown and a fixed condenser is shunted around the phones to offer the high frequency currents a path of lower reactance than through the phones. (This reactance is, however, so high for voice-frequency currents that they mostly go through the phones.) The essential addition to the circuit is, however, the coil in the plate circuit. This is called the "tickler" coil and upon being brought up near

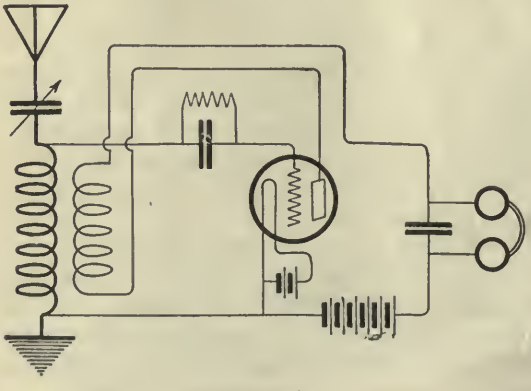


FIG. 24

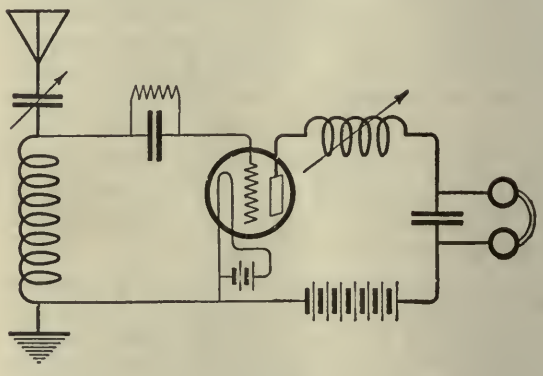


FIG. 25

the antenna coil its mutual inductance or transformer action affords a means by which energy from the plate circuit is fed back into the antenna circuit. The tickler must be connected the right way too, for if the connections are reversed its effect will be to reduce the antenna current instead of increasing it. The nearer the coils are brought together the greater will be the effect. If brought too close together a point will be reached where more power is being fed back to the antenna circuit than is being dissipated therein by heating the resistance of the circuit. When this happens all

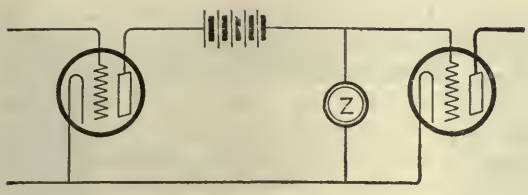


FIG. 26

the currents build up rapidly to an amplitude so great that our assumption $i_p = K(B + \mu \times \text{grid potential})^2$ is no longer correct, and the amplifying power of the tube has fallen to a value where only as much energy is being fed back to the antenna circuit as it is dissipating. The tube is then said to be oscillating and will continue to oscillate even if the radio waves cease coming in. The loudest signals are obtained just before the tube "breaks into oscillation." Signals can be received even while the tube is oscillating if the oscillation frequency is kept exactly the same as the carrier wave frequency, but this is very difficult.

50. PLATE VARIOMETER REGENERATION

FIG. 25 shows another common way for obtaining regeneration. The variable inductance in the plate circuit is not near enough to the antenna coil to have any appreciable "tickler" effect, but it is nevertheless capable of producing regeneration as follows: just as the radio-frequency currents flowing in the coil of the antenna circuit cause radio-frequency fluctuations of the grid potenital, so do the radio-frequency currents in the plate circuit cause fluctuations in the plate potential. On account of the close proximity of the plate to the grid the fluctuations of plate potential affect the grid potential and it can be shown that the effect is to re-enforce the grid potential fluctuations caused by the antenna current. If the variometer or variable inductance is gradually made greater, the amount of regeneration will increase until, just as with tickler regeneration, the tube breaks into oscillation. (If a high resistance or a large condensive reactance were used in the plate circuit instead of the inductance there would also be fluctuations of plate potential, but the effect, if any, would be to diminish the grid potential variations.)

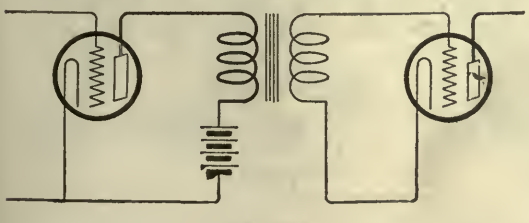


FIG. 27

51. IMPEDANCE AND RESISTANCE COUPLING

THERE are two general methods for obtaining amplification by means of vacuum tubes. The method of impedance coupling

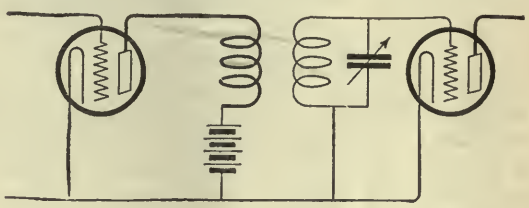


FIG. 28

shown in Fig. 26 is the one least used. The total voltage amplification attainable per stage (in Fig. 26 this would be the ratio of the alternating voltage on the grid of the second tube to the alternating voltage supplied to the grid of the first tube) cannot be greater than the voltage amplification constant of the tube, and in practice is usually considerably less. Hence to get good amplification by this method, special tubes having high values of μ must be used. The impedance indicated by

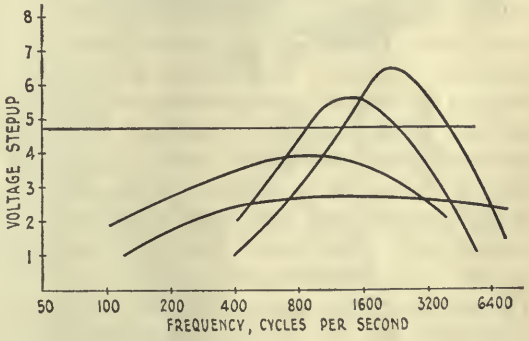


FIG. 29

the letter Z in Fig. 26 may be either a high resistance or a high reactance. The alternating grid potential applied to the first tube causes alternating current in the plate circuit. This alternating current traversing the impedance causes an amplified alternating potential difference between its terminals, and hence between grid and filament of the second tube. The coupling impedance should be several times as great as the plate impedance

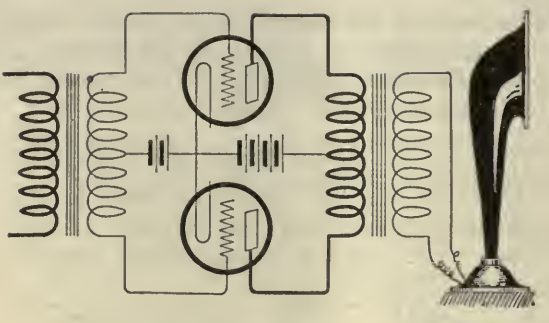


FIG. 30

of the tube in order to get good amplification and quality. A C-battery should be inserted in the wire from Z to the second grid to make the grid potential negative enough so that the addition of the alternating voltage never results in the grid attaining a positive value.

52. TRANSFORMER COUPLING

BY FAR the more common method of amplifying is shown in Figs. 27 and 28. Fig. 27 shows an iron cored transformer, designed to work over as large a range of frequencies and with as nearly equal efficiency, as possible. Fig. 28 shows a "tuned" transformer, designed to work only at the frequency to which it is tuned. In general, transformer coupling is different from impedance coupling in that the tube is not called upon to amplify voltage so much as to amplify power. The transformer receives the amplified power at a somewhat amplified voltage and delivers it to the grid of the next tube at a very much higher voltage. The increase of voltage is mostly effected by the transformer, while the amplification of the power is *entirely* due to the tube. If the greatest gain per stage is the only objective, the transformers should be designed for an "impedance match" with the tubes. To see what this means suppose that there were only one or two turns of wire on the primary. No matter how low the impedance of the primary, the current delivered to it will be limited to a small amount by the high plate impedance of the tube, which is in series with the primary. This small current will not deliver much power if it flows through only two or three turns. On the other hand if there are too many turns on the primary, the impedance will be so high that almost no current flows through it, and again there would be very little power delivered. In between these two extremes, there is a best number of turns and this is not far from the number of turns that makes the impedance of the primary (while the secondary is connected to the tube it feeds) equal to the plate impedance of the tube. A similar line of reasoning shows that there is also best value for the number of turns on the secondary.

53. AUDIO-FREQUENCY TRANSFORMERS

TRANSFORMERS designed to amplify speech or music should be made so as to amplify as nearly as possible equally all the frequencies into which the voice or music can be analyzed. As mentioned before, this means from about 30 to about 5000. It is difficult to make a transformer that will do this and at the same time give a very large voltage "step up." A compromise must be struck between good quality without much step up, and great amplification with distortion of the relative intensities of the different component frequencies. Fig. 29 shows the general nature of the performance of audio-frequency transformers.

54. OVERLOADING; PUSH-PULL AMPLIFICATION

TRANSFORMERS are not the only source of loss of quality in audio amplifiers. The effect of the curvature of the tube's characteristic is to introduce, for each frequency applied to the grid, a new current of twice the frequency. The relative strength of these double frequencies in the plate circuit must be kept small or the quality will suffer. With a given transformer in the plate circuit (or receiver if it is the last tube) about all that can be done for a given tube is to be sure that there is enough C battery to keep the grid negative (that is, the C battery should be as great as the maximum alternating voltage input to the grid) and then to use enough B battery to bring the operating point up onto the part of the characteristic that has the least curvature. Even after these precautions have

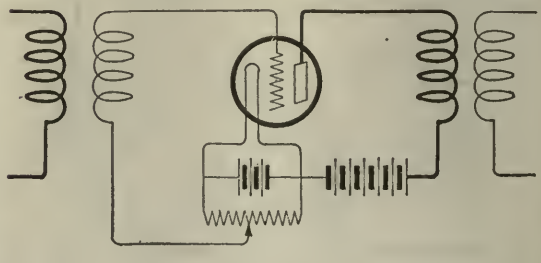


FIG. 31



CALL at your dealer's today and ask him to show you a Magnavox M4 Reproducer.

Try out the instrument critically; satisfy yourself that its clear tone and natural volume are sustained throughout the entire musical range; examine each essential detail of convenient size, handsome finish and sturdy construction; note that its operation requires no battery.

M4 is a definite contribution to the radio art—and one particularly welcome to the moderate income.

There is a Magnavox for every receiving set

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M4—requires no battery . $25.00
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R3—new model with Volume Control . . . $35.00
R2—same as R3 but larger size $50.00

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A1, AC-2-C, AC-3-C—Audio-frequency Amplifiers: one, two and three stage $27.50 to $60.00

To obtain the fullest enjoyment from your receiving set, equip it with the Magnavox.

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Oakland California
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M4
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★ Tested and approved by RADIO BROADCAST ★

been taken the tube can only handle a certain input before it begins to "overload." It should be obvious, but does not seem to be generally realized, that as each successive tube in an amplifier has to handle more current than its predecessor, the tubes in the last stages should be rated for greater power than the earlier ones. Of course the amplifier may be made up entirely of tubes, each of which is capable of working in the last stage, but this is often more expensive. The Western Electric Company makes an amplifier using what is called the "push-pull" circuit (which is simplified in Fig. 30) in which the double frequencies arising from the curvature of the characteristic cancel out in the differential transformer feeding the phones. Thus a far greater volume of sound may be obtained from small power tubes without loss of quality.

55. ADVANTAGES OF AMPLIFICATION AT RADIO-FREQUENCY

UNDER the heading, detection, it was shown that the detected current varies as the *square* of the radio-frequency voltage applied to the grid of the detector tube. For this reason it is very much more effective to amplify the radio-frequency voltage before applying it to the detector tube than to amplify the detected or audio-frequency current. For instance, suppose we propose to use a stage of amplification that will give tenfold gain. If the stage is used at audio frequency it merely increases the audio currents ten times. But if it is used to increase the strength of the radio-frequency voltage input to the detector tube, the audio-frequency current output of the detector will be one hundred times as great. Another important advantage of amplification at radio frequency is that the channel of radio frequencies that must be amplified is very narrow compared to the frequencies themselves, so that all the frequencies in the channel are equally well amplified and hence there is no chance of losing quality as is the case with audio transformers that do not amplify all the voice frequencies equally well. Finally, low-frequency noises originating in the tubes themselves on account of jarring etc., are not built up in the radio-frequency amplifier the way they are in an audio-frequency amplifier.

From the above, it is seen that radio-frequency amplification is not only desirable, but necessary for weak signals. But unfortunately, it is not easy to obtain.

56. DIFFERENCES IN AMPLIFYING OF RADIO FREQUENCIES

RESISTANCE coupling cannot be used at very high frequencies, for the low condensive reactances of the capacities which are inherent in the tubes themselves offer easier paths for the high-frequency alternating currents than the high plate circuit resistances, and hence the currents will not travel the proper paths and the amplification is spoiled. And if reactance coupling or transformer coupling be used, another difficulty arises. Under "Regeneration," we saw that when a circuit possessing a natural frequency is attached to the grid of a tube, oscillations will occur if there is enough inductance in the plate circuit. In a transformer-coupled amplifier the secondary winding, connected to the unavoidable capacity between grid and filament, constitutes a circuit of definite natural frequency, while the primary winding of the transformer feeding the next tube will often supply the necessary amount of inductance in the plate circuit. The amplifier then oscillates. Some device has to be employed to stop this oscillation. A method commonly used is called "potentiometer stabilization" and is shown in Fig. 31. By moving the sliding contact over to the positive end of the potentiometer, the grid of the tube is made positive and hence receives electrons. The energy abstracted from the oscillation circuit in pulling electrons to the grid may be enough to kill the oscillations. This is a very undesirable method because the deliberately introduced losses cut down the amplification.

WHAT the Radio Broadcast *Laboratory does and how it does it, will be the subject of an article in this magazine for September. Since its inception, a little less than a year ago, the Lab has made many contributions of great help to radio constructors and builders, and has received widespread approval.*



R E L

Ultradyne Kit

Consists of 1 type "A" Ultraformer, 3 type "B" Ultraformers, 1 Tuning Coil, 1 Oscillator Coil, 4 matched fixed Condensers.

The Ultraformers are improved long wave radio frequency transformers, specially designed by R. E. Lacault, Consulting engineer of this company and inventor of the Ultradyne.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. Ultraformers are guaranteed so long as this seal remains unbroken.

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—and the Ultradyne received it!

Faithful reproduction over great distances is no unusual performance for the Ultradyne Receiver.

The "Modulation System" of radio reception used exclusively in the Ultradyne, is a decided advance over the detector arrangement used in all other Super-Heterodynes. The "Modulation System" causes the incoming signal to modulate the oscillations produced locally just as the speech modulates the carrier wave of a broadcasting station.

This new principle, the latest development of R. E. Lacault, A. M. I. R. E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories, makes it possible to get far greater distance, because of its unusual ability to provide greater rectification. Weakest signals are made to operate the loud speaker.

You will never enjoy the full pleasure of radio until you operate an Ultradyne Receiver.

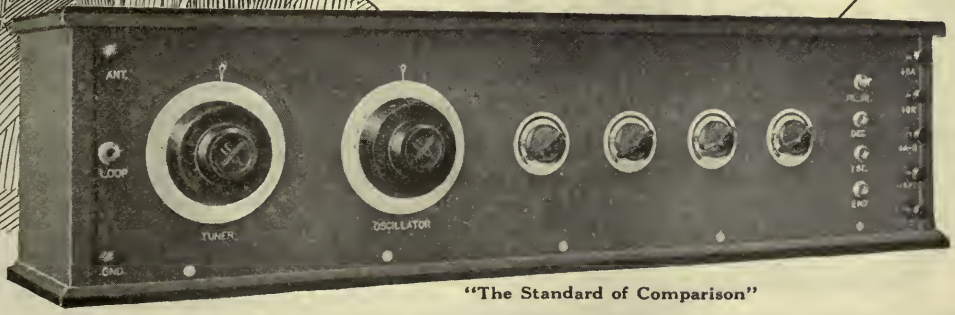
Write for descriptive circular

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★ *The Improved* SUPER-HETERODYNE

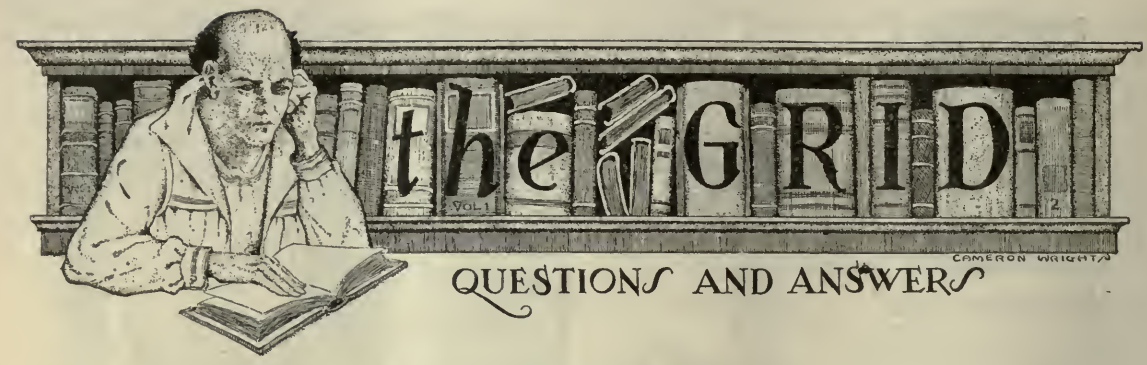
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QUESTIONS AND ANSWERS

QUERIES ANSWERED

WHAT IS A GOOD PUSH-PULL AMPLIFIER CIRCUIT? . . . . . *A. K. H.*, Ottawa, Canada
HOW CAN I MAKE MY DRY-CELL TUBE OSCILLATE? . . . . . *W. E. M.*, Baton Rouge, La.
WHAT IS THE CORRECT METHOD FOR CONNECTING AUDIO-FREQUENCY TRANSFORMERS? *H. J. S.*, Woodhaven, L. I.

A PUSH-PULL AMPLIFIER

IN Fig. 1 is shown a standard circuit for a push-pull amplifier. It has been found that the push-pull unit works better when the signal is first boosted by a stage of straight audio amplification before it. Several push-pull amplifying transformers are now on the market, but in case you have a supply of standard transformers they may be used as follows: For the input use two standard transformers connecting the primaries in parallel and the secondaries in series. The pair of transformers (in output or input side) should each be of the same turn ratio. In the output, the primaries are in series while the secondaries are in parallel. Notice the reversed tube connections of the lower tube. This will be evident when the filament sides of two sockets are placed together.

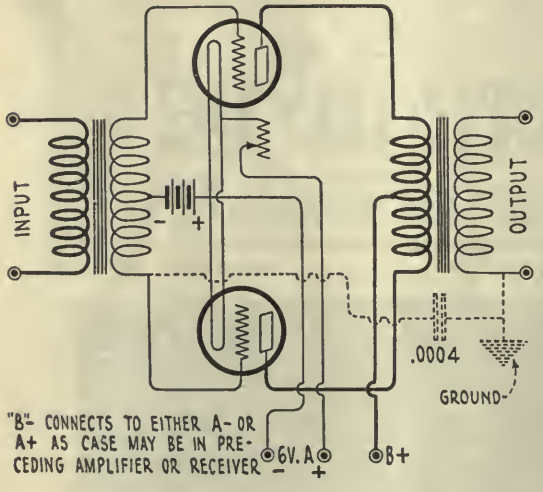


FIG. 1

DRY CELL TUBES AND OSCILLATION

IN SOME instances it has been found difficult to make dry cell tubes, especially the 1½-volt type, oscillate at various wavelengths. A remedy for this condition is easily provided by making the grid and plate connections of flexible insulated wire and twisting both together for 3 or 4 inches. This produces a small capacity effect which will tend to make the tube oscillate over a wide range of wavelengths. This wavelength range can be controlled by either increasing or decreasing the length of the twist.

The use of this system is not recommended for single-circuit receivers. It is especially useful for sets combining regeneration and radio-frequency amplification.

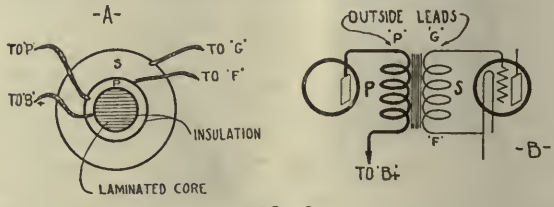


FIG. 2

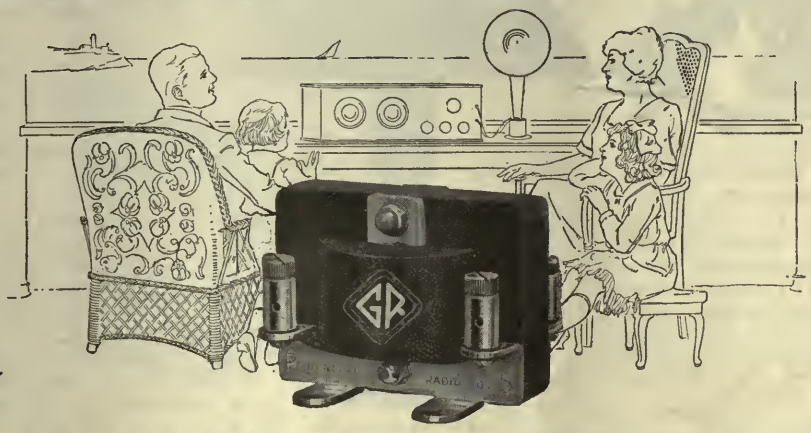
AUDIO-FREQUENCY TRANSFORMER TROUBLES

MANY are the troubles that have resulted from improperly connected primaries and secondaries of audio-frequency transformers. It has been computed that the average percentage of decrease in receiver efficiency for improperly connected transformers is about 70 per cent. In Fig. 2, A shows the side view of a standard transformer. The iron core is wrapped with insulation material upon which is wound the primary; then more insulation, and on top of this, the secondary is wound. The outside or top lead of the secondary coil should be connected to the grid of one tube while the outside of the primary is connected to the plate of the preceding tube. Most manufacturers mark the posts of their transformers so the user may avoid wrong connections. The remaining ends are connected as shown in B. Any alternating energy flowing through the primary must be transformed or induced into the secondary at its maximum efficiency for best results.

The purpose of the audio-frequency transformer is to provide voltage amplification. The high potential or high voltage end of each winding is at the top or outside leads. Therefore, if the connecting leads to either coil be reversed, the high potential which should be fed to the grid, will be passed to the filament side of the tube, resulting in a decrease in amplification.

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Consisting of a special Red Seal receiver attached to a heavy non-resonant metal base with diaphragm especially designed to operate the large air column of a reproducing horn. It is very sensitive to weak signals and reproduces with fidelity. Made by the Manhattan Electrical Supply Co., Inc., 17 Park Place, New York City. Price, $5



RADIOLAMP

A novel loud speaker which will add to the appearance of your radio corner. The loud speaker unit is located at the base. The signals travel up through the cast shaft and are reflected by the parchment shade. This gives a very mellow reproduction of the received sound. Made by the Radiolamp Mfg. Co., Newark, N. J. Price, $35



PYREX INSULATOR

An efficient antenna insulator of high mechanical strength. This insulator is reasonably light in weight and is impervious to weather. Made by the Corning Glass Works, Corning, New York. Price, 45 cents each



APCO BATTERY CHARGER

A newcomer among vibrating rectifiers and one which gives fine service. The noise from the vibrating arm has been pleasantly minimized. It maintains an even charging rate and its current consumption is not great. Made by the Apco Manufacturing Company, Providence, R. I.



SONORA LOUD SPEAKER

A neat appearing and well made instrument employing the wooden sound chamber which has been found so satisfactory in the phonograph. The tone quality and volume are very fine. Made by the Sonora Phonograph Co., 279 Broadway, New York



THE DERESNADYNE RECEIVER

Employing two stages of tuned radio-frequency amplification, detector, and two stages of audio-frequency amplification. Designed for broadcast reception, this receiver will give good loud speaker volume over fairly long distances. Made by Andrews Radio Company, 506 Webster Bldg., Chicago, Ill.

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



Eveready "B" Battery No. 772 for detector and amplifier. Connections at 22½ and 45 volts. Three Fahnestock Clips. Approximate over-all dimensions, 8¼ in. x 3¼ in. x 7¾ in.

Sustained power!

WHERE table or cabinet space is limited, use this *new* vertical 45-volt Eveready "B" Battery No. 772. It has the same long life, the same steady high power as the horizontal Eveready 45-volt "B" Battery, but because it stands upright it takes less than half the table space.

Tables and most battery cabinets have more headroom than floor space. This battery is built in recognition of that fact. It fits the Radiola Super-Heterodyne cabinet perfectly.

Many multi-tube receiving sets use a "hard" detector tube which does not require fine adjustment of "B" voltage, so the new Eveready Vertical 45-volt "B" has but three plainly marked terminals, negative, plus 22½ and plus 45 volts.

Standing upright to save space, made of large, powerful cells to last longer, here is the battery you've been looking for.

Manufactured and guaranteed by

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Headquarters for Radio Battery Information

Canadian National Carbon Co., Limited, Toronto, Ontario

If you have any battery problem, write G. C. Furness, Manager, Radio Division, National Carbon Co., Inc., 126 Thompson Ave., Long Island City, N. Y.

★ **EVEREADY**
Radio Batteries
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No. 764 The Space Saver. Vertical 22½-volt "B" Battery



No. 7111 Eveready Radio "A" Dry Cell. Specially manufactured for use with dry cell tubes

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Among Our Authors

ZEH BOUCK, who is one the most active radio writers we know, turns this month from writing about broadcast apparatus to describing an excellent amateur receiver. And he is well qualified to do it, since he is at once an ardent broadcast listener and deep-dyed amateur. His amateur radio telegraph station, 2 PI, is well known throughout the second radio district. Just now the active Mr. Bouck is weighing methods on how to take his vacation in Europe and get back in three weeks without resorting to an airplane.

JAMES C. YOUNG is a newspaper writer whose home is in New York City. "It was a cold, thick day when we went out to see those gently tossing ships, that were waiting for the business which came," he says. It is good to think in these humid days that it wasn't so long ago that people were wearing overcoats.

WILLIAM P. GREEN, through the associations of his daily business has been in close touch with the devious ways of some advertisers in that vast field. For the last six years, it has been his duty, as associate director of the

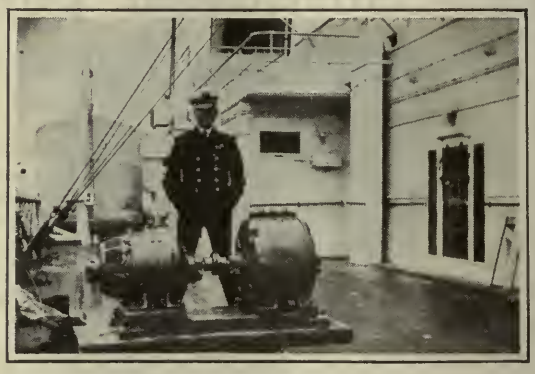


WILLIAM P. GREEN

Associated Advertising Clubs of the World to investigate methods and results. In this interesting and authoritative article, "The Way of the Transgressor," he discloses some of the malpractises which have had an unfortunate effect on other industries and may discredit radio if allowed to go unchecked.

J. E. ROBERTS is one of the most active and interested of the many broadcast listeners in Cleveland, Ohio. The adaptation he describes of the Roberts Knock-Out receiver came as a result of the great success he had with the first model of that receiver which he built from Mr. Walter Van B. Roberts' article in RADIO BROADCAST for April.

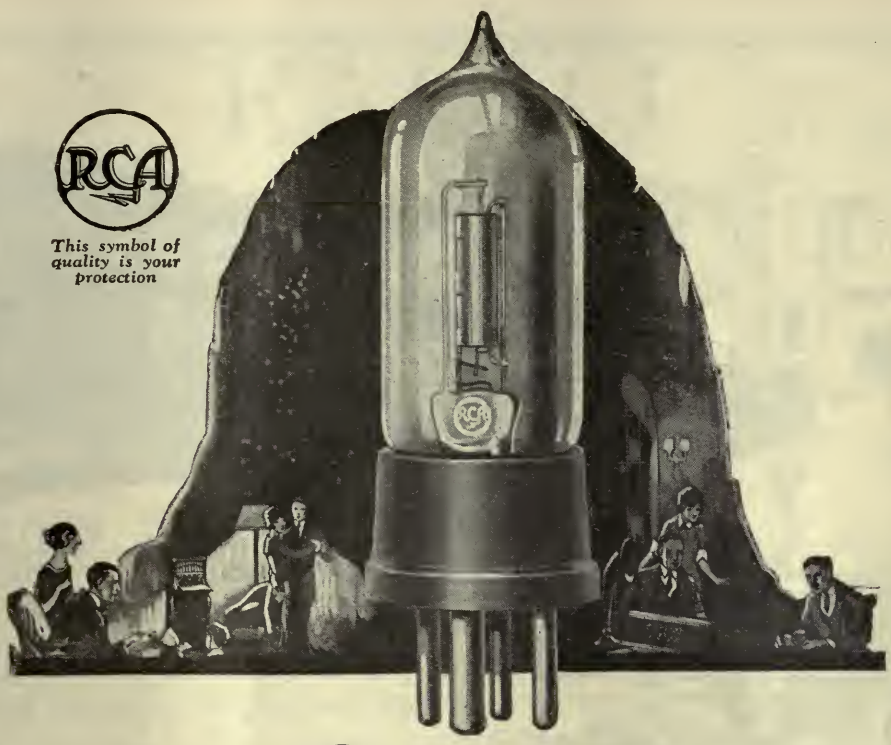
JACK IRWIN whose absorbing story of the unsuccessful voyage of the *America* appears in this number, was born in Australia and educated at King's School, Melbourne. His first experience with a telegraph key was on the overland circuit connecting the cable landing at Java with the northwest of Australia. He served with the Australian troops in the Boer War as signaller,



JACK IRWIN

and later came to the United States with the Commercial Cable Company. He joined the Marconi company as operator in 1906 and has been active in radio ever since. The accompanying photograph shows Mr. Irwin on the SS *Leviathan* standing behind one of the motor generator sets which he installed on that vessel. Mr. Irwin was assigned as one of the six operators on the *Leviathan* when she became the property of the Shipping Board. He is now shooting across the country as pilot of RADIO BROADCAST'S COVERED WAGON.

J. E. DREYER, JR., is an instructor in the department of electrical engineering Stevens Institute of Technology, at Hoboken, New Jersey. He has assisted Professor L. A. Hazeltine, of that same institution, in development and testing work with the neutrodyne set.



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THE START OF A GREAT RADIO ADVENTURE

Captain Jack Irwin and the RADIO BROADCAST COVERED WAGON *at the entrance of the Country Life Press, Garden City, New York, where* RADIO BROADCAST *is published. Captain Irwin is standing near the steps to the wagon, Arthur H. Lynch, editor, is inside the wagon, tuning the eight-tube super-heterodyne, which is one of the five receivers developed in the laboratories of this magazine which will be carried on the trans-continental trip of the travelling laboratory*

RADIO BROADCAST

Vol. 5, No. 5 September, 1924

Making Permanent Records of Radio Programs

How a Thin Iron Wire and the Force of Magnetism is Being Used to Record the Famous Bits of Radio Programs with the Very Shading of the Speaker's Voice

BY I. R. LOUNSBERRY

THE crowd is yelling—the excitement is intense, and our favorite, J. Andrew White, says clearly: "Third round—now the men have left the corner—they are in the center of the ring—Berlenbach looks for an opening—Abbot is backing up from Berlenbach—this powerful man crouches low—Berlenbach has just received three, four, five to the body and he hooks to Abbot's jaw—three, four, five, six, seven—Abbot is taking the count—eight, nine—he's up—Abbot is up—" And the fight goes on with the frenzied fans at the ringside yelling away and the radio audience listening with a thrill to every word of the announcer.

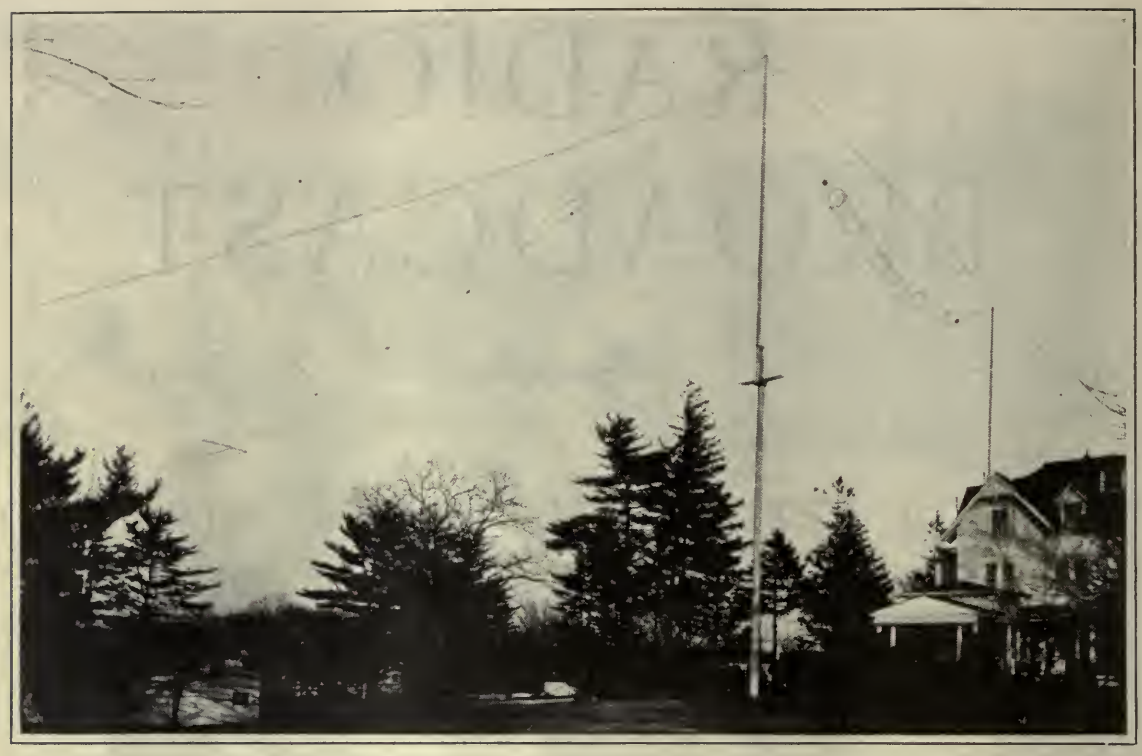
But—the time of this is eight A. M., August second, and that fight occurred at night, April twenty-ninth. How is this? And in a similar way to-day, or a hundred years hence we may hear the radio announcer say, "The next voice you will hear will be that of the President of the United States, Calvin Coolidge, speaking from the White House, Washington, D. C." The answer is the "phonowire," the latest addition to the art of radio broadcasting.

The "phonowire" as we call it, is an application through considerable circuit development work of an old system of stenographic-dictation machine made by the American Telegraphone Company. This new system has been developed by the W. R. Seigle Laboratories at Mamaroneck, New York, and is the work of Mr. W. R. Seigle, director of the laboratories, and of the writer. This process of magnetic recording

The Voices of Great Men May Live After Them

A radio program is here this minute and gone the next, "followed by the next number in to-night's entertainment." Many thoughtful persons have deplored the ephemeral quality of some of the notable speeches which have been broadcast and wished that there were some practical way to preserve them. A written speech preserved in type is a cold thing at best, but with the Phonowire, an adaptation of the invention of Valdemar Poulsen, it is possible to record any notable radio event and retransmit it at a later time.

There are other methods of recording, such as Mr. C. A. Hoxie's Pallophotophone, but the method Mr. Lounsberry describes is very simple and quite effective.—THE EDITOR.



THE LABORATORY AT MAMARONECK, NEW YORK

Where development work is being done on the Phonowire, which magnetically preserves voice or music of a radio program and by a reversal of the recording process can retransmit the "record"

was originally the work of Valdemar Poulsen, that famous Danish inventor, who first accomplished a record on a steel disc. This later took the form of a fine steel wire. It is the application of this original method to the radio and other modern devices which has held our attention for a long time.

HOW THE PHONOWIRE WORKS

THE recording unit consists essentially of a long steel wire one-hundredth of an inch in diameter which is wound on spools and driven from one spool to another by an electric motor. As the wire is wound from spool to spool it is passed through a magnetic field which is varied in density at audio-frequencies corresponding to music, voice, and so forth, as accomplished by the radio receiving unit. This varying field magnetizes the wire in spots and as the wire is of steel, the record is made permanent and will last indefinitely. Although the wire is wound in layers on the spools, the proximity of one section to another does not affect the magnetism in either section. An interesting feature of this device is that, unlike the phonograph or phonofilms, visibly there is no change in the wire. The wire keeps its own weight, size, shape, appearance, and physical strength and what happens is within the wire in the form of magnetic "lining up" of the molecules.

After the record is made, the wire is again passed through a magnetic field at the same speed and direction. This magnetic field this time is affected by the permanent magnetism of the steel wire and electric energy is created that corresponds to the signal previously recorded. The output of this field is applied to the audio amplifiers and a duplicate of the program is heard as loud as desired and as clearly. In this system there is the advantage of being free from mechanical or other noises as in the phonograph. A program recorded without interference, when reproduced gives out all of the familiar tones and characteristic styles of the announcers.

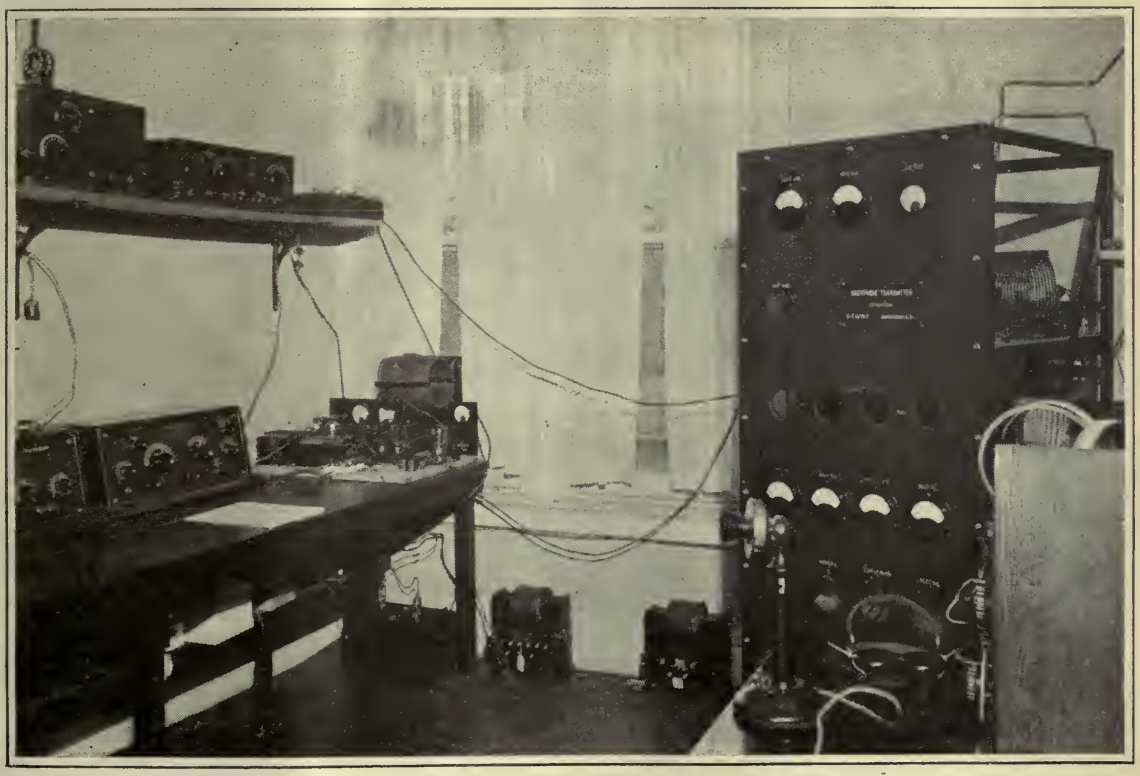
In making radio programs, the amplifier-control panel which we have developed, and the recording unit are connected to a receiving unit. In our experimental work, an ordinary

tuning circuit with detector was used, the output of which was applied to the amplifiers and then into the recording unit. For ease of control and simplicity of circuits, we found it best to use a three-stage power amplifier circuit with Western Electric type 216-A tubes and specially designed transformers.

PRESERVED PROGRAMS

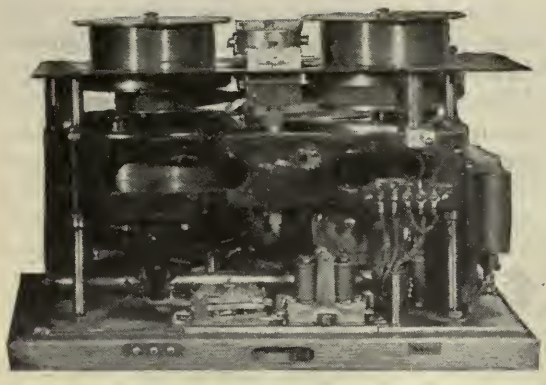
THE recording unit requires very little energy to make a record and in the case of local stations the volume was cut down in the tuning circuit to that required for the recording. This method was found to be more desirable than putting in jacks and plugging in less amplification for these powerful signals. When long-distance signals were recorded the tuning unit was worked to its full extent. It was often found that in recording from extreme long distances where the signal just came to audibility that the reproduction from the steel wire was much louder than could be accomplished in the radio reception itself and thus the device could be used as a booster of signals. It can readily be seen that a device of this kind would be of great value in long-distance radio telephone work in verifying reception and giving a means of checking some part of the conversation that was questionable due to some unlooked-for interference in the receiving room or otherwise. The control panel permits listening to a radio program while the record is being made, as the loud speaker can be cut in on the output side of the amplifier in shunt with a properly designed transformer that couples the amplifier to the magnetic field of the recorder.

Reproduction of a program is accomplished by applying the energy generated by the magnetized wire to the input of the three-stage amplifier. This is accomplished through a simple switching system which throws the transformer, that was used to couple the output of the amplifiers as the time records are made, to the input transformer of the amplifiers. It can therefore be seen that a minimum of apparatus is used considering the different operations of recording and reproducing. The same amplifier tube circuits are used for both



THE EXPERIMENTAL TRANSMITTER

At the Seigle laboratories. Reproductions of the recorded radio programs are frequently sent out on this amateur broadcasting station, of 200 watts power, known "on the air" as 2 BOH



THE RECORDING UNIT

The received audio-frequency energy is fed to this device where it is recorded directly on the thin iron wire shown wound on the spools at left and right. Three and one half miles of wire can be wound on them, which will record a radio program thirty-five minutes long

duties and also the same coupling transformer. The loud speaker can be used when a record is made and during reproduction of a program.

The amplifier-control panel is also designed so that it is capable of running the recording unit. The panel has three buttons which when pressed operate relays in the recording unit. The machine can be made to run in a forward direction for recording or reproducing. It can be stopped by pressing a button or it can be run backward so that it rewinds the recorded program and places it in a position again to be run forward for reproducing. In order to save time, the wire when being run backwards travels at twice the recording speed. The record can be listened to while it is running backwards at this high speed and some very amusing results are obtained. In some instances we have found that musical programs running backwards actually give out pleasing harmony.

SECRET BROADCASTING POSSIBILITIES

THE possibilities of secret radio telephone transmission also come within the scope of this device as it would be a simple matter to transmit a voice record backward and at a different speed than when recorded. Then at the receiving end, make a record with a machine running in the same direction and speed as the transmitter and when reproducing regulate these points so that they again correspond to the recording condition. Any one desiring to "tap in" on such radio transmission would have to develop similar machines and synchronize them completely.



WGY COMING IN OVER THE LOUD SPEAKER

W. R. Seigle, owner of the laboratories, where development work is now being done with the Phonowire, is standing with the microphone, and I. R. Lounsberry, in charge of the laboratory, is at the left. The recording device is at the right, the amplifiers in the large center cabinet, and the radio receiving apparatus at the extreme left



TALKING THINGS OVER
J. J. MacDonald, a laboratory assistant, W. R. Seigle, owner of the laboratory, and I. R. Lounsberry, author of this article

This would indeed be a difficult bit of work and it would, of course, always be possible for those transmitting such signals to change the speeds of their machines from time to time. To the human ear this kind of transmission would be absolutely unintelligible.

In addition to the recording of radio programs, the amplifier-control panel is equipped with a microphone circuit which will allow the making of records of the operator's voice. In this way records may be dated, weather conditions and other things of interest regarding a program may be noted. The instrument as a whole could therefore be used to considerable advantage in checking long test programs of broadcast transmitters. Later one could correctly ascertain what the adjustments on the transmitter accomplished. Such listening tests could be run off at a time when the broadcasting transmitters are not allowed to test and in this way considerable valuable time would be saved and less congestion of the ether result.

The spools which hold the wire are capable of taking three and a half miles of wire and this amount run in a forward direction will permit a thirty-five-minute continuous record. This long record makes it an admirable device for recording public speeches.

THE PHONOWIRE RECORDS IMPORTANT ADDRESSES

WE have had excellent results in making records of President Coolidge which were broadcast from the White House through station WEAF. After the novelty of a certain type of record, such as the substance of a speech, a musical selection or a prize fight, becomes of no further interest, the wire can be cleaned or magnetically erased. This is accomplished by simply pulling a snap switch which is located on the amplifier-control panel and allowing the wire to run either forward or backward. It is also possible, in order to save the time of running the machine for erasing purposes alone, to erase at the same time a record is being made. This results, however, in a slightly inferior record. When a record is erased the wire is passed through a magnetic field of unvarying density and the previous magnetic charge is broken up, making the

wire once more in a condition to have a record accomplished. This recording and erasing has no affect on the physical strength of the steel wire and it will last indefinitely. This is quite an advantage over the cylinder form of phonograph record where part of the wax is shaved off for erasing. This permanency offsets the original cost of the wire which comes in the neighborhood of twenty dollars for spools and wire.

In our experimenting we have often logged a number of different programs from long-distance stations on the phonowire. It is possible by means of an indicator, which is also incorporated in the amplifier-control panel, to make notes of what stations and nature of programs are recorded on the different portions of the three and a half miles of wire. For instance, the indicator reads from zero to one hundred and WGY orchestra may be recorded from zero to fifteen, WTAM with jazz music from fifteen to thirty, WEAF with a talk by some eminent person thirty to fifty and so forth. While the record is being made, these positions may be noted by pencil and then later the operator will know just where to run his wire to get the type of program he desires. This indicator works in synchronism with the spools on the recording unit and will also work backwards when the wire is being rewound.

PRACTICAL APPLICATIONS

THE long-record feature together with the fact that this device works on the magnetic principle, places it within the range of a number of practical applications. It could be used to great advantage in educational institutions where the assembly halls of schools were equipped with the amplifier-control panel and recording unit. Speeches, music, lectures, all sorts of programs of educational value can be reproduced by this method right in the class room. These lectures and educational features could be sent in the mail and rotate around to the different schools. This lecture feature could easily be worked in conjunction with illustrated lectures where stereopticon slides were used. It would place the prominent lecturers in touch with a much larger field and at the same time mean a considerable saving of time and traveling expense. This method has already been used in medical work where permanent records of cardiac and respiratory sounds have been made and reproduced. In this work a sensitive microphone together with a stethoscope is used for picking up these sounds and then the "signal" is put through the amplifier-control unit and recorded in the same way as described for radio recording, and, of course, the record once made would be reproduced in the standard method. Heart and lung sounds have actually been recorded and reproduced so as to fill a large room with their sounds. By means of pick-up systems similar to broadcasting transmitters, records of public lectures, music, court proceedings, and so forth could be recorded and used at will. In our laboratory we have retransmitted radio programs using the phonowire coupled to our transmitting equipment. Thus the device could be used to help the broadcasting station that is located where radio talent is limited by mailing programs taken near some large city with its abundance of excellent talent and then retransmitting the program.

A PORTABLE SUPER-HETERODYNE

COMPLETE description and data for building a portable super-heterodyne using seven UV-199's will appear in an early number of RADIO BROADCAST. *This receiver is highly compact, using standard and available parts, and can easily be built by the average radio constructor. It is an extraordinarily good receiver. Articles on the super-heterodyne have been printed in this magazine since February, 1924. This is absolutely the first workable portable super-heterodyne described in any magazine.*

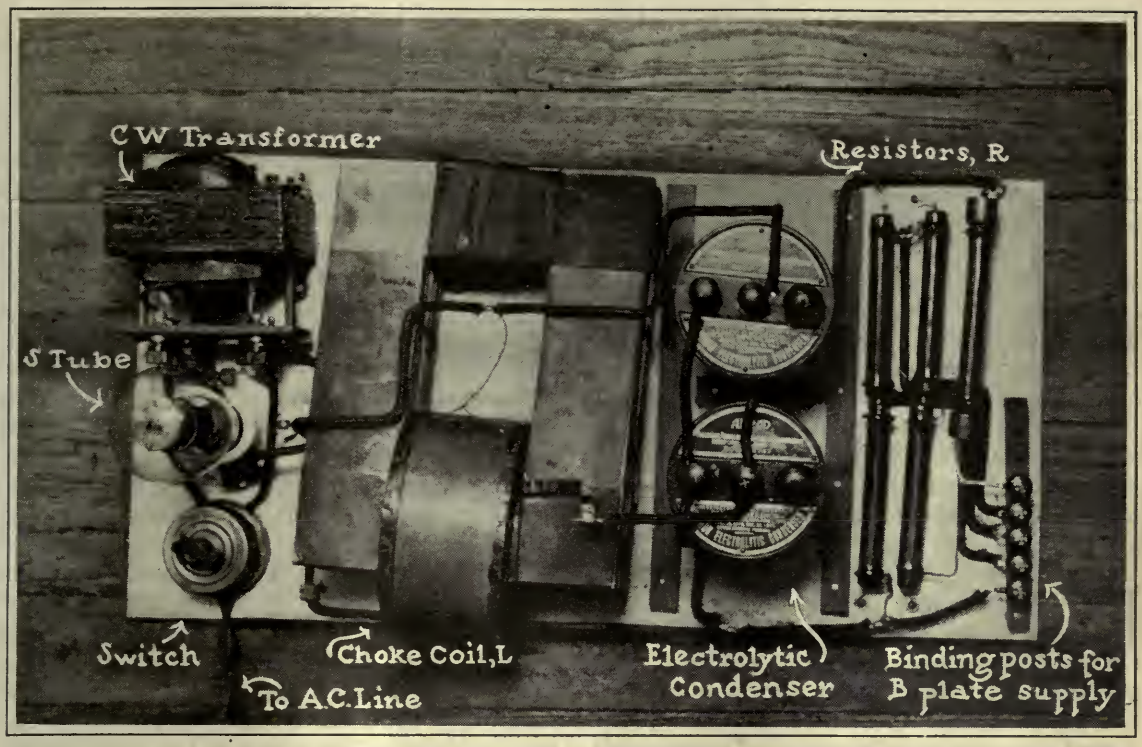


FIG. 1

The experimental layout of the B battery substitute. In most cases, the large choke coil can be eliminated

A B-Battery from Your Lamp Socket

How to Build a Simple Rectifying Circuit Giving Absolutely Pure Direct Current from an Alternating Current Source at a Cost not to Exceed $35—For any Number of Tubes and any Type of Receiver

By C. J. LEBEL

THE radio tendency of late has been toward larger and larger sets. A few years ago the average set used one or two vacuum tubes, and the plate current never exceeded two or three milliamperes. To-day, we have five tube neutrodynes, eight tube super-heterodynes, nine tube super-pliodynes, and power amplifiers of all sizes. The average radio outfit of to-day may consume as much as forty milliamperes. Under such conditions the life of a dry cell B battery decreases enormously. As a result, the purchase of storage B batteries and a special rectifier-charger is often resorted to. This is a rather expensive practice. There is also the inconvenience of frequent charging, and worst of all, some fifty or sixty storage cells to water carefully. The demand for a device to replace B batteries has steadily increased, hand in hand with the increase in the size of sets. Why rectify the current, charge a battery, and then draw current from the battery? This is a highly inefficient practise. It is far better to use the rectified current directly and eliminate losses necessarily associated with the battery. The outfit to be described will supply plate current for as many tubes as the average listener will ever use at once.

No hum can be heard in the phones or loud speaker.

The plate current supply outfit consists of few parts, and is easy to assemble. However, it would be well to group these parts, and explain their functions so that the reader may thoroughly understand the principles of rectification and filtering.

First there is the transformer (T in the circuit diagram). Inasmuch as the average house current is supplied at 110 volts, A. C., it is necessary to step it up somewhat. This the transformer does. The theory of the transformer is too well known to need explanation. It suffices to say that the output is at a pressure of 500 volts. If this A. C. were to be sent directly to the set, the only result would be a terrific hum, and the set would not operate.

HOW THIS ARRANGEMENT WORKS

HOWEVER, the alternating current is passed through a rectifier (S) which changes it to a pulsating direct current. The average reader is probably not familiar with the action of the rectifier employed by the author—the Amrad "S" tube. The principle of operation is quite new. The shape of the two electrodes (anode and cathode) is such that the helium gas in the tube can ionize only when the current tends to flow in one given direction. As the tube can conduct only when the gas is ionized, rectification results. The reader who wishes to learn more about this most interesting tube is referred to an article on it in the August, 1922, issue of the magazine, *Q S T*. The Proceedings of the Institute of Radio Engineers for February, 1922, may also be consulted.

The pulsating direct current, however, is almost as undesirable as the A. C. (though it resembles more closely the steady direct current delivered by a battery), so it is sent through a unit known in electrical parlance as a filter. The final output is a pure, smooth direct current, at a pressure of 350 volts. The condensers (C) are, likewise, a departure from the conventional types. They are of the Mershon electrolytic type, also an Amrad product, and have a capacity of about 30 microfarads. As every fan knows, the thinner the insulating material between the plates of a condenser, the greater is its capacity. Why not use a dielectric a few thousandths of an inch thick? Ordinarily, mechanical difficulties interfere. Howard Mershon solved the problem by using an aluminum sheet, covered with an oxide layer, as one plate, the oxide covering as the dielectric, and a liquid in which the aluminum is immersed as the other plate. The nickelled container is the means of connecting to the liquid.

In order that the current may be supplied at any potential from 0 to 350 volts a drop wire (D) is used. This drop wire is the same in principle as the potentiometer, which is a well-known piece of apparatus. Instead of a moving contact, however, a fixed resistance is employed, divided into sections so that the voltage drop across any amount of resistance may be selected.

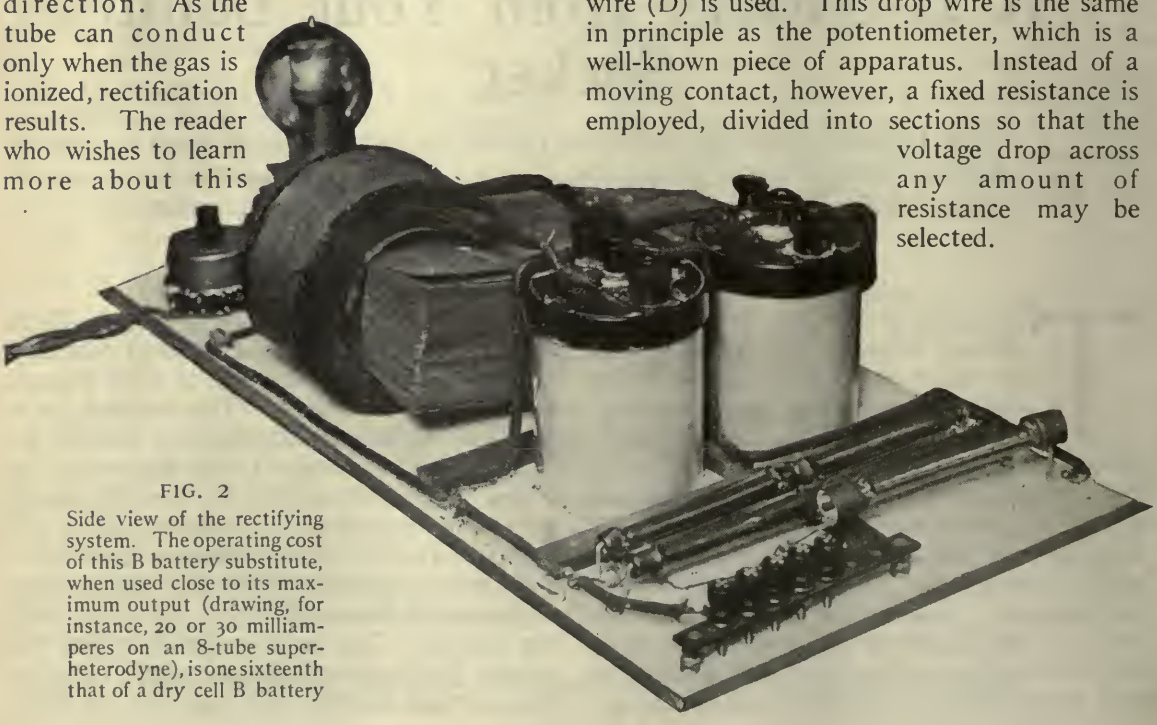


FIG. 2

Side view of the rectifying system. The operating cost of this B battery substitute, when used close to its maximum output (drawing, for instance, 20 or 30 milliamperes on an 8-tube superheterodyne), is one sixteenth that of a dry cell B battery

VALUES OF THE PARTS

THE transformer (T) has an output rating of 500 volts, 100 milliamperes. Its construction is so difficult that the man without adequate facilities, the average fan, is advised to buy a 75 or 100 watt C. W. transformer. The expense is not great.

The inductance L has a value of 30 henries. Here, again, the construction is somewhat difficult, and it would be well to purchase it. Under some conditions it is possible to omit the inductance (L) from the circuit without decreasing the effectiveness of the filter to a perceptible degree.

For the sake of the technical man who has the facilities to construct it, the specifications of the choke coil, L, are as follows:

CORE

Cross section 2" x 2"
Long core piece 2" x 5.5"
Short core piece 2" x .95"
Wt. 14 lbs.
Material 14 mil, or thinner silicon steel
Air gap $\frac{7}{64}$"
All butt joints

WINDING

No. 30 enamelled wire
Wt. 1 lb. 6 oz.
4100 turns
B 18,000 lines to the sq. in.
Permissible continuous overload, 10 per cent.—for short time, 25 per cent.

It is by far the best practice to use an Amrad S tube as a rectifier. Having no filament, it cannot burn out, and the wiring is very simple. The ordinary porcelain incandescent lamp receptacle is used as the socket. Under special conditions it may be necessary to use another type of rectifier. In such a case, a 20 watt kenetron, type UV-216, may be used. The filament winding on the transformer should be of the value of 7.35 volts. The number of turns must be determined experimentally, though it probably will be about 25. The outfit will work as well in either case, inconvenience and limited life being the only objectionable features of the kenetron.

The potentiometer must be capable of carrying 50 milliamperes continuously. The neatest way to build it is to order a 20,000 ohm type C Ward-Leonard resistor, tapped at 1000, 1400, 3000, 6000, 15,000, 20,000 ohms. This will give plate voltages from 20 to 350 volts, in small steps.

The next neatest, but equally efficient method, is to assemble it from standard Ward-Leonard or any of several makes of lavite resistance units. The cheapest method is to use a carbon rod with movable wire loops for connection. The fan who would like to try such a method should write Joseph Dixon & Co., the graphite manufacturers located in Jersey City, for information.

When buying these parts do not go to a "gyp" radio shop. They are never carried there. A shop run by an amateur, or an old firm which has handled radio apparatus for some time will carry them in stock, or can get them very promptly. So, if you are told by the proprietor of a radio store, as I was told by one, that he never heard of such apparatus before, set him down as one who is a salesman, not a radio man, and patronize more reliable stores thereafter.

Having gathered the parts, hook them up as shown in the diagram. Unlike most radio

Simplifying Radio

The need for replacing B batteries often diverts the attention of the experimenter with a laboratory full of receiving sets with varying numbers of tubes—and very often decidedly limits his field of experiment. There is an undoubted need for a simple and not too-expensive device to rectify and smooth alternating current from the usual household 110-volt lines so that it will be suitable for use as a plate supply. This supply must be free from "hum" or "ripple," as well as constant in voltage, dependable, and cheap. This arrangement described by Mr. LeBel meets all these requirements. It can be used as a 350 volt supply for one or two five-watt transmitter tubes as well.—THE EDITOR.

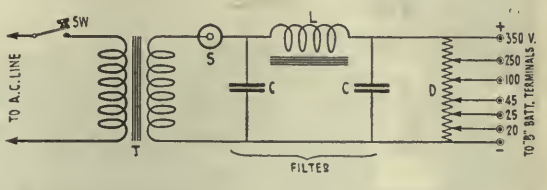


FIG. 3

The circuit for connecting the rectifying arrangement using the S tube. The choke coil L can be made by the constructor with the facilities according to specifications in the accompanying article

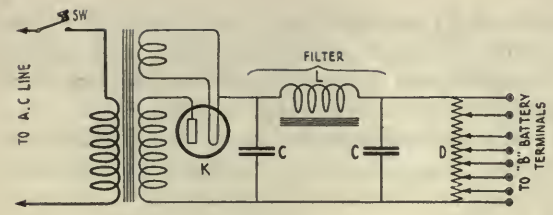


FIG. 4

The circuit of Fig. 3 altered for the kenetron tube as rectifier. The values of the parts remain substantially the same. Note the extreme simplicity of both arrangements

hookups, this is simple. Be sure to fasten the 350 and 500 volt wires firmly. One suggested design is shown. The only necessary thing is to keep the transformer and choke coils at right angles. No other special precautions need be observed.

This outfit is as near fool-proof as anything made by human hands can be. If the outfit fails to operate, look first for poor connections to the coils. If this produce no result, test for open circuits. Next, test the resistances for "opens" or short circuits. As a last resort, replace the S tube by another, to see if the first is defective. For the first hour or so of operation of the condensers they will have to "form," and as a result both condensers and transformer will probably run hot. After that period, however, they will cool off, and stay formed indefinitely.

In conclusion, I should like to emphasize the versatility of this plate supply outfit. It will supply any voltage up to 350, and any reasonable current. This means that the number of sets that a fan owns is limited by his pocketbook, and the room available, not by how long his B batteries will last. To the man who has learned the code, and has a small transmitter, I should say that this outfit, minus the drop wire, will supply one or two five-watt "bottles." The C. W. produced will be so pure that interference with the neighboring receiving sets will be nil. So the man who builds this apparatus will find that his time was spent in the best possible way.



HOW A CONNECTICUT RADIO SHOP COÖPERATES WITH LOCAL RADIO AMATEURS

The Lyford Company, Torrington, Connecticut, owners of this shop, recently conducted a prize contest for the best home made receivers

Radio—A New Field for Investment

An Analysis of the Industry and Three Companies Whose Shares Are in the Public Eye

By JOHN MORROW

THE radio industry in the United States is still young enough, still so exuberant as to make a few statistics of its growth interesting rather than wearisome. According to Vice President Sarnoff of the Radio Corporation, the public will be spending $500,000,000 a year on radio within a few years. It is estimated that $150,000,000 was so spent in 1923.

Just a few years ago it was predicted that the growth of the wireless industry would be slow, because it was thought then that progress depended upon the development of wireless for commercial messages, mainly transoceanic. Then came broadcasting, and with it the revolutionizing of the industry. At the present time there are about 600 broadcasting stations in the United States, of which about 10 per cent. are important. The number of radio sets is estimated at 2,500,000, which means a daily radio audience of perhaps 10,000,000 persons.

Within five years it is estimated that these audiences will increase fivefold. At first it was predicted that radio was going to be a craze—that it would soon die out, amount to little. Now the same prophets realize that the industry is more or less a serious competitor of the phonograph business and the moving pictures. Naturally in a new industry where there is so much experimentation to be done; where fresh discoveries are made almost by the minute, there is bound to be constant change and what may be regarded as instability; but it is the instability of growing pains.

From a corporate standpoint there are not many soundly established companies that depend for all their revenues upon the radio. The big manufacturers of electrical equipment were quick to see the possibilities in the manufacture of wireless sets and parts and became interested in what is now the Radio Corporation of America, and recognized as the leading company of its kind. Two other smaller corporations which recently have come into prominence, and which are attracting quite a little speculative attention, are the Hazeltine Corporation and Dubilier Condenser. These companies are purely manufacturing concerns, are new, but progressing along proper lines. In a pioneer industry it is, of course, not possible to have an opinion on stocks representing that industry backed up by a mass of statistical and historical data, but the radio business has grown so fast that public participation in those radio stocks which are upon the open market is increasing to substantial proportions, mainly because of the known facts of the developments in the industry as a whole. Therefore, an attempt to line up and to individualize the best known companies appears of pertinent interest.

RADIO CORPORATION OF AMERICA

WHEN the Radio Corporation of America was incorporated in October, 1919, practically all of the assets of the Marconi Wireless Telegraph Company of America were purchased, and the latter company dissolved. At that time, while the War had given a great impetus to wireless communications, operations were confined to interchange of messages largely between ships and shore, and even the interchange of commercial messages was small.

As late as 1921, the gross income of the Radio Corporation was five million dollars. In 1923, the gross income was more than twenty-six million dollars, and of this total more than twenty-two millions came from the sales of radio apparatus. It is obvious that the whole nature of the business of the Radio Corporation has been revolutionized in the last three years. The company operates nine international radio communication circuits with the leading European countries, and with Japan. The rates of transatlantic commercial messages are on even terms with cable rates, but on the Pacific Coast the wireless rates are somewhat lower than those of the cables. It is expected that China will soon be added to the list of international communication circuits.

Another branch of the business is radio service between ships and shore and the sale and rental of radio equipment for use on ships of American registry. However, to show what a

small proportion of the total revenue is derived from this department, may be cited the fact that the gross total for 1923 was less than one million dollars.

Early in 1924, the Radio Corporation put a complete new line of receiving sets on the market with prices ranging from $30 to $425. Without going into technicalities, it may be said that the prime object of the apparatus is to eliminate the increasing amount of interference in the ether and to simplify operation so that the novice can enjoy broadcasting entertainment, which is fast becoming a feature in American homes.

There is, of course, considerable expense incidental to the maintenance of the large broadcasting stations such as the Radio Corporation operates, but the company feels that these activities are justified because they are really essential to the development of sales of radio apparatus.

When the Radio Corporation of America was organized, the General Electric was prominent in the organization and really was one of the prime movers. A year ago, the General Electric was the largest individual stockholder, holding almost two million shares of common and six hundred and twenty thousand shares of preferred. The Westinghouse Electric was the next largest shareholder; followed by the American Telephone & Telegraph and United Fruit Companies. During 1923, it was understood that both the General Electric and the United Fruit sold some of their holdings, while the American Telephone & Telegraph liquidated its entire shares. A majority of the outstanding stock is not held by the big electrical equipment manufacturers, but naturally they exercise a considerable influence.

Is There Any Money In It?

When wireless first dawned on an unbelieving public back in the early years of the present century, many were the stocks sold in many companies which made claims which, in those days, were to say the least extraordinary. And many were those who fell by the financial wayside. The public thought that the great claims made for this marvellous new science were going to come true and their dreams of untold wealth would materialize. They didn't. Then came the skeptics who were sure no one could make any money out of radio investments. Very little stock was sold—generally speaking—between 1912 and 1921. But when broadcasting came into being, the story was different. Mr. Morrow reviews the present investment situation quite ably, we think. He does not attempt to cover the field completely, but he analyzes the three concerns receiving the chief present attention.—The Editor

CAPITALIZATION AND EARNINGS OF THE R. C. A.

THE capitalization of the Radio Corporation of America has been unwieldy. There are outstanding almost four million shares of preferred stock of par value of $5, and nearly six million shares of common stock having no par. At no time has there been a funded debt. Early in May of this year, stockholders approved a recapitalization plan. By this plan the preferred stock will have a par value of fifty dollars, and will be exchangeable on the basis of ten old shares for one new and the old common stock will be exchanged on the basis of five shares for one share of the new "A" common. When this change is complete it is believed that application will be made to list both classes of stock upon the New York Stock Exchange. The market to date has been upon the New York Curb.

At the time stockholders approved the capitalization plan, J. G. Harbord, President of the company and who incidentally was a Major General with the American Expeditionary Force in France during the War, said the outlook for 1924 was very encouraging. Business to-day is ahead of last year with production still behind orders on the books. There is as yet no basis for determining what is a profitable margin of operations, that is, normal overhead. It may be mentioned that the introduction of a complete new line of radio apparatus at the beginning of this year added considerably to expense, and also necessitated the withdrawal of older sets from the market. It is explained, however, that depreciation charges, figured in the income of 1923, adequately took care of this contingency.

There are only two classes of Radio Corporation of America securities to consider; the 7 per cent. preferred which will have a par value of fifty dollars and which is cumulative from January 1, 1924, and the common. It is now expected that in July of this year dividends upon the preferred, covering the period from January first, will be paid. To pay 7 per cent. upon the proposed amount of outstanding preferred stock, as it will be when the recapitaliza-

tion is effected, will require approximately 1.4 million dollars. Net income in 1923, after all proper charges, was about 3 millions, or more than twice annual preferred requirements. Assuming that dividends will be instituted within the next month or two, the preferred stock is selling to yield almost 9 per cent. at the annual rate of 7 per cent. To be conservative, the stock is a promising semi-speculative commitment, suitable for those who can afford the risk.

There is no apparent thought of a dividend on the common stock at the present time, and it is frankly speculative. On the new basis it is selling equivalent to less than 20, and at that level has not altogether discounted the establishment of the preferred in the dividend ranks. The outlook for the stock primarily depends upon the continued growth of the radio industry, but even with present volume it is demonstrated that the junior shares can show an earned surplus, and the prospects seem more than fair for larger volume and increased stability.

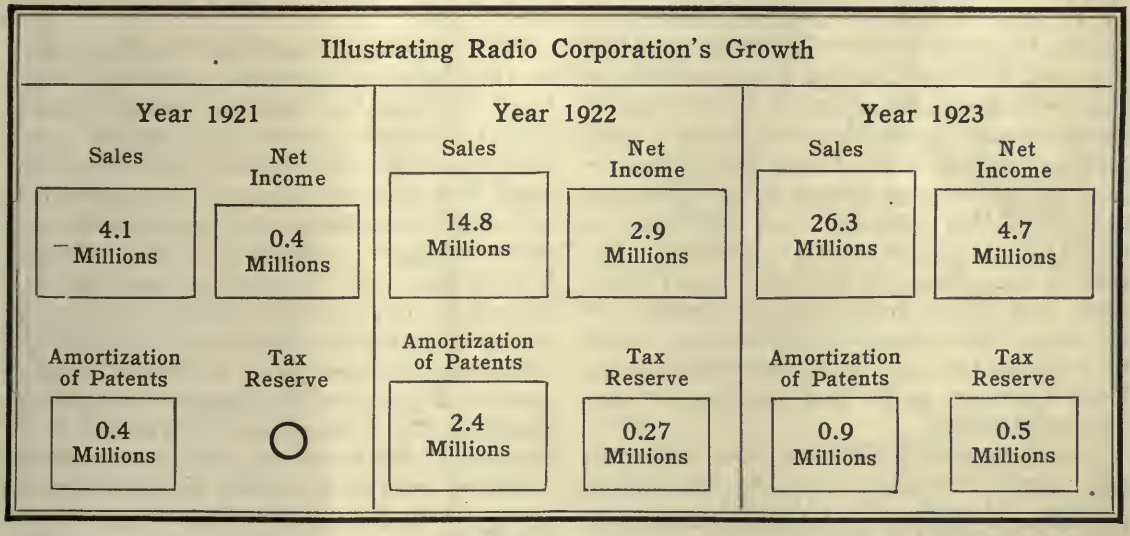
HAZELTINE CORPORATION

WITH proper sponsorship it has already been demonstrated that the public will buy radio securities. The growth of the industry is enough to inspire the imagination and to make pretty plain the fact that a big field for profits is rapidly being opened up.

The Hazeltine Corporation has been in existence but a few months, and in that period revenues have grown from nothing. The Hazeltine Corporation is the sole exclusive owner of the trade marks "Neutrodyne" and "Neutrodon" and all the patents covering these developments. The corporation takes its name from Professor L. A. Hazeltine of Stevens Institute, who is the holder of the patents which the corporation controls. There are no other large assets, no plants, no physical possessions.

When the Hazeltine Corporation was formed, the Independent Radio Manufacturers, Inc., was also organized. This association consists of some thirteen radio equipment manufacturers, and these thirteen have exclusive rights to manufacture and sell the Neutrodyne Receivers, Neutrodon Condenser and Neutroformer coils and will pay royalty to the Hazeltine Corporation, based on the percentage of the sales value of equipment.

Commercial production of Neutrodyne receivers began in the summer of 1923, and five of the thirteen manufacturers were in substantial commercial production at the beginning of the current year. Back in January, it was estimated that the gross sales by the licensees manufacturing Neutrodyne apparatus for the first quarter of 1924 would approximate 5.6 million dollars. It is reported that actual sales for the first three months of 1924 exceeded



FROM 1921 TO 1923

The Radio Corporation of America has shown extraordinary growth. The table shows that the increase in sales has been accompanied by a proportionate increase in net income. Brokers are of the opinion that the future listing on the New York Stock Exchange of both preferred and common stocks will do much toward broadening investment interest in the radio industry

The Position of the Hazeltine Corporation

— Year 1924 —

Capitalization	Estimated Earnings Per Share	Recent Quotation	Earned on Market Price
175,000 Shares	$3	16	18.7%

THE HAZELTINE RADIO CORPORATION

Controls the manufacture and sale of the neutrodyne receiver. Their stock has received considerable attention from the radio investor

the estimate by 2 million dollars. This rather startling growth may be better emphasized by comparing the sales of the first three months of this year with the sales for the quarter ended September 30, 1923, when the total was less than 500 thousand dollars. Furthermore, sales for the first quarter of 1924 do not represent the activities of the entire thirteen licensees, as not all of them were in production. No estimates are available to show the actual earnings of the Hazeltine Corporation from the royalties received, but it has been estimated that for the current year the corporation ought to earn at least $3 a share upon the 175 thousand shares of capital stock outstanding.

LITIGATION

WHERE there are patents, particularly patents in a new and unstabilized industry, there are likely to be law suits, litigation, and already Hazeltine Corporation is at odds with a well known radio manufacturing company—the Freed-Eisemann Radio Corporation. Early in April, Hazeltine brought injunction proceedings against Freed-Eisemann to prevent that company from continuing to manufacture certain radio appliances. The trial of the action will probably occur fairly soon, and in the meantime by direction of the court, the Hazeltine Corporation must turn over to the court all monies received from Freed-Eisemann to be held pending the outcome of the trial.

Freed-Eisemann is alleged to have refused to pay royalties for the use of the Neutrodyne patents. The value of the Neutrodyne patents is not a question, but the case seems to revolve around the point as to whether the Freed-Eisemann people should pay royalties on a complete receiver or only on patented parts. The impounding of the royalty money, pending the outcome of the suit, may upset to some extent estimates of Hazeltine's earnings, but it does not appear as if the litigation is basic or in any way threatens the operations of the Hazeltine Corporation in the use of the Neutrodyne patents.

EARNINGS POSSIBILITIES

HAZELTINE CORPORATION has outstanding 175 thousand shares of stock, of which 140 thousand shares were offered for public subscription at 10 dollars a share. The issue was oversubscribed. The offering houses are well known members of the New York Stock Exchange, and in view of all the circumstances the new company was considered to have conservative and well based sponsorship.

When the corporation was formed it had no funded debt, notes, bank loans or other usual and ordinary corporation liabilities. Obviously, it is impossible to present statistics to prove that the shares of the Hazeltine Corporation are either one thing or the other, but it can be shown that since the stock was sold early in the current year, it has maintained a price upon the New York Curb well above the public subscription price of 10 dollars a share, and the current market appears to be a natural one.

It is intersting to note that the radio shares on the Curb have moved against the general trend of speculative securities prices since the first of the year. There is nothing said about the possibility of a dividend upon Hazeltine stock, but operating expenses will be nominal and, under the circumstances, stockholders can expect a larger proportion of per share earnings than is usual with the ordinary manufacturing company. In an industry which has moved as fast as the radio industry it is impossible to anticipate developments. It is possible that someone might develop apparatus which would supersede the Neutrodyne receiver and limit the market, but those who are interested in the company believe it is very improbable that there will be a radical development to offset the Neutrodyne receiver in usefulness, simplicity, and efficiency.

Obviously the shares of the Hazeltine Corporation are speculative. There has been no

attempt made to show that they are not. The stock is up considerably from the offering price, but it has no discounted entrance into the dividend paying class, and it would seem within the range of possibilities that later in 1924 a rate of, say, $2 might be established.

There is no promise on this point, but the trend of earnings is pronounced enough to invite the speculative assumption that at current levels the shares have certain possibilities as a purchase for those in a position to assume speculative risks of this character.

DUBILIER CONDENSER & RADIO CORP.

DUBILIER Condenser & Radio Corporation shares have been one of the "sensations," to use a much abused word, on the New York Curb since the first of the year. They have risen from ten dollars a share to thirty-five dollars and, in spite of general market conditions, are still near their top price.

The Dubilier Corporation, as it is constituted to-day, has been in business about two years, and according to all reports is increasing net earnings to a point where the common stock is considered to be in line for dividends. The company owns twenty-three patents issued in the United States, and has made applications for additional patents. The chief product is the Dubilier mica condenser. This fixed condenser ranges in size from those a little larger than a postage stamp to condensers more than six feet high.

The Dubilier condenser was perfected during the World War by William Dubilier, an American engineer. The Dubilier condenser revolutionized condensers from the ones used prior to 1915, but it did not come into wide use until the amateur radio craze developed.

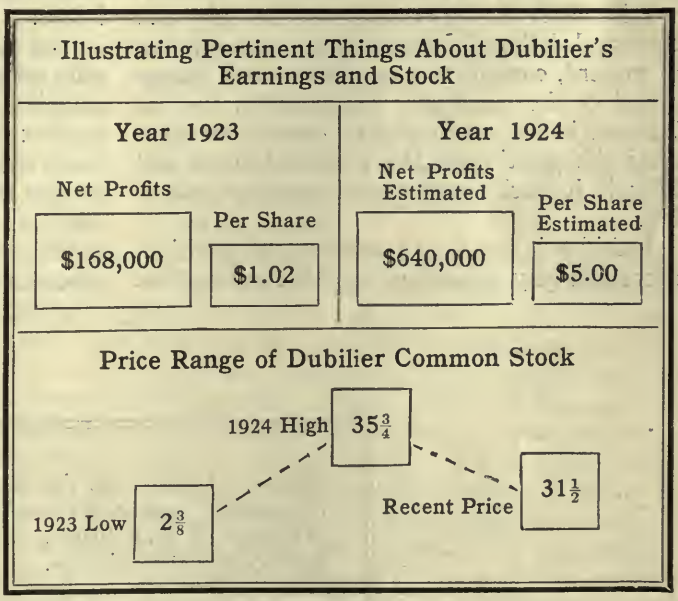
GROWTH OF EARNINGS

DUBILIER has its own factory located in New York City, and early this year output of condensers is said to have been twenty-five thousand a day. The manufacturers of Neutrodyne receiving sets are large users of the Dubilier condenser, and the development of the "neutrodyne" sets has been a big earning asset to the Dubilier Company.

Dubilier devotes its entire operations to the manufacture of radio devices. It does not make complete sets. To give an idea of the price range of its products, it may be mentioned in the twelve months ended April 30, 1923, gross receipts were made up of radio parts which sold from thirty-five cents to five dollars each. In those twelve months, sales amounted to 516 thousand dollars. In 1923, net sales were 726 thousand, and it is currently reported that since the first of January, 1924, sales have been running at the rate of more than one million dollars a year.

The margin of profit seems to be most satisfactory. A margin of 20 per cent. was indicated in 1923, and in some months so far this year, a margin of more than 30 per cent. is indicated. It is stated that the company devotes a substantial part of earnings to research and experimental work, but exact figures are not available. In the year ended December 31, 1923, earnings were equal to about one dollar a share on the outstanding common stock, which was not remarkable, and which did not indicate anything except to those who were especially close to the company's affairs.

As a matter of fact, practically all the outside interest in Dubilier has been created during the last four months. If current estimates of monthly earnings are correct, earnings on the



THE DUBILIER CONDENSER AND RADIO CORPORATION

Is another large radio concern whose stock interests the investor in the radio market. Like all radio stocks, it has been in the field only a very short time

common stock must be running along at an annual rate of about five dollars a share. The per share figures themselves are not as impressive as the fact that the company showed a net profit of less than 100 thousand dollars for the year ended April 30, 1923, but may show a net profit of three quarters of a million dollars this year.

Recently it has been reported that Dubilier will put on the market a new patent radio device which will add substantially to earnings. It is well to remember, however, that when a stock enjoys a rise like that enjoyed by Dubilier common, and when earnings apparently are making such remarkable strides, there are likely to be all sorts of reports about expansion. A growth in business, as demonstrated by the success of known production, is enough ground for recognizing the possibilities which the stock possesses. This does not mean that the company may not introduce any new radio devices to a waiting market; it is stated to show that it is not necessary to look for some mysterious revolutionary product to explain the appeal which Dubilier stock has made, assuming that the estimates of earnings are to be taken at face value.

Dubilier has eight per cent. cumulative preferred stock of 390 thousand dollars preceding the common. Dividends have been paid upon the preferred for a year and a half, but the total requirements on the senior issue are only 31.2 thousand dollars, and as earnings are running at present, constitute a relatively small charge ahead of the common. Incidentally, the big increase in net revenues has greatly strengthened the position of the preferred stock and brought it much nearer to an investment standing.

Dubilier is purely an earnings proposition, success largely depending upon the work of the engineering force to keep abreast of new developments in the industry. To date, the management has proved its right to be considered entirely competent in a field which is highly technical. The market for its products is much broader than it was two years ago, and judging by the increased interest in radio, limits of distribution have by no means been reached, or perhaps even approached. The common stock, of course, has discounted the change in earnings and is now apparently approaching the point where dividends may be considered, possibly at the annual rate of three dollars. On that theory the shares are a speculative purchase on a good-sized reaction. It should be considered, in any case, however, as nothing more than a speculation and should not be bought except by those who can afford speculative risks.

In conclusion, it is pertinent to point out that all the securities representing the radio industry are still in the speculative class, which is to be expected in view of the recent origin of the industry. For that reason, it is considered inadvisable for any one to purchase these securities, regardless of their outlook, unless the speculative nature of these issues is clearly recognized.

While it is true that great profits have been made by investment in securities in their early stages, it is also true that there have been great losses.

The radio stocks, herein analyzed, undoubtedly represent the best of their class. Nevertheless, their speculative nature militates against their being given our whole-hearted endorsement. Our purpose has been merely to outline the position of the industry and securities. It is consequently for those who are in a position to assume speculative risks to say whether they should make the commitments.

"Radio—A New Field for Investment" is reprinted from a late number of the Magazine of Wall Street, *through the courtesy of that publication.*

Radio Broadcast's Knock-Out Four-Tube Receiver

By JOHN B. BRENNAN

LAST year Walter Van B. Roberts did a considerable amount of independent investigating with various circuits and about the first of this year, evolved the arrangement which has gained unusual popularity as the Roberts circuit. That circuit, as most everyone now seems to know, if we are to judge by the tenor of the enthusiastic correspondence piling into the office daily, is sensitive, selective, uses a minimum of tubes for a long range receiver, and *does not radiate*. The extraordinary efficiency of this set is caused by its use of reflexing, regeneration, and proper tube-neutralization. Mr. Roberts described his set in this magazine for April and May. Two construction articles appeared on the receiver, one by Zeh Bouck telling how the circuit might be used for very short-wave reception, and the other by J. E. Roberts describing a layout with three tubes in our August number. The receiver described here is without doubt the best, for the constructor who is looking for results, that we have ever seen.—The Editor.

BY DEVELOPING his two-tube reflex circuit, Mr. Walter Van B. Roberts has contributed to radio a receiver of inestimable value and importance. The claims for this receiver made by Mr. Roberts have been fully borne out by the many reports from those who have lost no time in building it, as well as by the further research work conducted by Radio Broadcast's laboratory.

Combining the advantageous features of radio- and audio-frequency amplification through reflexing, regeneration, and neutralization, this circuit is particularly desirable since it does not radiate.

However, an attempt is not made here to repeat the theory of the operation of this circuit as given by Mr. Roberts (Radio Broadcast, April and May, 1924), but to supply the radio fan with the data sufficient to enable him to construct this receiver with the addition of an efficient push-pull amplifier.

The ordinary amplifier unit will not consistently operate efficiently with this receiver unless special corrective features are incorporated to control the resultant distortion, howling, or overloading.

The push-pull amplifier unit has been found to supply the desired stability, faithfully amplifying over the average audio-frequency range without distortion.

When a signal is applied to the grids of the tubes (Fig. 1) by the inductive relation of the primary to the secondary, one grid becomes positive while the other is negative. Naturally an alternate push and pull action of the currents flowing between the plates of the tubes through the primary winding of the output transformer takes place. When the current is increasing in one section of the windings and decreasing in the other it would be expected that the resultant current in the secondary would be small. But the natural polarities of the two sections oppose each other, for the B battery current flows through the end leads of the coils out through the center tap. This causes the two currents induced in the secondary to add up, and the maximum current is delivered to the loud speaker as alternating current.

In the ordinary type of amplifier the current in the plate circuit is pulsating "direct current" with the loud speaker winding in series. When a heavy current is passed through this circuit the diaphragm does not readily respond to the minute changes of current intensity.

By inductively coupling a secondary to the primary and removing the loud speaker connections to the secondary terminals (as in the push-pull unit), the pulsating direct current is transformed to a modulated alternating current.

In the push-pull amplifier, we have a primary delivering energy to two tubes through a split secondary, a C battery to supply the proper negative bias to the grids, a split primary delivering the sum of the output of the two tubes

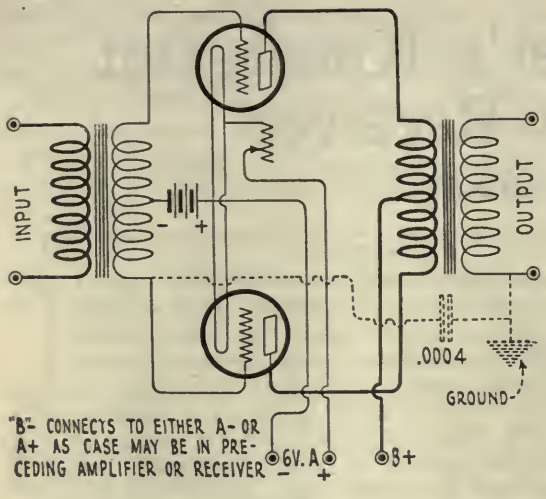


FIG. 1

A standard push-pull amplifier circuit. Usually this unit is used as a second stage but with the Roberts circuit the first audio stage is reflexed and its output passed into the circuit shown here. Exceptional volume and tone quality result

in pulsating direct current, and the secondary delivering alternating current to the loud-speaker. Each one of these features helps in its own way to prevent the possibilities of distortion and overloading.

The value of the C battery varies with the value of the B battery used as the following table shows:

B BATTERY—VOLTAGE—	C BATTERY
80	3.0 to 4.5
100	4.5 to 6.0
120	6.0 to 9.0
150	9.0 to 12.0

It follows, that if the ordinary type of amplifier be added to the Roberts Two-Tube receiver, the resultant signal produced will be greatly distorted unless special corrective measures are incorporated in the general layout. Due to the loud speaker volume produced by the Two-Tube set these corrective controls are frequently ineffective because of the subsequent excessive overloading of the extra stage of amplification and the peculiarities of various transformers.

Taking these obstacles into consideration it was evident that some means of effectually surmounting them would have to be provided. After a series of elaborate tests the push-pull type of amplifier proved entirely satisfactory.

Fig. 2 and the several photos show the general appearance and layout of the RADIO BROADCAST Four-Tube receiver.

MATERIALS

The parts used, with the approximate cost, are listed as follows:

1 Panel 7 x 21 x $\frac{3}{16}$	$2.00
1 Base-board	.50
1 Set Turney Coils	8.00
2 Variable Condensers .0005 mfd. $2.50 ea.	5.00
3 Vernier Dials, $2.00 ea.	6.00
1 Switch Arm	.25
7 Switch Points	.10
2 Switch Stops	.05
4 Sockets, $1.00 ea.	4.00
1 Transformer (ratio approximately 5-1)	7.00
2 Push-Pull Transformers (set)	12.50
3 Rheostats, $1.00 ea.	3.00
2 Jacks (Open and double circuit)	1.25

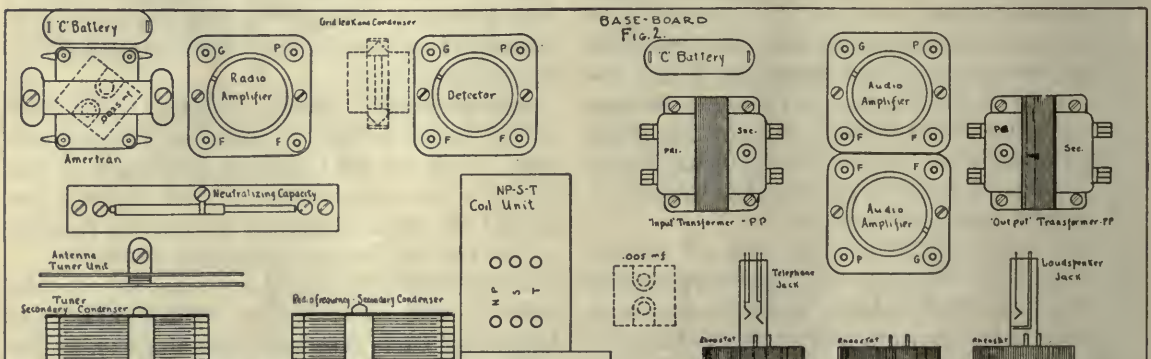


FIG. 2

This base layout shows the general placement, spacing, etc., of the units. On account of the difference in size of the various manufactured parts that may be used, no dimensions are given, which allows the constructor to use his own judgment. Room enough has been allowed for all types of apparatus designed for the functions necessary as units in this circuit

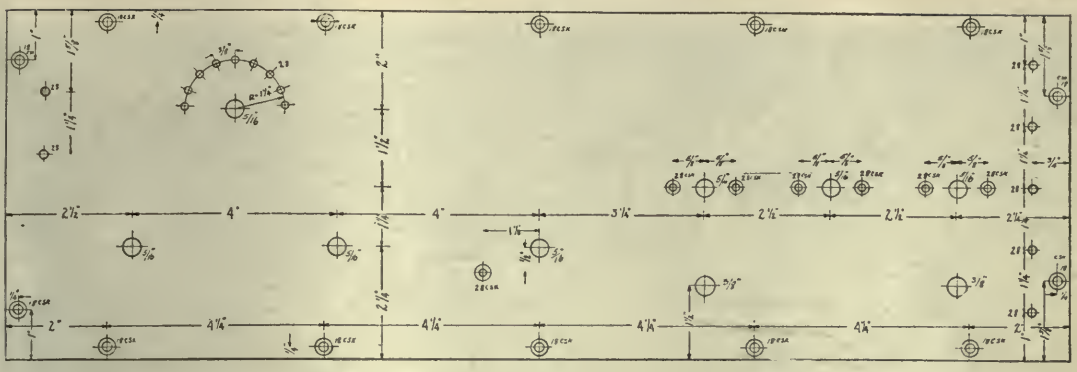


FIG. 3

The panel layout shows the mounting holes on the panel on a small scale, the actual location with dimensions

7 Binding Posts $.20 ea.	1.40
1 Neutralizing Condenser	1.50
1 Grid Leak (3 to 7 megohms)	.60
1 Grid Condenser .00025 mfd.	.40
2 Micadons .005 and .0025 mfd. $.40 ea	.80
2 C Batteries 4½ volts $.40 ea.	.80
—Miscellaneous bus wire—spaghetti—screws—bolts—nuts— lugs, etc	2.00
Total	$57.15

The prices given here are high enough to admit of the purchase of parts of good quality.

PREPARATION OF PARTS

IN PREPARING the various parts for assembly, the tri-coil unit, and the neutralizing condenser require alterations.

That part of the wooden section of the coil mounting protruding at the left (looking at it from the front) and containing the bearing for the shaft of the NP coil control is sawed off flush with the bakelite base. This is shown in Fig. 6. The dial control for this coil is discarded and the separation between the NP and S coils is maintained by the bolt and nut as shown. The coupling between these coils is varied to the correct value by means of this screw and is quite sharp in adjustment, effecting the tone quality and quantity to a marked degree.

The neutralizing condenser must be taken apart and the two lengths of bus wire replaced with one continuous piece. Great care must be exercised in performing this operation so as not to break the glass insulating tubing. If, however, the tubing is broken, a length of spaghetti tubing will serve as a substitute.

Tighten all the bolts and nuts on the sockets to insure a positive contact. This is done by first removing the round knurled thumb-nut and tightening the nut and bolt with screw driver and pliers. In doing this be sure that

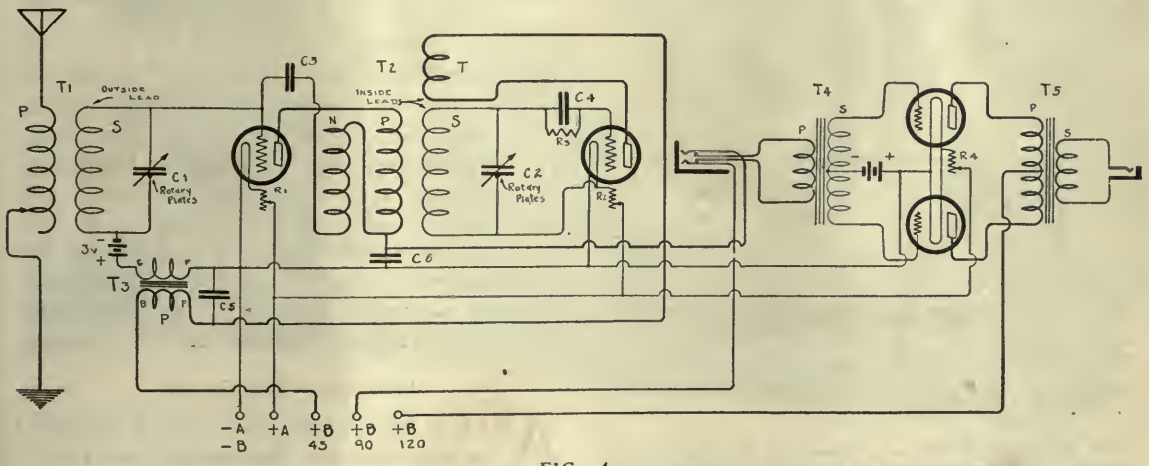


FIG. 4

In this schematic circuit diagram the original Roberts circuit may easily be identified and the push-pull amplifier is also strikingly evident. The left-hand jack forms the dividing line

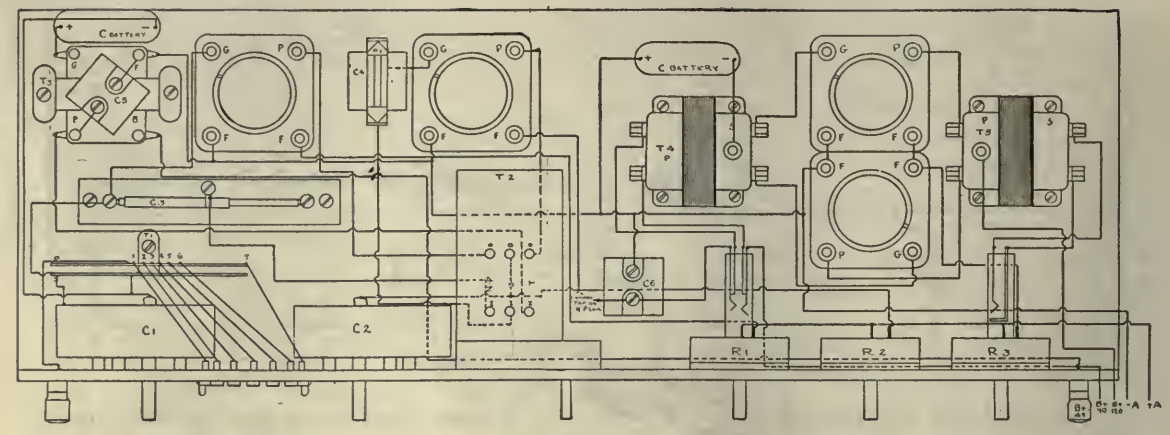


FIG. 5

Shows the actual wiring diagram of the receiver as applied to the base layout shown in Fig. 2. In wiring the set it is advisable to make frequent references to Figs. 4, 5 and 8

the contact blade of the socket does not move out of place.

Lugs are placed at all connection points wherever possible.

DRILLING THE PANEL

TO PREPARE the panel for drilling, lay out the various center points by direct reference to Fig. 3. With a light hammer and centerpunch mark these points and after securing the panel substantially, drill all the holes first with a No. 28 drill. Once drilled, the holes may be enlarged to their proper size. All the holes for mounting the parts on the panel should be countersunk.

The screw holes around the edge of the panel for fastening it to the cabinet are drilled with a No. 18 drill and countersunk. A No. 28 drill is used for the binding post, switch points, coil mount, and rheostat holes. The latter two are countersunk. All center holes such as condenser shaft, rheostat and switch arm holes are drilled with a $\frac{5}{16}$" drill. The jack bushings take a $\frac{3}{8}$" hole. The holes for the condenser mountings obviously differ with the type of condenser used, but for the Duplex condensers a countersunk No. 28 hole is drilled.

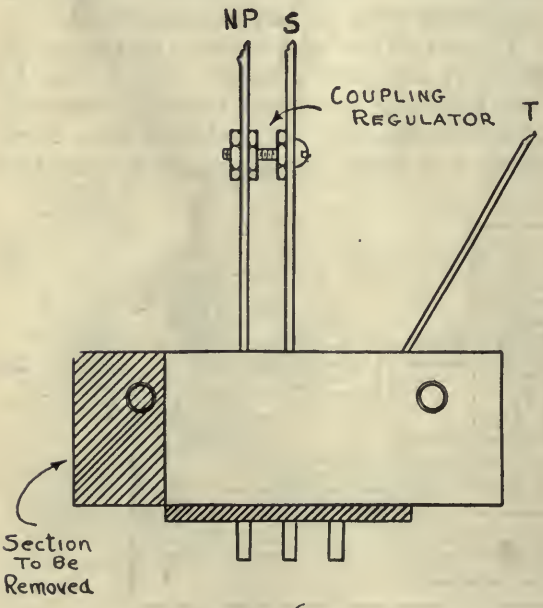


FIG. 6

The alterations of the 3-coil mounting are clearly indicated. The manufacturer of this type of coil has since produced a unit in which similar features have been permanently included. As may be seen by referring to Fig. 9

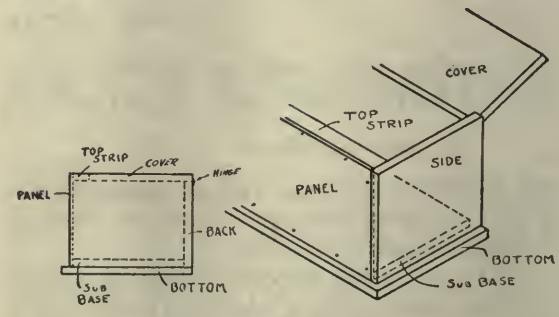


FIG. 7

Although there are many cabinets of standard panel size procurable, the builder may construct his own from the details shown here

GRAINING THE PANEL

A VERY fine panel appearance is obtained by adopting the commercial practice of graining. Firmly fix the panel on a bench or table and with a sheet of No. 00 emery cloth

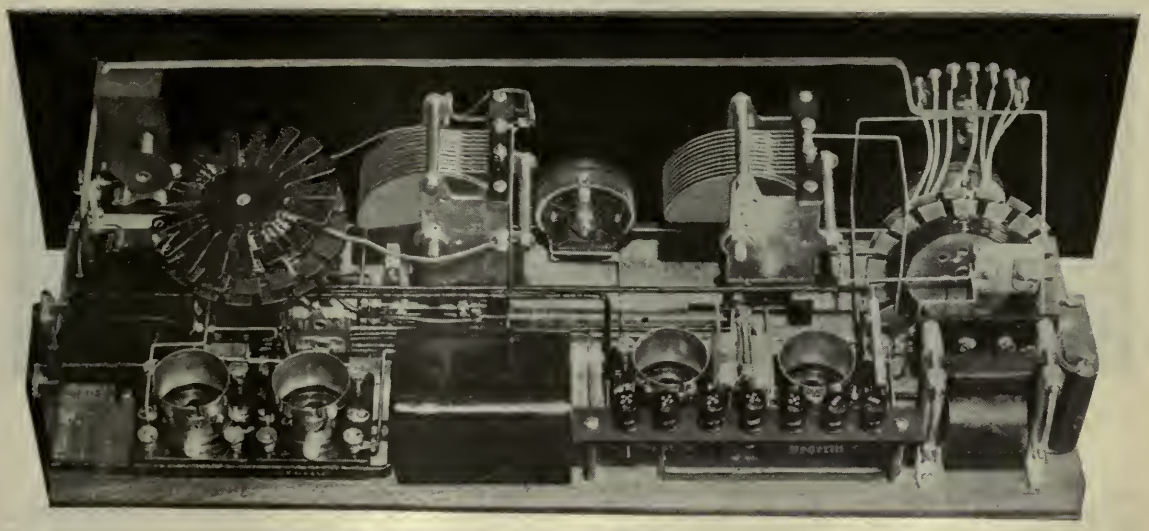


FIG. 9

Another view showing more compact placement and construction, where a standard panel and cabinet have been used. A good job, well done, by the Radio Research Laboratories

wrapped around a block of wood, rub down the panel, removing all the "high lights." The direction of graining is parallel with the long side rather than with the width of the panel. When all surface marks have been removed, a few drops of machine oil may be rubbed in by the same graining process. A finely grained, highly finished panel surface results.

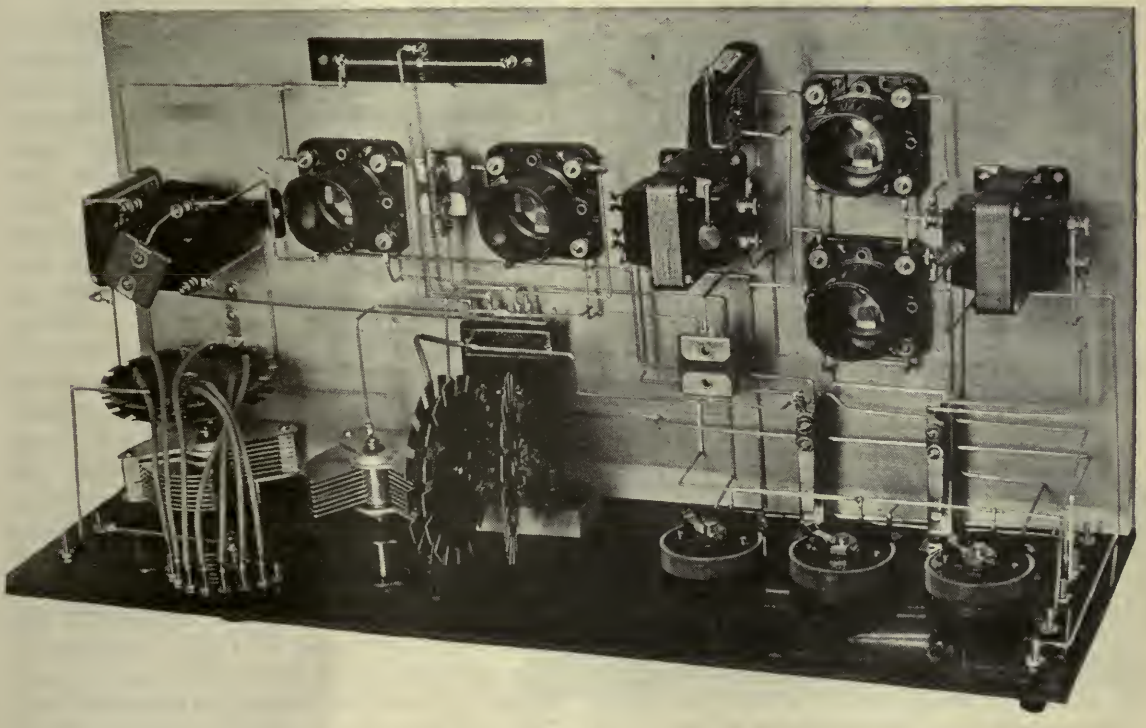


FIG. 8

A base of our test set photographed in RADIO BROADCAST's laboratory. In this receiver generous spacing of the parts is the distinguishing feature. An arrangement of this kind is simple to wire, but it will not fit in a standard cabinet

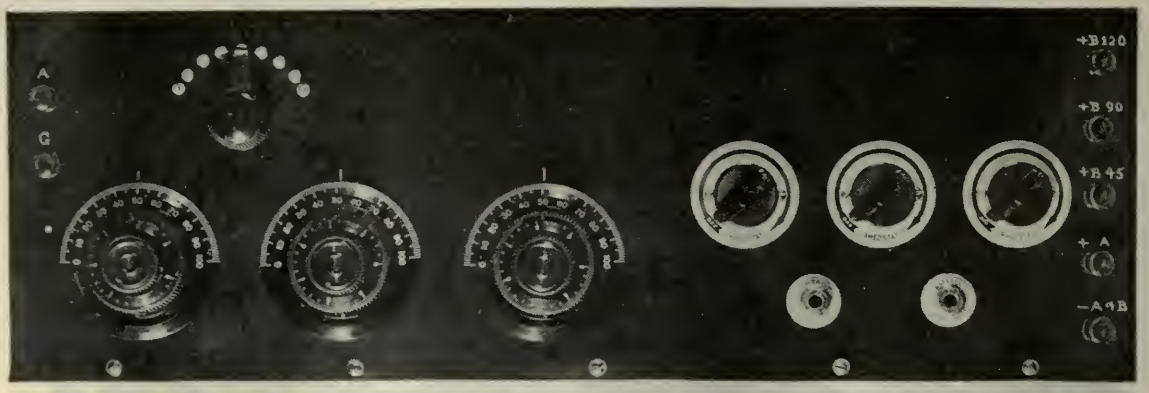


FIG. 10

The panel view of the set shown in Fig. 8. The vernier dials greatly facilitate sharp tuning

Countersink the heads of screws slightly under the surface of the panel so that they will offer no obstruction to the turning of dials or knobs.

ASSEMBLY

THE next operation is in assembling the parts upon the panel. The switch points, stops, and arm are first mounted so that there is no interference to the hand motion which might be caused by the proximity of the other units. Before mounting the remainder of the units, attach the panel to the base. This supports the panel in a rigid manner facilitating the assembling of the condensers, tri-coil unit, jacks, rheostats and binding posts in the order named.

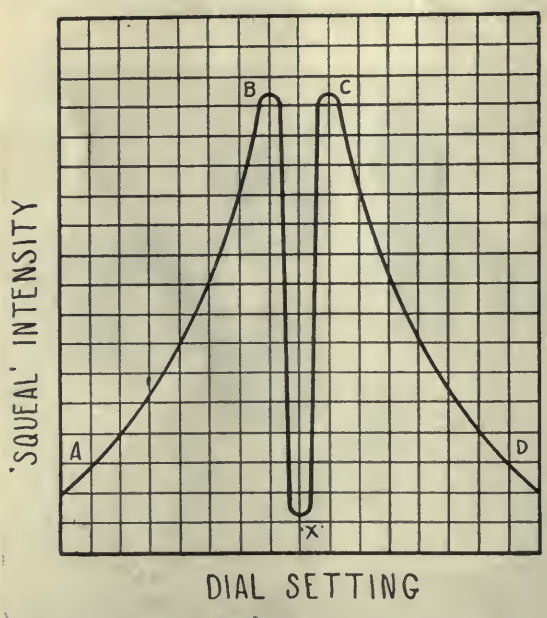


FIG. 11

Graphically explains the system and theory of proper neutralization in the Roberts Circuit

The base layout is shown in detail in Fig. 2. It will be noticed that no dimensions are given. This allows the use of other types of apparatus with the same layout scheme. Round head wood screws, $\frac{1}{2}$", No. 5 are used to fasten the parts to the base. Where the base of the sockets is thicker than $\frac{1}{4}$", longer screws are necessary for this purpose.

In a receiver of this type, the electromagnetic and electrostatic fields set up by the several units unquestionably have their effects on the successful operation of the receiver. Whether this is detrimental or not depends largely upon the crowding or generous spacing of the various parts. Naturally there is a safe medium at which both crowding on one hand and the possibility of extra long leads on the other are reduced to a minimum. Fig. 4 shows such a layout with the actual wiring circuit. Both variable condensers C1 and C2 are of .0005 mfd., while the fixed condensers C5 and C6 are of .005 and .0025 mfd. respectively. The grid leak condenser C4 is .00025 mfd. For the grid leak, several values are recommended ranging from 3 to 7 megohms. C3 is the neutralizing capacity. The inductances are of the standard Roberts design and are of the manufactured type. Dimensions for the home-made coils have appeared in the April and May issues of RADIO BROADCAST. The filament circuit of the first tube is controlled by a 20 ohm rheostat as is the detector. The two push-pull amplifier tubes have their filaments in parallel with a 15 ohm rheostat in series with the supply.

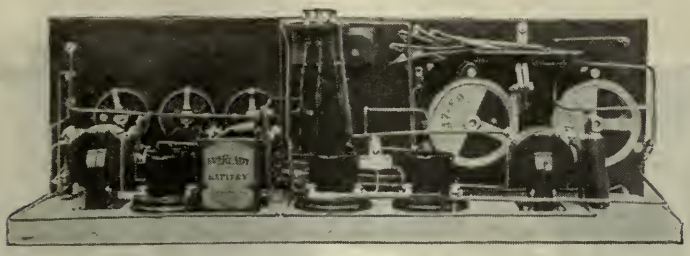


FIG. 12
A rear view of another Roberts experimental model

The photograph Fig. 8 shows the first laboratory model built and strongly indicates the generous spacing of the elements. The photograph Fig. 9 is a revised layout showing the more compact construction.

In following the panel template of Fig. 3 it will be noted that the position of the jacks is slightly altered so that the socket may be brought nearer to the panel.

WIRING THE SET

THE actual wiring of the receiver is shown in Fig. 5. The schematic circuit is shown in Fig. 4. Together with the base photos these wiring layouts clearly indicate the attempt to keep the wires short, parallel to the length and width of the base, and to make all turns at right angles to each other. The observance of these few rules add to the workmanlike appearance of the finished job. Soldered connections were made to the lugs attached to the various parts. Half and half strip solder and a solution of resin mixed with Carbona or alcohol to the desired liquid consistency, was used, resulting in a clean, permanent connection. The use of spaghetti insulating tubing is optional excepting where there is danger of short circuiting, then its use is absolutely necessary.

OPERATING NOTES

WE USED UV-201-A tubes throughout, but any standard tube may be substituted providing the necessary changes in value of the filament rheostats are made. The grid leak resistance of the detector tube controls to a large degree the volume output of the receiver. The value of this resistance will vary according to the tube used, from about 2 to 7 megohms.

If all the batteries etc., have been connected and the set is otherwise ready to operate, the following proceedure of tuning is followed. Turn the tubes on to normal brilliancy and listen-in on the first jack. Turn up the tickler control so that the coupling between the secondary and the tickler is quite close. Now, set the tap switch on the middle point and simultaneously rotate the two condenser dials slowly. Gradually the squeal of a station will be tuned-in until it reaches its loudest point. Let these controls remain at this setting and then slowly reduce the coupling between the tickler and the secondary until all the squeal vanishes and the music or speech is clear. The quality and quantity of the reception can be increased by clearing up the tuning with a further adjustment of the rheostats and the switch taps.

The operation of the push-pull amplifier is entirely controlled by its filament rheostat. It is important to observe that a loud speaker be used that is capable of handling the large output volume without distorting the tone quality. Signals from this receiver are so loud that some loud-speakers can not carry them when the set is turned on full. Undue oscillation or howling that seemingly cannot be controlled by any of the tuning units may be eliminated (providing the correct connections to the coils have been made) by reversing the leads to the primary of the audio-frequency transformer used for reflexing. It is also necessary to vary the detector B voltage to its proper value, depending upon the individual tube used.

Fig. 12 shows how the tuning squeal would appear if visualized. When the cylindrical tubing on the neutralizing condenser has been adjusted so that at a certain point on the dial of the first condenser there is a comparatively quiet spot a few parts of a degree either side of this point, but gradually and equally in-



FIG. 13
A panel view of Fig. 12. A manufactured inductance switch, shown at the left-top has replaced the ordinary switch arm and contact points

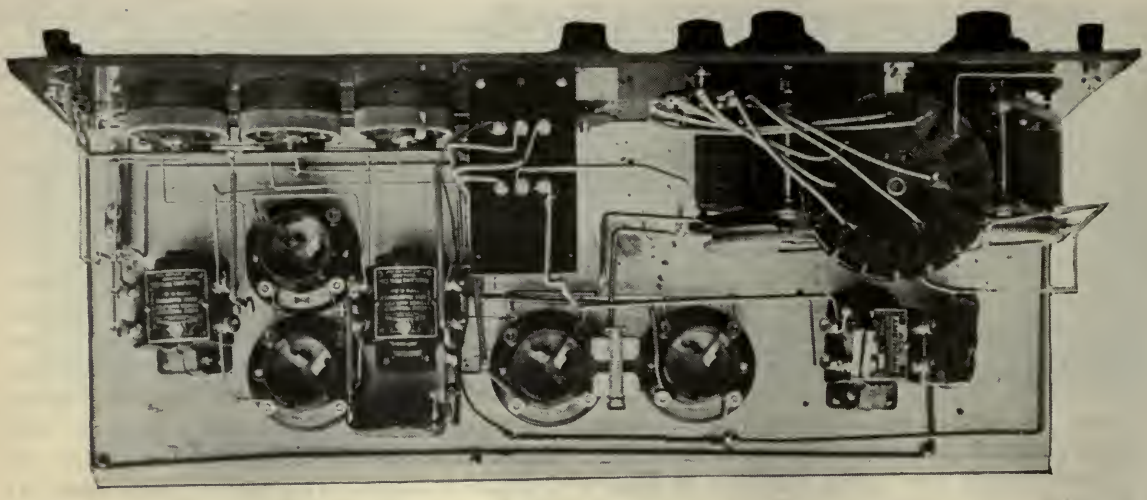


FIG. 14

Another base view. Other parts and a different base and panel layout prove the wide flexibility of design

creasing then decreasing in a whistle as the dial approaches and passes this point, it may be assumed that the correct location of the tube has been determined. But, if it so happens that the squeal first increases gradually, then quickly slumps down, then quickly increases and quickly decreases, it is evident that the proper balance has not been obtained. Try sliding the tube in the opposite direction of its original position for only a short distance and repeat the variation of squeal intensity. In Fig. 12, X shows the silent point extending from B to C, while A-B indicates a gradual increase in intensity and C-D indicates a gradual decrease in squeal intensity. This constitutes the proper squeal adjustment.

The tapped primary allows the use of practically any size of antenna. In the RADIO BROADCAST laboratory two hastily constructed antennae were used, both not being more than ten feet in height. One was 18 feet long, the other about 150 feet long. No great difference in volume or in sharpness of tuning was noticeable in the use of either.

The use of vernier dials is a decided aid in the tuning of distant stations.

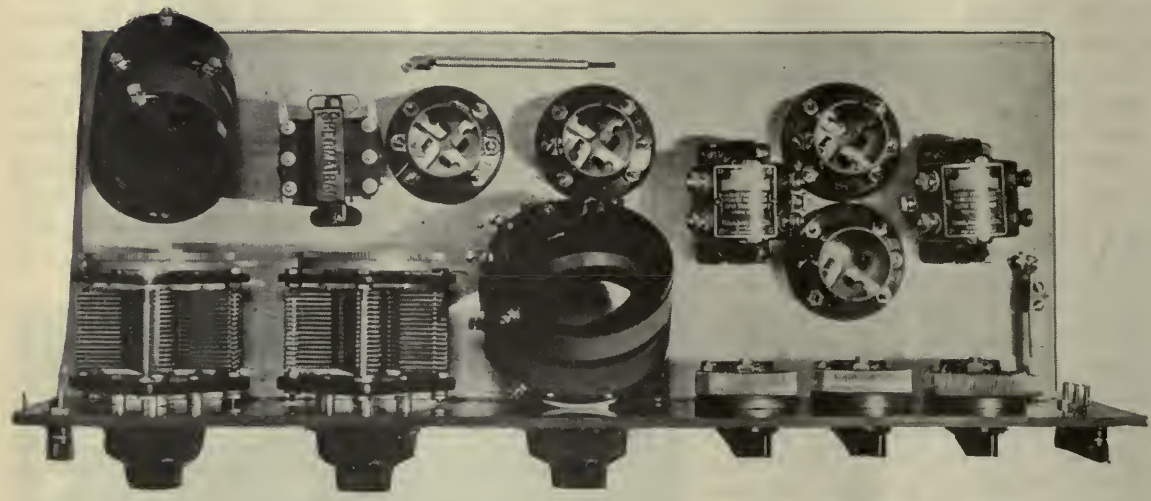
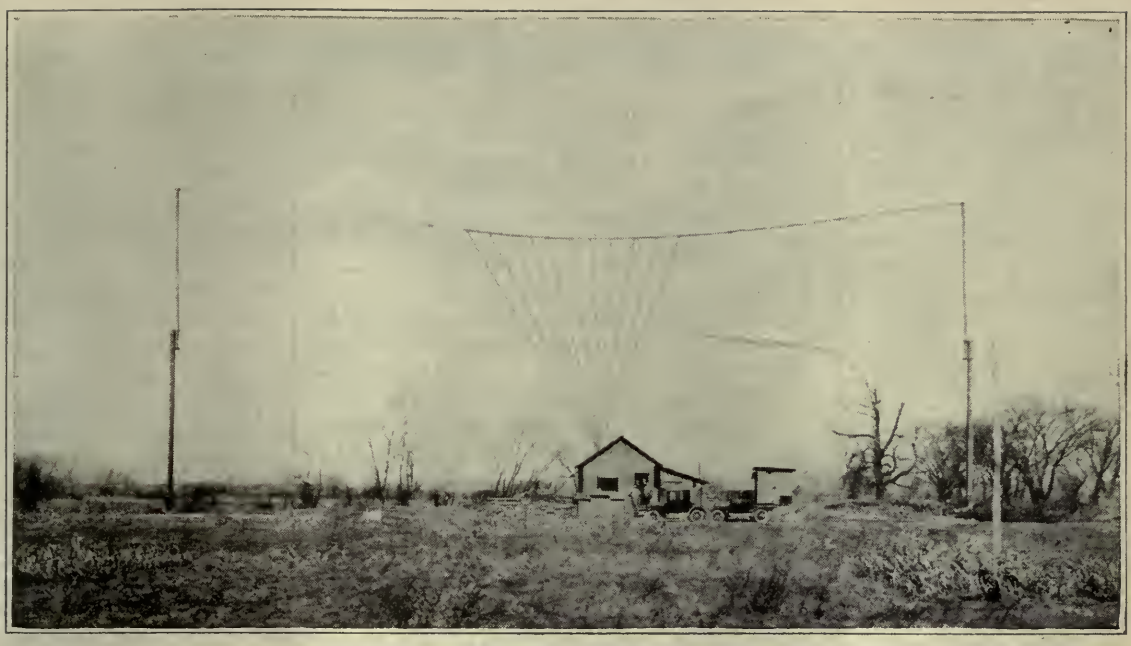


FIG. 15

Adapting the circuit to tuning units of a more standard nature. A 180° coupler is rewound to take the place of the spiderweb NP-S-T coils and the antenna inductance is wound on a cylindrical form mounted at right angles to the coupler. No matter what type of apparatus is used, it is well to make a permanent, complete layout of this character before doing any of the wiring



THE SPECIAL INSTRUMENT HOUSE AND ANTENNA

Used at WGY for sending their programs out on 107 meters for rebroadcasting. A special heavy mast is used to prevent swinging and consequent changes in wavelength. The antenna itself is made of $\frac{3}{8}$" hemp wound with many fine bare copper wires

The Rebroadcasting Set at WGY

Behind the Scenes of the High Power 107 Meter Transmitter at the Schenectady Station—The Novel Electrical Arrangements Which Have to Be Made Where the Powerful Short Waves Are Produced

By W. J. PURCELL

Engineer in Charge, Station WGY, General Electric Company

ONE of the most interesting contributions to radio during the present year has been the development and successful operation of the short wave transmitter. By its use distant places heretofore only occasionally reached on long wavelengths become readily accessible with a fair degree of reliability. Signals are transmitted so clearly and with such volume that it is possible to pick them up 3,000 miles away and successfully rebroadcast them.

For several months past, WGY, the Schenectady station of the General Electric Company, has been experimenting with a short wave transmitter, and on April 5, these experiments, carried on in coöperation with the British Broadcasting Company in England, reached a climax. On that day, every station in England relayed or rebroadcast the WGY short wave signals. One radiogram received from London during the progress of the concert enthusiastically proclaimed it "all as clear as if played in London." The concert broadcast was held in the Wanamaker auditorium in New York, and consisted of organ, tenor solos, trumpet selections, and speech. The program was conveyed by line circuits to WJZ in New York, from which point, after amplification, it was conveyed over wire to the control room of WGY in Schenectady. There it was twice broadcast, once on a short wavelength of 107 meters, and on 380 meters from the regular transmitting equipment. The short wavelength signals, inaudible on most receiving sets, crossed the Atlantic and were picked up on a sensitive receiver by 2 LO and were then fed by wire to all the stations making up the British Broadcast-

ing Company group. Crystal set owners in London, Manchester, and other English cities, and near-by English transmitting stations, all reported excellent reception of the music played in New York.

WGY was informed recently on excellent authority that the Gilbert & Sullivan comic opera "The Mikado" produced in the Schenectady studio and broadcast on both 107 and 380 meters had been heard in Johannesburg, Africa, May 15. The short wave signals were received. This constitutes a new distance record for WGY as Johannesburg is 8,034 miles from Schenectady.

The Importance of Rebroadcasting

Many of the prophets among those radio men who ought to know, say that broadcasting eventually will mainly be done by super-power broadcasting stations, located in leading cities of this country, where excellent speakers, excellent music, and the other bone and sinew of radio programs are easily had. The smaller local stations will not be disposed by this scheme of things, these forecasters say, for they will be able to pick up the super programs and rebroadcast them. KDKA and WGY have been doing some extensive and quite successful experimental work with transmitters for rebroadcasting. Before the finished commercial product must come the experiments. This story by Mr. Purcell of the special set at WGY should interest the host of amateur operators and broadcast listeners who have heard the surprisingly penetrating waves of WGY on 107 meters. "Broadcasting Complete American Programs to All England" in this magazine for March, told of KDKA's experiments in rebroadcasting.—THE EDITOR.

NEW RADIO WRINKLES AT WGY

WHILE the design of a short wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2,803 kilocycles—requires the use of some unusual and novel apparatus. As shown in the accompanying picture, the antenna used is of the fan type, but it differs in some respects from the conventional antenna. In order to decrease resistance losses, its conductors are made of three-eighths inch hemp, over which is braided many fine strands of bare copper wire. The two wooden poles supporting the antenna are much larger than necessary to support structure of this size, but they are essential to prevent the antenna from swinging. A swinging antenna would cause unfortunate frequency changes.

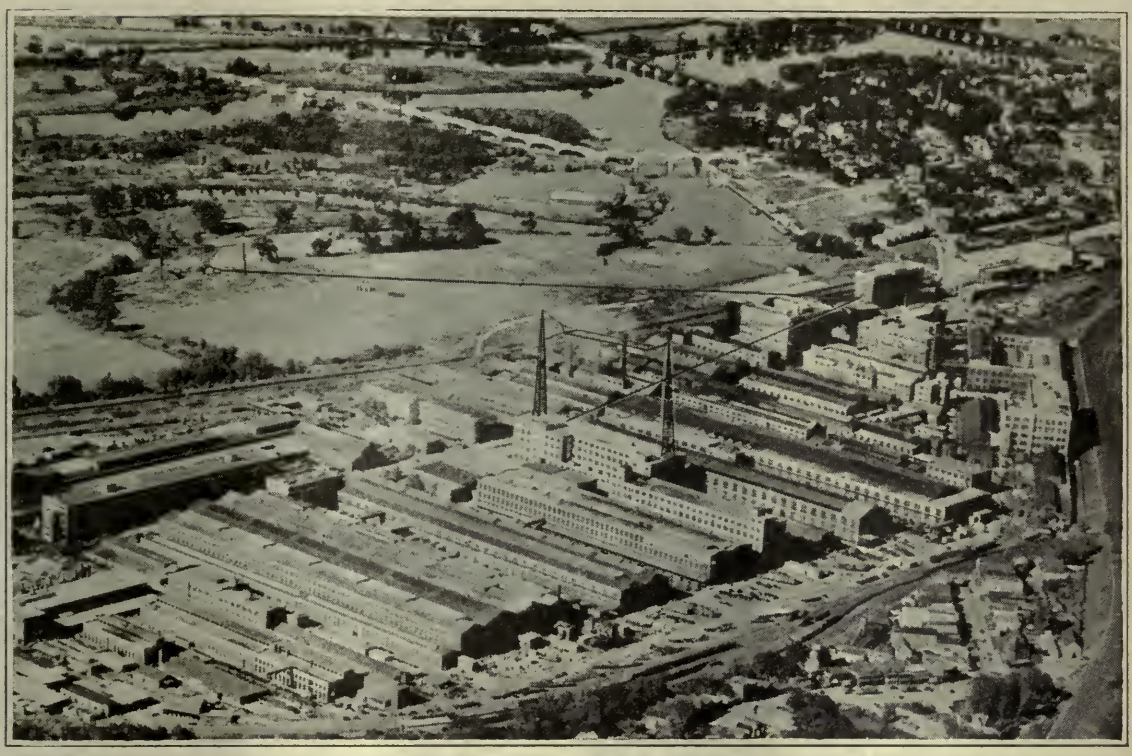
The building sheltering the transmitter proper is located slightly to one side, allowing the counterpoise to come directly underneath the center of the antenna, greatly increasing the radiating efficiency of the system. The antenna is eighty feet high and sixty feet in width at the top portion of the fan. Its fundamental wavelength is 160 meters. When the antenna is operated below the fundamental period, its current seems very low. Measurement, however, shows a much higher field strength and radiating efficiency on the short wave adjustment than when a smaller antenna and a higher antenna current are employed.

In order to secure maximum radiation, the transmitter is located on level ground, a mile from the nearest building. The instrument house is located near a bend in the river and the conductivity of the soil in that vicinity is therefore comparatively great.

The oscillating system is of the conventional coupled-type in which the frequency is controlled by a tuned circuit rather than by the antenna circuit. This method greatly decreases the possibility of frequency change due to the swinging of the antenna in the wind. The primary coil consists of one and a half turns of copper ribbon two inches wide and this is tuned by an air condenser made of aluminum plates three feet square. In solving the problem of a spacer for these plates that would not break down it was decided to use very thin hard rubber strips. The power tubes are water cooled and are connected to a pump to a large radiator which insures an uninterrupted supply of water. Coupling to the antenna is secured through a single turn of copper ribbon clearly shown in the photographs.

Because the wavelength used is extremely low, we have had some odd electrical effects in the operating room. When a transmitter is built, the usual practice is to connect all metallic objects, such as iron frame work, transformer cases, and motor generator frames together with copper ribbon. This procedure, we discovered, could not be followed in our short wave transmitter because, while the inductance of a conductor only a few feet long is very small, it is great enough to allow a considerable voltage to be built up across it at this frequency.

Because of the intense field about the transmitter it is necessary to be very cau-



WGY AND WGY II.

Seen from an airplane. The retouched photograph shows the towers of the main station a-top one of the buildings at the Schenectady works of the General Electric Company. Both transmitters, the 107 meter one and the 380 meter one, are connected to the control room and studio which serves for both

tious while the set is in operation. Two men standing on insulated stools, each holding a metal rod in his hand, can draw an arc six inches long between the rods. No shock is felt because current of this nature travels through the skin rather than through the body. However, if the bare hands were used instead of the metal rods, a severe burn would be the result. Arcs will jump from the stove to the shovel when adding coal, and care is necessary to prevent the body from coming in contact with any metallic objects. It is possible to light an ordinary sixty watt electric lamp to full brilliancy by holding the glass bulb in the hand. Metal pencils, watches and like articles cannot be carried on the person because of the small sparks which jump to them. Shoes with metal nails cannot be worn because of the sting one feels when he steps on the nails in the wooden floor.

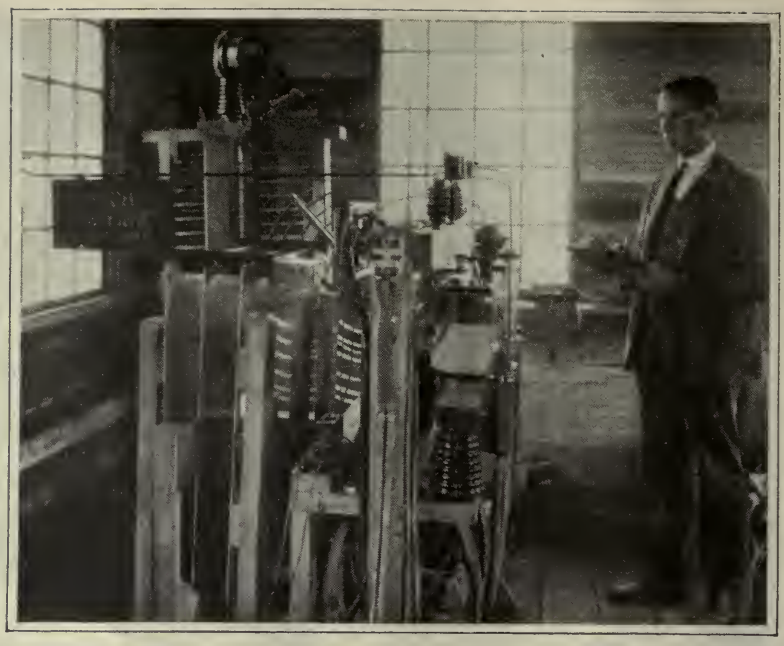
The modulator tube is water-cooled and it is connected to the same cooling system as the oscillator. The speech power amplifier is a 250 watt radiotron, and, because of the intense field from the oscillator and its associated apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded, and the lines to the studio and control room are covered with lead and are buried to prevent the radio signal from getting back into the input circuit.

The plate power supply to the water-cooled tubes is a three phase full wave rectifier capable of supplying thirty kilowatts at fifteen thousand volts. Filaments are lighted by special direct current machines to eliminate the ripple which results from the use of alternating current on tubes employing a high filament current.

The results obtained from a series of tests conducted with the coöperation of the British Broadcasting Company from January to April 5 have been extremely gratifying. The signals have been heard consistently in Los Angeles with loud speaker strength using only two tubes, and this at times when daylight covered the western half of the country. Tests have shown that the signals are remarkably free from fading which is very common on the longer waves.

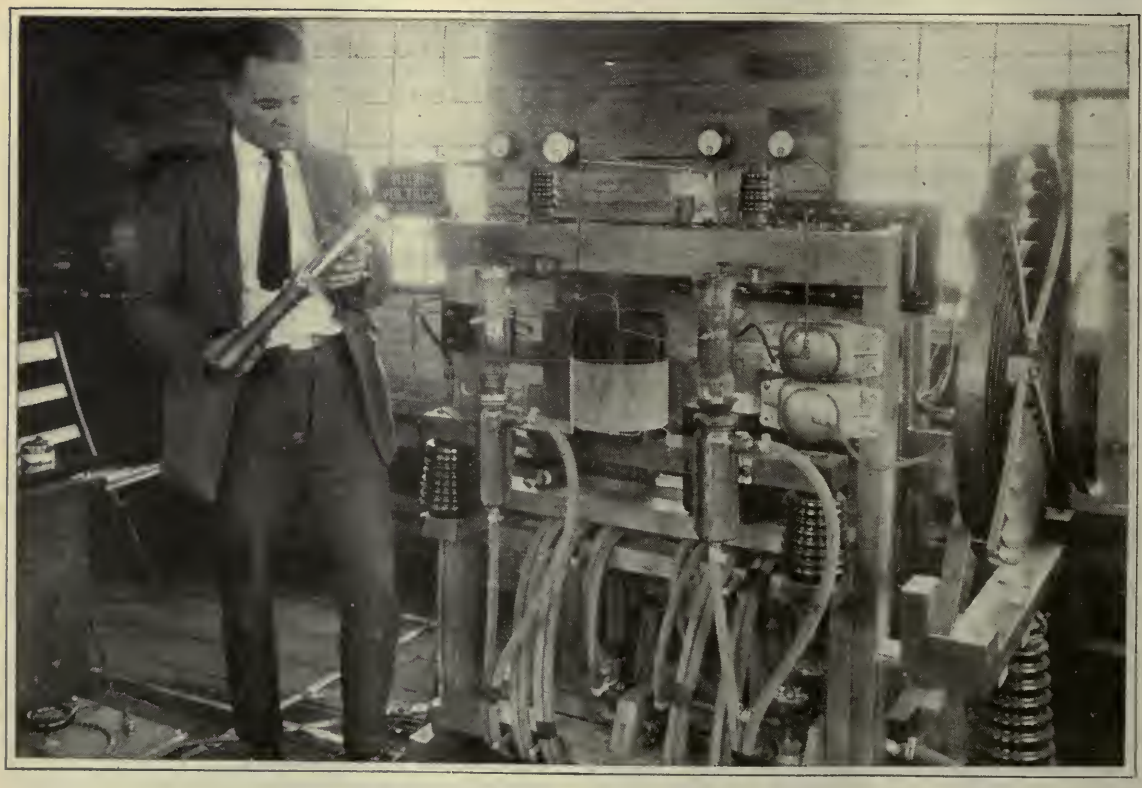
At the annual dinner of the Massachusetts

Institute of Technology alumni, in New York, WGY, connected to New York by a special circuit, broadcast the music and speeches on 380 meters wavelength and on 107 meters. The signals on 107 meters were so strong and clear that Pittsburgh picked them up and sent them to Hastings, Nebraska, which again rebroadcast. Finally KGO, the General Electric Company at Oakland, caught the three-times-relayed signals on delicate receiving apparatus and again put the dinner program into the air. The only wire used was that between WGY and WJZ in New York.



THE SHORT WAVE OSCILLATOR UNIT

Showing the special aluminum plate air condenser, at the left. Many difficult radio engineering problems were involved in getting this transmitter to work perfectly



THE 107 METER TRANSMITTER

With the short wave oscillator and modulator unit. The two water cooled tubes are in the foreground. One tube is used as an oscillator and the other as modulator



For and Against the Woman Radio Speaker

BETWEEN receiving expressions of opinion from six men associated with broadcasting stations, and hearing by radio nearly all of the speakers at the Republican and Democratic national conventions, quite a bit of light has been thrown on the question discussed in this department last month relative to whether or not a woman's speaking voice is always displeasing over the microphone. The discussion started from the statement of a writer in RADIO BROADCAST that his experience in the phonograph business, and the experience of many others in this business, had proved conclusively that the public finds a woman's speaking voice displeasing unless she can be seen as she speaks. Therefore, women should never be allowed to talk over the microphone either as announcers or lecturers.

Mr. Martin P. Rice, manager of broadcasting station WGY at Schenectady, disposes of this moot question briefly and with emphasis. Here is what he has to say:

"It would be about as logical arbitrarily to condemn all women's voices for radio broadcasting as it would be to ascribe all the known virtues to women and all the vices to men. Women, as a class, have not had opportunities to adapt their voices to varying audiences and auditoriums. An insistent high-pitched voice may readily develop unpleasant characteristics, but this is just as true when the speaker appears in person as when she addresses a large audience by radio. Women have decided to take a part in public life as well as in domestic life, and they will master the technic of radio if they have not already done so."

That scores one for the women.

Then along comes Mr. W. W. Rogers, of the publicity department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, and associated with station KDKA since the day it sent out the first program ever broadcast.

"Women as radio entertainers were pioneers at KDKA," he tells us. "They have had a definite place on the radio schedule since, and I cannot remember one radio program presented by KDKA which did not have at least one woman participating. As I remember, the worst lecturer and the best singer I ever heard by radio were women.

A Woman is Rarely a Success

BUT a woman speaker," goes on Mr. Rogers, "is rarely a success, and if I were a broadcast manager, which I am not, I would permit few women lecturers to appear. The reason is that their voices do not carry the appeal, and so, whatever the effect desired, it is lost on the radio audience. One of the chief reasons for this is that few women have voices with distinct personality. It is my opinion that women depend upon everything else but the voice for their appeal. Their voices are flat or they are shrill, and they are usually pitched far too high to be modulated correctly.

"Another reason is that women on the radio somehow don't seem able to become familiar

with their audiences, to have that 'clubby' feeling toward the listeners which is immediately felt and enjoyed. Still another thing that is lacking in most women before the microphone is summed up in that trite old phrase, 'sense of humor.' I didn't believe this at one time, but now—well, I think it's true. We need quite a bit of light and airy stuff, or humorous quirks by radio. To sum the matter up, women who are heard by radio seem unable to let themselves go. They are too self-contained to carry a real friendly feeling out past the transmitting station, through the ether, and into the homes of the radio audiences."

Passing from the opinion of one expert to another we come to Mr. Corley W. Kirby, director of station WWJ at Detroit. As do the majority of the others, Mr. Kirby rather brushes aside the premise that no woman under any conditions whatsoever can be acceptable to a radio audience when she is speaking. He states his position without equivocation.

"Women Are Not Fitted for Radio Announcers"

I DO not believe that women are fitted for radio announcers. They need body to their voices, and this is the most important thing, I think. I grant though that some of the women announcers have better sense than some of the men announcers. I look at an announcer in very much the same light that I would consider the old show announcer. He has something to tell the people, and what he has to tell them they want to hear. His announcements should be short, business-like, and to the point.

"When women announcers try to be congenial in their announcements, they become affected; and when they attempt to be business-like they are stiff. There also seems to be an



—Trinity Court Studio

AS THEY WOULD HAVE LOOKED IN 1860

No, the girls are not wearing a new style of bloomers. They're wearing what was the style back in 1860, and you know what they called 'em. Here, from left to right, are Raymond Griffin, baritone, Mabel King, contralto, Irma Carpenter, soprano, Roy Strayer, tenor, and Earl Mitchell, pianist. They took part in the concert of old-time melodies given at Carnegie Lecture Hall, Pittsburgh, staged and broadcast by station KDKA. This was the first of a series of costume recitals to be broadcast by this station and given before a public audience.

offensive nasal quality in their announcements. Their voices are pitched too high. As for women readers, they are as a rule simply terrible. This applies both to those we have had at our station and those I have heard from scores of others."

That is so clear that he who runs may read. So we will pass on to the next, Mr. J. M. Barnett, director of station WOR at Newark, which probably features more women speakers than any other station in the country.

"To my mind a woman's voice on the radio is not generally considered uninteresting," says Mr. Barnett. "It depends upon the work that she is doing and the way she does it. It is the same with a man's voice. There are many male voices that are very uninteresting. For certain types of radio work I consider that a woman's voice is very essential; but for announcing, a well modulated male voice is the most pleasing to listen to. I have absolutely nothing against a woman's announcing, but really do believe that unless a woman has the qualifications known as 'showman's instinct,' it really does become monotonous. As a general thing, a woman's voice is considerably higher pitched than a man's voice and sometimes becomes distorted. This, of course, is simply my personal opinion in the matter."

This leads one to conclude that WOR has not been deluged with complaints against women speakers.



—Knight, New York

EDWIN FRANKO GOLDMAN

Conductor and founder of the Goldman Band, whose summer night concerts in Central Park, New York, have been a bi-weekly feature of WJZ and WJY programs

Mr. Charles B. Popenoe, manager of stations WJZ and WJY, New York, disposes of the subject with few words, confining his statements wholly to the quality of transmission of a woman's voice. He says:

"We use, of course, just as every other station, a great many women speakers on various subjects, but in no case does the female voice transmit as well as that of the man. As a general thing it does not carry the volume of the average male voice. As far as women announcers are concerned, we have never used them with the exception of Miss Bertha Brainard, who occasionally broadcasts theatrical material or announces a play being broadcast directly from the stage. In this case she is used because she knows a great deal about the theater."

Humor Has No Place in Radio Announcing

AS FOR Mr. M. A. Rigg, manager of station WGR at Buffalo, announcing and voice are in most instances, "concerned chiefly with the individual and not with sex." He goes on to explain, "Although we have a woman announcer at this station, it is not my intention to feature a woman in this capacity. There are many reasons why, to my mind, it seems advisable to use a man as announcer, especially during the heavier part of the work."

Mr. Rigg also has something to say about the try-to-be funny announcer.

"Listeners-in will remember when it seemed

to be the policy of the various companies operating broadcasting stations to have a comedian as announcer. He would continually make supposedly bright remarks about the performers and every one in general during his announcing. WGR is especially watchful to keep all phases of entertainment out of announcements. We plan to make them simply as statements of facts. In other words, we believe in letting the performers do the performing."

The present writer has never yet heard a woman announcer who thought it her duty to entertain her listeners by constant jollying, and that, at any rate, is one thing in the women's favor.

It is clear from the consensus of opinion expressed by these six broadcast managers that women as microphone entertainers have come to stay, although they are not at present considered the equal of men in this capacity chiefly because of the defects in their voices.



THE ARION TRIO

A frequent and always popular feature of the programs given at KGO, the Pacific Coast broadcasting station of the General Electric Company. Left to right they are, Margaret Avery, Josephine Holob, and Mrs. J. H. Barthelson

When Woman Radio Speakers Surpassed the Men

AND then—there are the memories of the speakers at the Republican and Democratic national conventions to upset this verdict.

Speaking before the microphone during those conventions were many men (far too many), all of whom should have proved that they knew something about the use of the voice and about diction when addressing an audience. But it was quite otherwise. The large majority of them pitched their voices high, adopted a booming aggressive tone, and never, during one sentence, changed either its pitch or quality. This meant not only that the voice was absolutely lacking in individuality, but intolerable to hear. But that was not all. These men talked on the back of their tongues, swallowing all of their consonants and spreading all of their vowels. Many of them gave the impression that they were talking through whiskers that had been allowed to go uncut since the last election.

No wonder that at both conventions many speakers were not allowed to finish, being ragged off the platform by the bored audience. Many a seconding nomination never got so far as to let the audience know who was, "the man I am about to name." The speaker was boo-ed off the stage.

With marvellous fidelity a good receiving set reveals such faults in tone and diction. Probably millions of listeners-in passed judgment on those men speakers and called them uncomplimentary names. But the moment someone rose to speak who had even a halfway idea of enunciation, and how to poise the tones, that speaker so far as this writer's experience goes was as plainly understood as if he had been in the very room where the listeners sat.



—Colegrove, Buffalo

GEORGE ALBERT BOUCHARD

Organist for WGR at the Hotel Statler, Buffalo, where he gives a daily program, Sunday excepted, from 12.30 to 1 P. M.

asphalt after being jolted unmercifully over cobblestones.

These conventions proved conclusively that if a woman knows her business when she tries to speak before the microphone she can create a most favorable impression. All who listened-in to these conventions must have felt the pleasing personality of some among the women speakers. And, by the same token, they must have felt just the opposite regarding many of the men.

Good Radio Drama from KGO

AT KGO, the General Electric Company's Pacific Coast station, at Oakland California, they use a good many women as speakers and readers and also in the casts of their dramatic productions, as those who keep track of their programs know. So far as the present writer can discover, more dramas are given at KGO than at any other station in the country, with the exception of WGY, also a General Electric station. Among the plays

Which brings us back to women radio speakers. At these conventions some of them had it all over the men. Occasionally one heard a woman who talked through the top of her head—or shall we say through her hat?—and the opening seemed small. But there were others who came near to being ideal orators. Voices perfectly poised, flexible in pitch, and faultless diction.

The managers of both these conventions seemed to think that the calling of the roll of states for votes should be done by a man chosen only for the size of his voice. Diction was apparently not taken into consideration. One heard—"Wan" for one—"twarnty" for twenty—"saxty-sax" for sixty-six, and so on. Not from all the clerks, but from altogether too many of them.

The Democrats had a woman clerk who followed a man at times who spread all his vowels and was not on speaking terms with any consonant. After trying to understand what this man was saying, listening to the perfect diction of the woman clerk was like riding along



MARJORY GARRIGUS SMITH

Wife of Fred Smith, director of the Crosley radio station, WLW, was recently heard in a piano recital at the Cincinnati Conservatory of Music. She is the artist pupil of Marcian Thalberg and accompanist for Mme. Reiner, wife of Fritz Reiner, conductor of the Cincinnati Symphony Orchestra

recently given at KGO were, "Passing of the Third Floor Back," "Kindling," and "Peg O' My Heart"—a trio of titles that shows the standard aimed at in matters dramatic. Some of the best planned musical programs given by radio in the entire country come from this station, as note the following composers taken from a program that happens to be at hand: Handel, Grieg, Sinding, Leschetizky, Arthur Foote, Chadwick, Mendelssohn, Landon Ronald, Cadman, Huhn, Mrs. H. H. A. Beach, Massenet, Coleridge-Taylor, Lieurance.

Many of these musical programs are interrupted by an address absolutely foreign to music, as is the case with practically all broadcasting stations. The reason for this aggravating and inartistic custom is an unfathomable mystery to many listeners-in.

One of the outstanding features at KGO during the last months was the performance of Mendelssohn's "Hymn of Praise," given by chorus, soloists, and the KGO Little Symphony Orchestra, the entire production under the direction of Mr. Carl Anderson. This was not the broadcasting of a public concert, but a program prepared wholly for the purpose of radio listeners, something that few broadcasting studios have the enterprise or faith in the public to undertake.

This choral performance was preceded by Mendelssohn's overture, "Ruy Blas," and a short biography of the composer. All other music played during the performance, such as interludes, was also by Mendelssohn. It is not often that a musical program of such standard, and kept so throughout, is given at a radio studio.

The Radio Audience Likes Regular Radio Features

EVERY week day, at 12.30 P. M., in the dining room of the Hotel Statler, Buffalo, George Albert Bouchard gives a short organ recital which is broadcast by station WGR. While the lighter numbers predominate in Mr. Bouchard's concerts, he manages to give a goodly number of standard works as well. This half hour program has proved one of the best liked regular features of WGR.

People who listen-in to programs given in hotel dining rooms have the advantage over those who are right there on the spot where the music is played. The radio audience does not suffer from the confusing sights and sounds that inevitably distract the attention when one is surrounded by diners and those who serve them.

People like it when a certain station features a certain kind of program at a given hour daily, as these programs of Mr. Bouchard's are featured. If they enjoy the feature they like to tune-in on it whenever the mood to do so prompts, and always find it at hand. According to Mr. M. A. Rigg, manager of WGR, Mr. Bouchard has a very large following of daily listeners.



ROBERT A. MUNN

In addition to being an announcer at station WGR, Buffalo, Mr. Munn, who is an accomplished musician, is frequently heard as organist from that station, and he could also present an excellent program of baritone solos if he so desired. He is the lone bachelor of the WGR staff, but doesn't look at all worried about it

The Radio Pianists Play Good Music

CONSIDERING in retrospect the music that has been heard by radio since this department was started, it has been decided that to the



BERTHA BRAINARD

Of the staff of station WJZ and WJY, New York. Miss Brainard is heard on the air regularly from "Broadcast Central" in her talks called "Broadcasting Broadway"

pianists goes the credit for giving the largest number of selections taken from the standard composers. Of these composers Chopin and Liszt have been played the most often, with, perhaps, Rachmaninoff coming third, although he is seldom represented except by one of his two well-known preludes. Beethoven has been by no means neglected by these pianists who have broadcast, nor have Mozart or Grieg. Indeed very few poor compositions are played before the microphone by pianists who are capable of playing something better.

Violinists and 'cellists come next in the quality of their selections, but are not on a plane with the pianists. Let it be understood that this refers to the quality of the works they play and not to the quality of the playing.

Singers do only fairly well when it comes to presenting numbers that are really worth the hearing. Some numbers they sing little better than Annie or Susie, Joey or George next door could. Singers' programs are monotonous because they are so often made up of the same numbers one hears night after night, from broadcasting stations, east, west, north, and south.

Orchestras play more trash than all the other musicians broadcasting combined. The same thing, night after night, in the same places—which means everywhere. But, before another year has passed, radio orchestras will be giving us real music. A few of them do now. But how many? This is what the present writer is trying to find out.

IT IS so unusual to get a thoroughly good musical program these days when you tune-in, meaning by this the sort of music you would be willing to pay to hear, that when WSAI was tuned-in some time ago and some really stunning music came through the horn, astonishment was on the faces of all who heard. Soon we learned from the announcer that the graduating exercises of the Cincinnati Conservatory of Music were being broadcast. Which accounted for our surprise and pleasure.

IT IS a question whether it is desirable to prelude each number of a musical program broadcast by an explanation of the number or an analysis of its mood. We doubt it. But it is being done. We wonder how many people actually like it.



—Swan, Buffalo

HELEN M. WHITE

Who is secretary to M. A. Rigg, Jr., the manager of station WGR, and is also sometimes at the microphone making announcements



J. ANDREW WHITE

Who announced the proceedings of the Democratic National Convention for stations WJZ and WGY. He is shown before the microphone in his sound-proof cabinet in Madison Square Garden, New York

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

Excellent Broadcasting of the Political Conventions

JUNE and July have passed and with them the nominating conventions of the two great political parties. National nominating conventions are always a test for the party holding them. Conventions test men and they test principles. But at both the Republican and the Democratic conventions, radio broadcasting was also on test. For the broadcasters and the politicians were acute enough to see, almost before the campaigns for the various candidates were much more than a breath in an otherwise pretty calm political atmosphere, that radio, linked with the Presidential nominating convention and campaign would be extremely valuable.

The Republican Convention at Cleveland was the first task the broadcasters faced and they did a good job. The broadcasting stations as far west as St. Louis and Kansas City and as far east as Boston and New York were linked up with that beautiful Public Auditorium in Cleveland by special land wires.

More stations were linked together for the Democratic Convention, and, as everybody knows, they were linked for a much longer time. Eighteen stations used the wire telephone links of the American Telephone and Telegraph Company, and WJZ and WGY of the Radio Corporation, used separate Western Union connecting lines and their own announcer.

During the short span of the Republican convention—which went off with neatness

and dispatch—and the dull, dreary succession of balloting of the Democratic convention, radio demonstrated its ability to spread information as no other medium possibly could. It is bromidic to speak of "atmosphere" from the conventions being one of the chief charms of the material that emanated from loud speakers in uncounted homes practically all over the nation, but unavoidably, that was one of the most compelling bits about this new political broadcasting which has people talking about radio as people have never talked before.

There is no doubt that the convention broadcasting was a success. To the small army of A. T. &. T. engineers and maintenance men who were constantly on the job much approbation should be given. For their complete arrangements and constantly exercised skill, the gratitude of the vast radio audience is due. But to Graham McNamee, chief announcer of WEAF, whose voice has undoubtedly been heard by more people than any other living man, goes honor and credit for a most thoroughgoing and able task, excellently accomplished. He had tact, keen observation, and a charm of manner which has made radio listeners quite willingly sing his praises. J. Andrew White, who announced for WJZ-WGY during the Democratic convention, earned his share of the announcing honors by his careful observation and extraordinarily fine descriptive powers.

The convention broadcasting was a great and an interesting lesson to millions of people in this country in practical politics; and, what is more important, the millions liked it.

The Radio Orator Must Be Good

THERE is no doubt whatever that radio broadcasting will tend to improve the caliber of the speeches delivered at the average political meeting. Radio oratory is obviously much different from oratory on the platform, as a recent editorial on the quality of political harangues points out. Personality will count for nothing as far as the radio audience is concerned. Ill built sentences express-



RADIO ABOARD THE S. Y. "VANADIS"

Owned by C. K. G. Billings. All hint of a radio receiver has been removed from the cabin with the exception of the loud speaker at the lower right. It is a small yacht indeed these days that does not have its radio receiver aboard

ing weak ideas cannot succeed with the aid of forensic gesticulation. The flowery nonsense and wild rhetorical excursions of the soap box spellbinder are probably a thing of the past if a microphone is being used. The radio listener, curled comfortably in his favorite chair is likely to criticise the vituperations of the vote pleader very severely Woe be unto the candidate who depends for public favor upon wild rantings and tearings of hair. Political campaigns of past years have been liberally supplied with artificiality of this sort.

The Blind Should Have Radio Sets

EQUALLY to be recommended with Roxie's campaign for disabled soldiers is that originated by Alfred M. Caddell, Secretary of the American Radio Association, to obtain radio sets for all the blind children who come to the attention of the American Foundation for the Blind. Thousands of blind people maintain their principal contact with the world in which they move, by sound—by messages which reach them through the ears. Near the larger cities there is now available a more or less continuous program throughout the day and evening so that the blind BCL may really know as much of the goings-on in the world as the rest of us who get it from the printed page.

It is eminently fit that such a movement should receive the support of Helen Keller who has already done so much for her blind companions, not only in a material sense but also by her practical example. It is possible to get much enjoyment even without the use of eyes. The radio set conveys to the blind listener messages by electromagnetic vibrations, just the kind which the defective eyes of the sightless listener cannot perceive without such a translating device as the radio set. How fine it would be if something could be devised to make the blind aware of light waves, which are just the same kind as the radio waves, and for which our eyes ordinarily act somewhat as the radio receiver does for the blind.

The American Radio Association, 50 Union Square, New York City, has arranged with the American Foundation for the Blind mutually to coöperate in their coming campaign to secure radio sets for the blind. It is fortunate that the A. R. A. which is doing such able work for the broadcast listener, is to lend its aid to this good cause.



SENATOR PAT HARRISON

Of Mississippi, delivering the keynote address at the Democratic National Convention at Madison Square Garden, New York City. Two of the four microphones were used for energizing the battery of twenty loud speakers which were clustered above the speaker's platform, while the other two were divided one each to WJZ-WGY, and the other to the 17 other stations connected with WEAF

"Radio Reaching Out Farther"

CONTINUALLY we hear of the increasingly remarkable feats of radio transmission. There seemed to be a preconceived notion that short waves could reach only to correspondingly short distances, but such ideas are now being discredited rapidly nowadays. It is becoming an every day ac-

complishment for a few watts, radiated at a wavelength of a few hundred meters, to span thousands of miles of land and ocean. Of course the transmission of these waves is no better to-day than it was a few years ago; the advance has come about in the better receiving sets which have been introduced in the short wave receiving station.

We must always discount the statements of publicity and advertising managers because of their well paid enthusiasm, but we are much startled to see in an English radio journal, "Get America every night." If we discount this claim 50 per cent. and think of the English boys getting America only every other night, we can realize what tremendous progress is taking place. It's only two years ago that this was accomplished for the first time by the best amateurs and apparatus America could afford!

It won't be many years before many of us consistently hear English programs, if they will run their stations sufficiently late at night for us. Incidentally there must be lots of sleep lost by the enthusiastic British listeners, who wait until about three o'clock in the morning to hear our speeches and jazz.

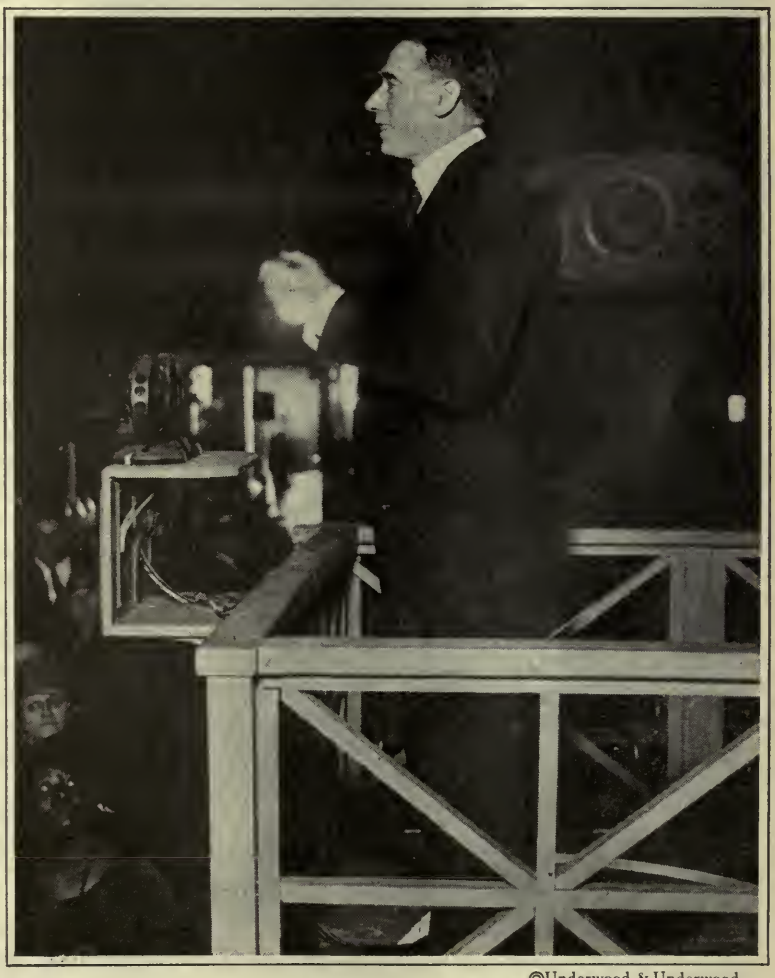
And not only in the British Isles are our stations being heard, and even used for modulation of local stations, but from far off Cape Town, 8,000 miles from our eastern coast, we get reports of the reception of WEAF and WGY.

How Broadcasting Reached a Balloon

THE Springfield station of the Westinghouse Electric and Manufacturing Co., WBZ, is reaching out and up. During the recent James Gordon Bennett Cup races for free balloons, held in Europe, the pilot of one of the entries, Mr. Van Orman of balloon *Goodyear III*, picked up its radio messages and sent to station WBZ the following cablegram from Amsterdam.

"Heard call letters 2:37 Monday morning—Van Orman."

It may seem odd that a balloon perhaps two or three miles high should be able to pick up earth-conducted radio signals, but from what we know of radio transmission and its relation to airship reception it seems sure that he would have received them almost as well had he been ten or twenty times as high—which is of course impossible for a machine which depends upon the supporting power of the air to keep it aloft.



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DR. MARION LEROY BURTON

President of the University of Michigan, nominating Calvin Coolidge, his former neighbor at Northampton, Massachusetts, for President of the United States at the Republican National Convention, at the Public Auditorium, Cleveland, Ohio. The microphones which picked up the proceedings of the convention are on the lectern in the foreground. Fourteen stations were linked to broadcast it

International Broadcasting

AT THE same session of the electrical dealers where our favored word, broadcast, was being legislated out of existence, David Sarnoff, general manager of the Radio Corporation of America, predicted that within the next year the farmers in Kansas and Missouri, as well as the city dweller, *might* hear radio programs from Paris, London, South America, and other parts of the world, according to a press despatch. International broadcasting which will link up the farthermost corners of the earth is closer at hand than the public imagines, said Mr. Sarnoff. Greatly increased power of our broadcasting stations and more completely developed rebroadcasting schemes, he thought, would enable programs to be heard simultaneously over large parts of the earth's surface.

Mr. Sarnoff was careful in his choice of the right word. The word *may* denotes either a permission or a possibility, it by no means tells the man from Missouri that he *will* be hearing European stations next year but that he is allowed to listen for them and take a chance on the possibility of hearing something.



REX F. PALMER. CHIEF ANNOUNCER

Of the British Broadcasting Company's nine stations. His voice is one of the best known in England, for when S. B.'s, or simultaneous broadcasts, occur in which all the stations in the chain are linked together, the announcing is done from London with Mr. Palmer in charge

Radio is a Career for the Trained Man

APPARENTLY there are still many boys and young men to whom radio holds out the glamour and lure which the gold fields of '49 held out to their grandfathers—offers so wonderful a field of opportunity and advancement that the long hours of study and application, and the natural aptitude required, seem entirely to escape their notice. It is easy to comprehend this unwarranted judgment of the newcomers in the field. The radio art is not yet sufficiently old to have put into their proper perspectives the few dominant figures which rose more or less automatically on the tremendous wave of popularity which has swept radio along during the last year or two. Marconi, DeForest, Armstrong, Sarnoff: in a few years one of them jumps from wireless operator to General Manager of the Radio Corporation—another from a poor student to a wealthy man—another from an embryonic scientist to the popularly acclaimed founder of the art claiming millions of devotees. With such feats accomplished before his eyes, it is no wonder that the young man with ambition (even though he has nothing else) should think of turning to radio.

It is well to strike a warning note. The gold of to-day is not picked up as large nuggets by the lone prospector ignorant of metallurgy, geology, engineering and the like, but is obtained by the careful working of low grade ores which the 49'er would have passed by without a second glance. Staffs of skilled engineers and technicians, who have had education and experience, are getting our gold for us to-day and a very similar change has taken place in radio during the last few years.

To-day there are hundreds and hundreds of men who can be truthfully designated as radio engineers, working night and day in intense competition with each other to capture the rewards which radio still offers. But these men are well educated in the principles of radio. Most of them have had engineering school training as electrical engineers or physicists before specializing in radio. They have accurate knowledge of the past development of radio and of the needs of the future, and their training enables them to attack new problems as they arise. While new ideas will pop up occasionally from the activities of an untrained experimenter, most radio advancement must come from the activities of these trained engineers.

What then should be our advice to a man, say thirty years old, who comes to us to find out how to get into the radio field, his previous training having been in agriculture, his ambition to become a radio engineer or technician being so intense that he had already given up his job on the State Agricultural Staff? To kill high ambition is unworthy, but what else is to be done in a case like this? His chances of success are not more than one in a million and they are growing less each year as the knowledge of radio becomes more systematized and the technically trained workers more numerous. Any one who wants to have reasonable chances of success in radio to-day must travel the long and arduous path of high school and technical school.



MASANAO HANIHARA

Former Japanese Ambassador to the United States, listening to the activities of the Democratic convention in his office at Washington, just before he left to return to Japan

Short Radio Beams Probably Are Not Satisfactory for Voice

SOMEONE in the British Isles is trying to carry on long distance radio telephone communication. At a frequency in the region of 3,000 kilocycles we have frequently heard, in unmistakably English accents, inquiries for a certain Mr. Thomson who, presumably was located somewhere in Canada, from the manner in which the one sided conversation was carried on. We have also heard tales of tens of kilowatts of power being sent out from Poldhu at these high frequencies so we are not surprised to hear the announcement from London that Signore Marconi has been able to talk directly to Buenos Aires from Poldhu, Cornwall. According to the London despatch the radio beam system was used. A listener in the United States would have been in the edge of the beam so it is possible that "Mr. Thomson" instead of being in Canada as we guessed, was in South America.

While we are not yet supplied with sufficiently accurate data to make the statement definitely, it seems likely that these very high frequency channels will not be as suitable for radio telepone traffic as we had thought. The prospects, as has been many times pointed out, seemed very bright for using wavelengths between 50 and 100 meters for radiophone channels. This energy can be reasonably well directed and there are as many channels between 50 meters and 100 meters as there are at present in the whole broadcasting range. Excessive fading of these short waves was prophesied by some engineers, but Mr. Pickard's measurements showed this to be incorrect. The fading, which the investigations of Mr. Pickard showed, was of the kind that makes the signal wax and wane perhaps several times a minute, or at longer intervals. Fluctuations which occur several times per second could not have been detected by the apparatus which Mr. Pickard used. But in listening on some of these short wave channels a peculiar quality of the speech is noticed, which might be due to very rapid fluctuations in the signal strength, perhaps 50 to 100 times per second.

This apparently short period fading of the high frequency channels will make no difference in radio telegraphy, but it may very seriously limit their application to speech-modulated waves.

The I. R. E. Medal for Pupin

AT THE last meeting of the Institute of Radio Engineers the Medal of Honor of the Institute, awarded annually to that scientist or engineer whose contributions have been influential in forwarding the radio art, was given to Prof. M. I. Pupin. of Columbia University. In a brief speech of acceptance Professor Pupin (the same man who recently



DR. FRANK H. VIZETELLY

Editor, The New Standard Dictionary

"Steps should be taken to regulate the radio nomenclature before it becomes so unwieldy as to make it impossible to reduce it to simple terms. Nothing is going to help the plain people more than the use of simple terms wherever that is possible. Radio has won its way to the hearts of the people; it is a boon and blessing to men and women in all conditions of life. I don't know how many homes are already hooked up with our vast system of broadcasting stations, but I should not be surprised to learn that ten millions of them already tune-in somewhere. The skeptic "shallows" have written down radio as a passing fancy, and I have no patience with such silly nonsense. Personally, I hail radio as a God-given remedy to our modern paganism, and I hope it will continue to spread until it shall be found in every household from which love and happiness have been driven by the neurotism of the times. My faith is as strong as my hope that radio will survive as long as truth lives."

gained nation wide attention by the appearance of his remarkable autobiography *From Immigrant to Inventor*) reviewed the advent of radio, from the standpoint of the scholar and scientist. From Joseph Henry to Heinrich Hertz, with the intermediate work of Maxwell and Kirchoff, Pupin traced the development of the new thought in electrical theory which served as the basis of knowledge in this branch of science when the young Marconi began his remarkable experiments on the application of the art, which up to his time had been regarded merely as an interesting laboratory demonstration.

Radio Technicians Should Not Attempt Philology

DEALERS in radio receiving sets, recently assembled in solemn conclave in Atlantic City, made the shocking discovery that, according to the dictionary, the word broadcast was already used by the farmer, in the sense of broadcasting seed as contrasted to drill sowing. Having thus been shown by some embryo philologist that the very foundation of their trade was based upon a misconception, they immediately cast about for another more suitable term and happily (as they thought) alighted on the excellent term—radiocast. It was perfectly proper, and to the best of their knowledge, not used by farmers or any one else, so they solemnly decreed that hereafter they would cater to the needs of the radiocast listener and ignore that other formerly valuable customer, the broadcast listener.

It so happens however that this new word radiocast, is etymologically an unnatural hybrid and shocking to him who studies the origin and composition of words. If the man on the street wants to talk about broadcasting the dealers cannot say him nay—they will willingly sell him broadcast apparatus rather than keep their shelves stacked high with uncalled for radiocast apparatus.

Further, why do the dealers let us "radiate" energy from our antennae when some folks, fat, jolly ones like Irving Cobb, have been "radiating" good humor for quite some time past? Hasn't the fat man been seriously imposed upon by our thus appropriating his terminology and shouldn't the electrical dealers in special session take up the matter at once?

French Transmission of Pictures by Radio

PARIS is reported to be much elated over the successful radio transmission of a picture of General Ferrié, director of the Eiffel Tower Wireless station. The picture was sent by a process said to be the invention of Edouard Belin, who has been engaged in the development of picture transmission since 1912. Undoubtedly the picture transmission was carried out by practically the same process as that used by the A. T. & T. Co. for transmission over wires. It consists essentially of light-sensitive cells and synchronized sending and receiving apparatus. If the ap-

paratus at the two ends of the wire (or radio channel) stay in synchronism, and if no interfering currents step in to blur the picture, the reproduction is really quite truthful, and a reasonable reward for the great efforts which have been expended on this problem. Transmission by wires, it seems, is somewhat more reliable than by radio as the disturbing currents can be better controlled.

The *Matin* seems overenthusiastic about this scheme of Belin; its editor at once jumps to the conclusion that teleview, or long distance seeing, will soon be accomplished. To those who know how the picture transmission is carried out, however, long distance seeing is still far from a solution and apparently not to be attained by the methods at present used, if at all.

"Building Your Own" Requires Care

AT THE request of one of our friends we throw out a word of caution to those radio enthusiasts who spend most of the time formerly devoted to the theatre, cards, and billiards in dabbling with radio apparatus. It is really very instructive and satisfying to build a good radio set and the fewer the parts bought "ready made" the greater is the satisfaction—if it works.

There are radio experimenters who want a "push-pull" amplifier to operate their loud speaker. This unit requires special transformers. These special transformers are not legitimately on the market, we are informed, as they apparently infringe patent rights of the American Telephone & Telegraph Co. You can buy them from the company—providing you buy the rest of the amplifier unit. As the transformers are practically the whole thing in the amplifier it is quite in line for the enthusiast to try and wind his own.

So this experimenter with another devotee, decided to build his own push-pull transformers and thereby acquired experience—of a sort. To wind a suitable transformer it is advisable to use wire insulated with enamel only. Silk or cotton insulation takes up so much room in these small sizes of wire that a compact transformer with silk insulated wire is impossible. Many thousands of turns are required on a transformer. After calculating the design of the transformer in the proper way, they wound them, using up several afternoons which, it turned out afterward, might have been spent on the golf links to much better advantage. For after finishing the tedious winding job, the transformer wouldn't work. Tests showed that many turns were short-circuited—evidently due to weak spots in the enamel insulation and somewhat careless winding. If, during the winding operation, one turn of such a transformer is pulled so tightly that it imbeds itself deeply in the winding already on the core, a short circuit is probable. And so we received the suggestion, "Tell your readers of my experience. They had better make layer-wound coils if they are going to wind thousands of turns of small enamel covered wire."

WGY Finishes Its Dramatic Season

THE Schenectady station of the General Electric Co. can well claim the distinction of being the pioneer among dramatic broadcasters. This type of radio



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CARL W. MITMAN

Curator of Engineering, of the National Museum at Washington, holding what is believed to be the first radio tube. It was made in 1898 by D. McFarlan Moore of New York. Waves from this tube were used to blow up a miniature of the battleship *Maine*

entertainment was put on the air at Schenectady as far back as 1922. The development of this phase of broadcasting has been under the direction of Mr. E. H. Smith who has obtained unique and valuable experience from his work. What kind of play does the BCL want, how many people should there be in the cast, how long should it be, etc.?

It is realized at once that a good deal of alteration must be made in the ordinary play before it is suited to radio broadcasting. Gestures, scenery, lighting, and all such artifices are of no avail. The intonation of the voice must be developed to the limit as the only way of projecting the atmosphere of the scene to the radio listeners. New noise-producing pieces of apparatus have been called upon to help out the listeners' imagination. The broadcast director has a real task to carry his radio audience along with him as the melodrama unfolds itself. It has been found that not more than five characters can be used in the cast since it is practically impossible to recognize a greater number of actors as the quality of the voice is the only way the BCL has of telling who is doing the talking.

The WGY players have produced eighty-three plays since they first came on the air, most of them adaptations of stage successes. During the summer the radio players, like their confrères of the legitimate stage are taking a vacation, and will open their season in September.

Interesting Things Interesting People Say

MANSEL KEITH (New York City, addressing the recent Convention of the Associated Manufacturers of Electrical Supplies): "There has been a reduction of 41.7 per cent. in juvenile court cases in the United States during the past year due to the influence and growing popularity of radio. Radio has supplied the necessary interest and romance needed by the youth. He is now spending his time in tuning-in, or in making sets, rather than getting into mischief. Radio is helping to develop the boy's mind, and is a contributing cause which should make him a more intelligent man than his father."

ALFRED M. CADDELL (New York City; Secretary of the American Radio Association): "There are now more than 3,000 manufacturers of radio supplies in the country, ranging from the



H. J. WALLS, ASSISTANT RADIO ENGINEER

Of the Bureau of Standards, Washington. He is shown adjusting the radio relay mechanism which sets the clock by Naval Observatory time from station NAA at Arlington. By a system of relays controlled by the clock, Mr. Walls can set noisy alarms, turn on and off any number of lights. By the use of this device, domestic electric stoves can be regulated while the housewife is out shopping—or at the movies

makers of radio sets and tubes to the manufacturer of radio jacks and coils. There are about 1,000 distributors and 27,000 retailers. More than 250,000 people are connected directly or indirectly with the manufacture and distribution of radio supplies. All told, it has been estimated that a $350,000,000 radio business was done in the United States last year, and $50,000,000 of this was done in vacuum tubes alone. Judging from the volume of business done so far this year, it seems safe to predict a business aggregating $500,000,000 for the year 1924.

"Our figures show that there are probably between 3,500,000 and 5,000,000 tube sets now in use. Probably 5,000,000 to 7,000,000 crystal sets are owned in this country.

A. C. MILLS (New York City; Executive Chairman of the Society of Authors, Composers and Publishers, commenting on the attitude of his society toward commercial broadcasting): "The entire industry of public amusement, depends on the man who creates music. We have to start with music and the man who creates it.

"If we had not asserted our rights at the inception of commercial broadcasting about three years ago, we should now be supporting those broadcasting stations. Instead, a good many of them are now paying the music publishers for the use of their copyright works."

E. B. MALLORY (New York City; Chairman of the Radio Section of the Associated Manufacturers of Electrical Supplies): "Three million people listened-in on the Republican Convention. ". . . Radio is a great educational medium. During the Conventions, many schools discontinued regular classes so that students might receive first hand knowledge over the radio of how a Presidential candidate is nominated."

F. C. MORTIMER (New York City; writer of "Topics of the Times" in the New York *Times*): "While the radio did magnificently that part of the work of reporting the convention that was entrusted to it, not only to the telephone, but also to the telegraph should due credit be given. That simpler means of communication still is far from being superseded by its younger rivals. Their competition did not prevent the telegraph companies from preparing on a greater scale than ever before at a political convention to serve the press. More wires, more instruments, more operators than the newspaper men ever saw at a previous gathering of this kind had been provided in anticipation of increased demand for the familiar service, and these increased facilities were used exactly as if there were no such thing as a telephone or a radio.

"It is true that radio beat both of its rivals by several minutes—five, perhaps—in conveying the action of the culminating moments, but it was not from these that the compositors "set up" the long and numerous dispatches that appeared in print.

"The radio has its own domain, and is unapproachable there, but neither the telephone or telegraph is in any danger from it so far as yet can be seen."



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CAPTAIN W. A. MOFFETT, U. S. N.
Chief of the Bureau of Aeronautics, U. S. Navy

"I believe the day is not far off when commercial dirigibles will carry mail across the Atlantic in two days. Of course radio will play an important part in such a venture. An airship equipped with radio compasses, radio receiving and sending stations, and loud speakers all working in coöperation, with landing fields having mooring masts, radio sending and receiving equipment, loud speaker and beacon lights on captive balloons shining above the fog which may prevail, will have little difficulty in finding her home port and promptly anchoring to her mooring mast."

M. B. BARTEK (Saunders County, Nebraska; winner of a prize contest conducted by *The Nebraska Farmer* on the benefits the farmer secures from radio): "We do not have to go farther than our neighbor's house to see that radio is not merely a fad, but a reality and more or less of a necessity to the farmer and his family. Among the things that radio offers to the farmer are help in operating his farm more profitably, and educational and social advantages. . . . I have found the weather reports of inestimable value. . . . After the chores have been finished and supper is over, it surely is great to be able to listen-in on your choice of programs, be it lecture or a good instrumental or vocal selection. . . . To the farmer who has trouble in keeping his boys on the farm, I say buy them a radio set."

The Super-Heterodyne and Its Intermediate-Frequency Amplifier

A Thorough Discussion of the Design, Function, and Importance of the Intermediate-Frequency Amplifier in the "Super"—Should it be Used for High or Low Frequencies?

By A. J. HAYNES

IN SPITE of the many articles that have been appearing on this receiver there has been little or no discussion on one of its most important units, the intermediate-frequency amplifier.

The super-heterodyne may be for convenience's sake divided into three distinct portions. In the first section we may place the input tuning apparatus, the frequency-changing and oscillating tubes, together with their auxiliary apparatus, such as oscillator coupler, tuning condensers, etc.

The function of this first section is to receive the incoming signal and change its frequency by means of the heterodyne or beat method to some predetermined intermediate frequency at which it will be amplified.

The second section is composed of the intermediate-frequency amplifier, whose function is to amplify the intermediate beat-frequency which is passed on to it from the first unit.

The third division is composed of a detector tube and audio-frequency amplifier, the amplified intermediate-frequency is fed into the detector tube from the second unit where it is rectified and changed to an audio-frequency. It is then passed on to the one or two stage audio-frequency amplifier, as the case may be, and amplified at this audible-frequency, which of course is familiar to all of us.

Thus, for the sake of convenience, we can separate any super-heterodyne into these three parts, each having its own function to perform.

THE HEART OF THE SUPER

NOW the heart of this receiver is the middle unit, the intermediate-frequency amplifier. It is this section which we depend on to furnish us with the enormous amplification peculiar to the super-heterodyne, which should be given the most attention and consideration. Strange as it may seem however, there is very little public information available as to the proper design and functioning of this high-frequency amplifier. Indeed there seems to be considerable confusion about just what form this amplifier should take, whether long wavelength is best here or whether it is more beneficial to operate with a short wave intermediate amplifier. It is this phase of the super-heterodyne which I propose to discuss, and I will attempt to point out some of the facts that should govern the design of the intermediate-frequency amplifier.

TWO FUNDAMENTAL REQUIREMENTS

IN ANY radio-frequency amplifier there are two basic general requirements that must be met, these are roughly as follows:

1. In order to build up maximum voltage and maintain maximum selectivity, the transformers should be designed to tune as sharply as possible.
2. The received signal must not be distorted as it passes through the amplifier, which means in the case of the intermediate-frequency amplifier that the side band frequencies which compose the modulated component of the received signal must not only be passed through the transformers, but must also receive approximately uniform amplification.

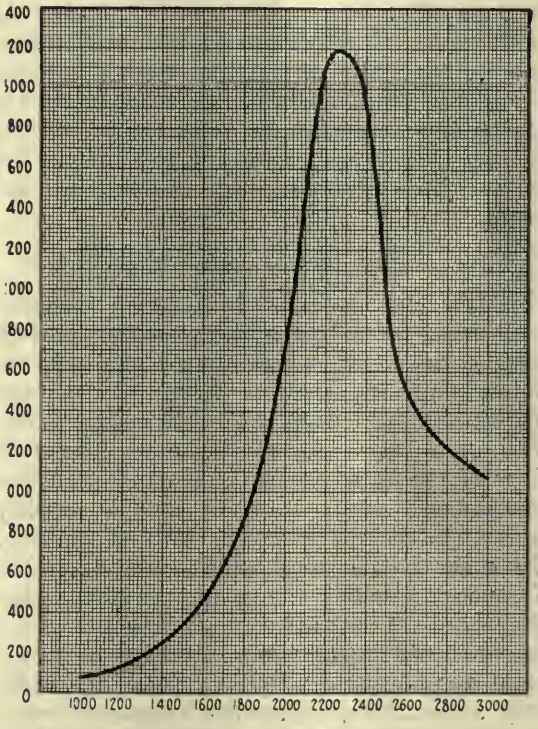
This latter consideration is of the utmost importance when considering an amplifier for use in the super-heterodyne, for here we must handle frequencies that are relatively low where it is comparatively easy to cause distortion. We are considering the reception of radiophone signals where quality of reproduction is one of the first considerations.

SHARP TUNING VERSUS DISTORTION

NOW, in order to maintain quality of a received signal, we must pass through the amplifier not only the fundamental wavelength or frequency of the carrier wave, but we must amplify as well one side of the so-called side band frequencies. This means that if our intermediate-frequency amplifier is tuned to a frequency of 50,000 cycles or 6,000 meters, that we must pass through the amplifier with equal

intensity frequencies from 50,000 cycles to 60,000 cycles. In other words, our amplifier must be tuned sufficiently broad to amplify equally over a band of approximately 1,000 meters. These are round figures. This, of course, is very broad tuning and an amplifier designed with a sufficiently flat characteristic curve to include this band of wavelengths with practically even amplification would necessarily amplify to a considerable degree over a very broad band. On the other hand, as we come down in wavelength, that is as the frequency increases, the side bands group themselves closer and closer to the fundamental wave until if we consider an amplifier with a wavelength of 2,000 meters, it is only necessary for this amplifier to pass a wavelength band of from 1,875 meters to 2,000 meters, or 125 meters in order to include 10,000 cycles below the fundamental. Therefore it is quite obvious that the lower we go in the intermediate-frequency amplifier wavelength, the sharper the tuning of this amplifier may be without destroying the tone quality of the received signal. As a matter of fact, at any wavelength below 3,000 meters, the side bands cover such a narrow wavelength that we need not worry about this type of distortion when using the ordinary form of transformer-coupled amplifier as long as excessive regeneration is not used.

Off-hand this seems to be a very strong argument in favor of very low wavelengths in the intermediate amplifier and it is. There is a very good reason however, why we should not carry this too far, for as we cut down in wavelengths here, while it is true that we can tune sharper without destroying our tone quality, at the same time it is true that the separation between the different stations after they have been heterodyned is decreased. This may be a bit confusing if the reader is not thoroughly familiar with the action of the super-heterodyne. Suppose we have two stations with a ten meter separation, one being on 300 meters and the other on 310 meters. In other words, the first one has a wave frequency of 1,000,000 cycles and the second a frequency of 967,700 cycles per second. Now let us suppose that we have two intermediate-frequency amplifiers, one operating on a wavelength of 2,000 meters and the other on a wavelength of 3,000 meters. Let us take the case first of the 2,000 meter amplifier. In order to heterodyne our 300 meter signal to 2,000 meters, we must set our oscillator at approximately 354 meters. Now, when we do this, we create a beat note with the 310 meter signal as well and it is also heterodyned to a higher wavelength. In this case when the 300 meter signal is heterodyned to 2,000 meters, the 310 meter signal will be changed to approximately 2,650 meters. In other words, the separation between these two signals is now 650 meters rather than 10 meters, as was the case originally. Now if our intermediate amplifier is capable of tuning sharply enough to separate these two wavelengths, it means that we can get absolute separation between 300 and 310 meters and of course it is a comparatively easy thing to build an amplifier that will tune within this degree of sharpness, in fact as noted above, we have a leeway of practically 525 meters here, that is we can tune as sharply as we choose, as long as we do not eliminate frequencies over a 125 meter band, but now let us see what happens if we take the other amplifier which is adjusted to 3,000 meters and heterodyne the 300 meter



AUDIBILITY CURVE OF THREE INTERSTAGE TRANSFORMERS

As used in intermediate frequency amplifier. This curve was made using the interstage transformers only without input or filter transformer. The potentiometer was retarded well back from the critical oscillation point so that there should be no excessive regeneration. Note the sharp tuning characteristic of these transformers even without input or filter transformer

signal to this. We find that to heterodyne the 300 meter signal to 3,000 meters our oscillator must be adjusted to a wavelength of 332 meters. While at the same time this adjustment heterodynes the 310 meter signal to a wave length of 4,433 meters. Now it is seen that the separation between these two stations when heterodyned to 3,000 meters is considerably greater than in the first case and while at 3,000 meters we cannot tune quite as sharply without causing distortion, at the same time it is not necessary as the wavelength difference here is so much greater. It of course follows conversely that if we use an intermediate wavelength below 2,000 meters the two heterodyned frequencies will be correspondingly closer together and the lower we go the closer they will approach one another, until at their former wavelengths of 300 and 310 meters we reach the original separation of 10 meters. It can easily be seen that if we place the wavelength of our intermediate amplifier too low, we will have difficulty in building our filter circuit for the amplifier sufficiently sharp to separate the two waves, therefore, all other considerations aside, it is quite obvious that there is a lower limit also beyond which it is not practical to carry this intermediate wavelength. Before we draw conclusions, let us consider a few of the other factors that enter into our amplifier design.

TUBE NOISES AND STATIC INTERFERENCE

THE limiting feature of distance reception with a super-heterodyne can be summed up in the one word—noise. We could keep on amplifying indefinitely if it were not for the fact that tube noises and atmospheric interference, hold us to a practical limit. Therefore it is of the utmost importance that our intermediate-frequency amplifier should amplify this type of interference as little as possible. In other words, it should be a pure radio-frequency amplifier and should not pass audio-frequencies with increasing volume.

Now, the higher the wavelength which is used, the lower the frequency becomes, gradually approaching an audible frequency. Accordingly, the higher the wavelength to which the amplifier is tuned, the greater is its tendency to amplify audio-frequency noises. In fact a radio-frequency transformer which is designed for wavelengths of 6,000 meters or greater, is a fair audio-frequency amplifying transformer and a 3-stage audio-frequency amplifier, even if its efficiency per stage is not great, can build up quite a volume of sound. This of course may be overcome to some extent by the use of an air core filter transformer in the amplifier output, but this does not correct it entirely. The real solution to this problem, as I see it, is to reduce the wavelength for the intermediate amplifier to such a point that comparatively low impedence air core transformers may be used which will not allow a large audio-frequency potential difference to build up across them and will accordingly give a considerable increase in the signal-noise ratio.

HAND CAPACITY EFFECT

THERE is another consideration which further justifies the use of a low wavelength for extreme amplification. This is the well-known and troublesome hand capacity effect.

The higher the frequency (the lower the wavelength) that is used in the intermediate amplifier, the less shielding is necessary. In fact if a frequency higher than 200,000 cycles (wavelength lower than 3,000 meters) is used, shielding may be entirely eliminated. This is due to the fact that changes in either the local oscillator or incoming wave frequencies due to capacity effects from the operator's hands on the tuning dials, etc., cause a smaller percentage of change in the heterodyne or beat frequency as this frequency is increased. In other words, the shorter the wavelength which is used in the intermediate amplifier the freer the set will be from hand capacity effects, resulting in more stable operation and easier tuning.

IMPORTANT TUNING CONSIDERATION

THERE is still another important point in favor of the low-wave amplifier. In heterodyning the incoming signal—changing its wavelength to the one which we are to use in the amplifier—we may use either the sum of the local oscillator frequency and the incoming wave frequency, or their difference. In actual practice there will be at least two places on the oscillator dial where any station may be received, providing the loop or antenna tuner, as the case may be, is not detuned from the station and also providing that the oscillator has sufficient range to cover both of these two points. Now, as the wavelength of the intermediate amplifier is increased, these two points at which the station will be reproduced come closer and closer together on the

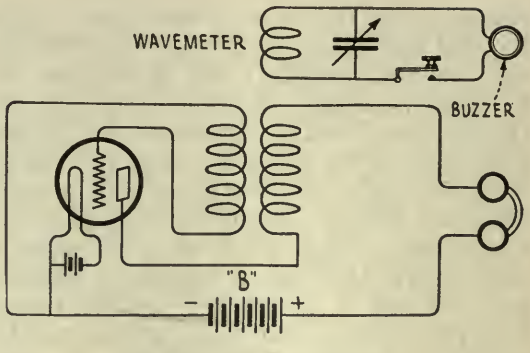
oscillator dial, until when we amplify at a wavelength of 10,000 meters. These two points, let us say, are separated by only a very few degrees on the oscillator dial and in fact are so close together that when tuning the set, the antenna tuner is not sufficiently out of resonance by the time the second one is reached and consequently the station is brought in at two points close together. This is confusing to the operator. It often happens that the station will come in again on its upper point exactly on top of the lower point of some other station, thus causing needless interference. Now the cure for this situation is to reduce the wavelength of the intermediate-wave amplifier to such a point that a low wave station will not be heard again until the high broadcasting wavelengths have been passed, or at least until the two resonance points are so far apart that by the time the upper one is reached, the antenna or loop tuner is far enough out of resonance to prevent it from coming through again, thus the local oscillator or heterodyne may be so designed as merely to cover the sum or difference of the oscillator frequency and the incoming wave frequency. Then the operator is not bothered by having the low wave stations repeating on him when he is attempting to receive those on high wavelengths.

STABILITY AND EFFICIENCY

THE super-heterodyne owes its existence to the well-known fact that high wavelengths are easier to handle at radio frequencies than the low ones. In other words, as we go up in wavelengths it becomes easier to build the radio-frequency amplifier and obtain stability and efficiency. However, this problem is not a serious one at any wavelength over 1,000 meters. In fact at any wavelength greater than this, even a resistance-coupled amplifier shows good efficiency, and while we can obtain a greater efficiency per stage as the intermediate wavelength is increased, at the same time we do it at a sacrifice of other desirable features, as have been pointed out above. If the transformers are properly designed and the leads are kept short, particularly the grid leads, the question of stability should not be a troublesome one.

BUILDING YOUR OWN

FOR the benefit of any readers who may contemplate building their own transformers, here is some advice about their construction. In the first place, if you are going to wind your own, choose a low wavelength, something in the neighborhood of 2,000 or 3,000 meters. This is not only on account of the points brought out above, but also because it is more practical to build a transformer for these wavelengths with the limited facilities and equipment available to most of us. This is mainly due to the fact that when the higher wavelengths are used it is almost imperative that an iron core in some form be used. This is done in order to flatten the curve sufficiently to prevent the transformers from distorting, which would be the case if they tuned too sharply at the higher wavelengths. While an iron core at radio frequencies introduces a considerable loss, if the construction is careful, thin laminations being used, each insulated from the other, this loss is well compensated for by the step-up ratio which may be used in the transformers themselves. The design of such transformers and their construction is rather difficult and the materials are hard to obtain, therefore if one wishes to experiment with them, by all means buy a set.



A WAVEMETER CIRCUIT

For testing the wavelength of intermediate-frequency transformers in the super-heterodyne

On the other hand, it is possible for the average person to build a set of fairly efficient transformers having their resonance point in the neighborhood of 2,000 or 3,000 meters, and while this work is by no means simple, and I do not recommend it to any one who has not had some experience along this line, at the same time it is a good experiment for the man who takes pleasure in this sort of work. Instructions for winding such transformers have already appeared in the April issue of this magazine. These transformers are comparatively sharply tuned and it is necessary that their natural wavelength should fall within

approximately 100 meters of each other. It is a physical impossibility to wind two coils so that their natural wavelength will be the same, due to slight variations in the wire, insulation, etc. On the other hand, if the mechanical dimensions of the forms are all the same and exactly the same number of turns are wound on each, the error will not be serious and they will almost always come within 25 or 30 meters of each other. However, it sometimes happens that one coil is wound considerably tighter than the others, or that wire from another lot or from a different manufacturer is used, which results in a considerable difference in resonance. A simple test for the transformers after they are wound may be made as follows: place the transformers in an oscillating circuit by connecting its secondary to the grid and filament of a vacuum tube and its primary to the plate and B battery of the same tube, placing a pair of phones in series with the plate circuit. We now have the transformer hooked up as it is in an amplifying circuit, with the exception that both primary and secondary are being used on a single tube instead of between two tubes. As the primary acts as a feed-back or tickler coil, the circuit will oscillate providing of course the primary polarity is correct. Now, by taking a wavemeter and placing the wavemeter coil over the transformer, that is, just above it (the wavemeter should be taken from its case to do this) the natural resonant frequency of the transformer may be measured by moving the wavemeter condenser until a click is heard in the phones. When the wavemeter is tuned to resonance with the transformer, it absorbs the energy in the oscillating circuit and at one point stops the circuit from oscillating. This registers as a click in the phones. If there are two distinct clicks, the wavemeter is too close to the transformer and should be lifted until this narrows down to a single one or two clicks which are very close together, in which case the proper wavelength is one half way between the two clicks. When the wavelength is noted on the meter, the other transformers may be tested similarly in operation. If the transformers are not in resonance, turns may be decreased until the transformers are all approximately matched.

It is not necessary to go through this procedure with the input transformer, as the condenser which is used across its primary can be made to throw the wavelength of this transformer one way or the other to coincide with the rest. While it is not necessary to have the transformers closer in period than 100 meters, at the same time, due to the fact that when placed in the circuit, variations in tube capacities, sockets, wiring, etc., will make them vary, it is well to have them matched fairly accurately, then any slight variations will not be noticed.

It can be seen that manufacturing transformers of this wavelength on a commercial scale is no small matter, and while if they are carefully made and wound they will run sufficiently accurately for all practical purposes, the danger is that someone may occasionally procure a set which combines the two extremes of variation and while of course this would only happen occasionally, it will give them trouble when it does occur. It is of course a considerable problem to measure the individual wavelength of each transformer and match them into sets on a production basis, at the same time keeping the cost within reason, but I have come to the conclusion that this is the only satisfactory method to use and the results obtained are well worth the additional labor.

FILTER TRANSFORMERS

A FILTER transformer is very necessary when the higher wavelengths are used and in this case it is best used in the output, immediately preceding the final detector tube. There are two reasons for this—first, as it is necessary to build the high wave interstage transformers so that they will cover a wide wavelength band, they are of course in themselves very broad tuned and it becomes necessary to have a sharply tuned air core transformer to determine the frequency at which the amplifier will function and to exclude other frequencies. Second, due to the higher impedence of the longer wavelengths to audio-frequency impulses, such an amplifier will amplify static and other disturbances at an audio frequency and this becomes very disagreeable when carried through three stages. This objection, however, can be somewhat overcome by using an air core filter transformer in the last stage coupled to the detector tube, which will have a tendency to reject the audio frequencies.

On the other hand, in the case of the short wave amplifier, a filter transformer is not strictly necessary, as the amplifier itself is sharply tuned and the degree of sharpness can

be perfectly controlled with the potentiometer, which controls the degree of regeneration in the amplifier. Therefore a special input transformer with a tuned primary is usually an advantage, because the condenser acts as a by-pass in this circuit to the two other frequencies which are passing through it. These frequencies are the incoming wave and heterodyne frequencies. This condenser can be adjusted at the same time to compensate for the variation of load which is imposed on this first transformer, due to the characteristics of its primary circuit and apparatus in series with it being somewhat different from the interstage transformers.

WHICH SHALL WE CHOOSE—HIGH OR LOW?

THERE are one or two considerations which would seem to indicate that the high wavelengths are best in the intermediate amplifier. On the other hand there are sufficiently strong arguments on the other side to make it well worth while to sacrifice something in order to gain the beneficial results which the low waves will give us. If we use a high wave intermediate amplifier, we will obtain good stability and large amplification per stage. On the other hand, to get this we have somewhat complicated the tuning and have decreased our signal-noise ratio, which after all seems to be the answer. Amplification, sharpness of tuning, and all other considerations are of little avail if our receiver brings in such a quantity of noise together with the signal that it is either unpleasant to listen to or even impossible to do extreme distance work when conditions are not perfect. This one consideration alone is sufficient in my mind to indicate a comparatively low wavelength as the best. However, if we carry this too far we are going to sacrifice our sharp tuning, which is such a valuable characteristic of this receiver and on account of this latter consideration I would not recommend a lower wavelength than 1,500 meters. With the other points in view, I would not recommend a higher one than 6,000 meters. I believe that the ideal wavelength lies between these two extremes. What it is depends to a large extent on the individual conditions. If a receiver is installed in a noisy location (and this is the case in or near most of the large cities) I would pick a comparatively low wavelength. On the other hand, if extreme sharpness is a consideration and the receiver is to be used in a neighborhood where there are several powerful broadcasting stations which must be worked through, it will be necessary to choose a higher wavelength to obtain that razorlike sharpness which must be had under these conditions. I believe that the most satisfactory all around wavelength for an intermediate amplifier lies in a compromise between these two extremes of 1,500 and 6,000 meters.

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THE HARBOR AND TOWN OF NANTUCKET

In the old trading days, Nantucket was a considerable port, but its importance has steadily declined. The wireless station at Siasconset is seven miles south of Nantucket on the southerly side of the Island

Historic Days at a Famous Wireless Station

Stirring Times at Station SC, Siasconset, Long One of the Best-Known Wireless Outposts on the Atlantic—The Shore Operator Tells His Story of the Wreck of the *Republic* and Jack Binns' Heroic Work

By JACK IRWIN

NANTUCKET ISLAND, Massachusetts, small in circumference, has not always been geographically or industrially insignificant. In the years immediately following the Revolution it might have been described as an island without a country, because at first it was not included in the new United States of America. The defeated Mother Country did not claim it, either. However, it was not long before Nantucket Island was to assert itself, and become as well known as the name of Rockefeller is to-day. It developed into the greatest whaling port in the world, when the world used whale products as Rockefeller products are now used. Nantucket ships and Nantucket men sailed the seven seas.

Gradually the whaling industry, through the substitution of cheaper and more readily acquired oils, dwindled almost to extinction. Hundreds of great ships, many claiming Nantucket as their home port, scattered into more

lucrative trades. Nantucket again slept. With the advent of the steamship, it became more or less known for its pilots. The lightship *Nantucket* anchored off its shoals, was one of the few reminders of a once famous port. As the cities of the neighboring states became more and more congested, Nantucket developed into a most exclusive summer resort, far from the madding crowd, and so it is known to-day, one of the most delightful and restful spots upon our coast.

A BIT OF HISTORY

MESSAGES dated from its shores were destined to make history in a new industry and science. When Marconi commercialized wireless, a company bearing his name was organized in the United States. The general public were sceptical of results, but no more so than the shipowners. This struggling industry and the young company had a strenuous financial existence for many years. Early in its history, the Marconi Wireless Telegraph of America rediscovered Nantucket Island. On the eastern shore of the island, in the village of Siasconset, this company established one of its wireless stations.

At this period (the beginning of the present century), the New York *Herald* was world famous because of its excellent shipping news. Its owner, the late James Gordon Bennett, was quick to see the significance of the new wireless service in its relation to shipping. He obtained permission from the United States authorities, and after making coöperative arrangements with the Marconi Company, installed a radio station on the lightship anchored off Nantucket Shoals. This was 40 miles due south of Siasconset where the new Marconi station had been installed. Primarily the lightship station was to be utilized for reporting passing vessels to the *Herald*. The lightship sent the messages to SC, as the new station was designated in the call list, reporting passing vessels to the *Herald*. However, a reciprocal arrangement was made whereby the lightship station was to relay any messages to or from steamships equipped with wireless. The operators at Siasconset and other Marconi stations alternated with the operator on the lightship, changing off in this duty every month or six weeks when the vessel was visited by a tender or relieved by another lightvessel. The distance separating the lightship and Siasconset, approximately 40 miles, was just about the limit of wireless transmission in those early days, when the coherer receiver was used. The operator could either read by sound, or from the tape which registered the message in dots and dashes. Thus, early in the history of radio was Siasconset placed on the map. For many years it was considered the most important shore station in the world. Ships outward bound from New York used it as the last station to which a message could be sent, while ships bound westward found it the first station they could communicate with on this side of the Atlantic. As the transmitting range of wireless was steadily extended through improvements in the apparatus, notably the substitution of the Marconi magnetic detector for the coherer, the importance of the station grew until it was working directly with transatlantic liners instead of employing the lightship as a relay station. Eventually Mr. Bennett withdrew from the wireless business and the lightship was equipped by the United States Navy and manned by navy men. Meanwhile, wireless had demonstrated its possibilities to steamship owners, especially the large English and other European companies, until every vessel of any importance was equipped, but the general public knew little of the new science, heard little about it, and used it even less. It remained for one of those great dramas of the sea, which seem to occur periodically, to advertise and to impress upon the world overnight, the great scope of Marconi's development. It was ordained that this great

"Time Was—When . . ."

Since the earliest days of wireless—now refined as radio—the wireless telegraph station at Siasconset, Nantucket Island, has been known to ship operators, ship travelers who filed their messages via that station, avid listening amateurs, and that other scattering few of the public who "just happened to know." Many famous messages have gone out from station SC, *later* MSC, *and many famous wireless men have pounded brass under the tall wooden masts on that picturesque little island. Jack Irwin tells of that famous night he picked up the* CQD *signals from Jack Binns on the* Republic *when those faint radio beams saved 1,400 people. This is a capital story, written by one of the earliest and best-known of old timers.*—THE EDITOR.



THE TOWN LANE

In Nantucket, near the famous old wireless station MSC, at Siasconset, Massachusetts. The operators when off duty at the wireless station used to wander in town through charming spots such as this

demonstration of the life-saving power of radio was to occur in the immediate vicinity of Siasconset.

A HISTORIC RADIO DAY

ON JANUARY 23rd, 1909, the writer was on duty as operator at Siasconset, assigned to the midnight to 8 A. M. watch. It was Friday night and there was very little business in the air. Few ships cleared from New York on that proverbially unlucky day. I relieved Operator Jack Cowden who had informed me at midnight that there was only one ship, the *Republic*, to be heard from. She had been scheduled to sail from New York, at 10 A. M. Friday and ordinarily should have communicated with us that evening. Realizing that there was only one operator on board, I deduced that he had turned in by midnight and that I would not hear from him until early in the morning. Events subsequently proved that the vessel did not leave New York, until 3 P. M. and therefore the *Republic* was not within the range of SC when I relieved the watch. During the early hours of my watch I occasionally exchanged messages or signals with the two or three vessels within our zone. There was the *Baltic* inbound for New York, who had passed Nantucket and was then in communication with the Sagaponack station on Long Island. About two o'clock there was the *La Lorraine*, 230 miles east of Nantucket who was cleared of traffic and who informed me that he would "turn in" until 6 A. M. The steamers *New York* and *Furnesia* were also coming within range of Siasconset and I knew they would be calling me about daybreak.

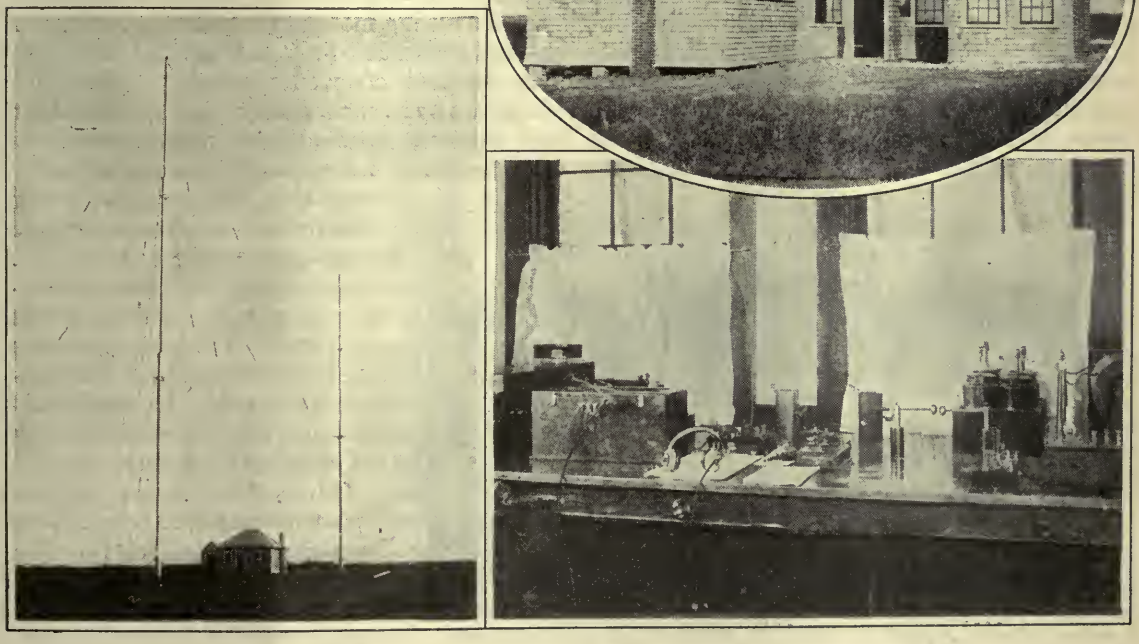
FAME COMES TO WIRELESS —AND SC

IT WAS a bitter cold night and the small coal stove was going to its full capacity. With nothing to do and a clear station file, I read and dozed, then dozed and read in my chair. I had not had much sleep the previous day, having gone into the town of Nantucket on errands. The fire in the stove became low and I suddenly became fully alert, chilled. I arose to heap some coal on the fire but as I did so I heard a faint signal and paused to listen. Dimly I could hear what sounded like a station calling CQ, meaning "all stations." This is the call ship operators broadcast when they came on watch after being away from their apparatus and wish to learn who is within their range. Listening intently I could not hear him sign his call letters, so at the moment, I paid no further attention. The fire was replenished, the work of a minute or two, I was again listening-in, lazily stretched in my chair. This time I detected something clearer coming into my head phones. CQD, CQD CQD-MKC MKC MKC.

It flashed upon me in a second that here was a ship in distress. Throwing in my switch I started the dynamo and answered him.

Faintly came the message that it was the *Republic* in distress, rammed by an unknown ship and rapidly sinking and assistance needed immediately. This message was rapidly followed by his position which placed the scene of the disaster about 60 miles south of Nantucket. I immediately answered that assistance would be forthcoming. With my log in front of me I was able rapidly to estimate the nearest ships to the *Republic* with which I was in wireless communication. I sent out a general call and broadcast the particulars. The first to answer me was the Frenchman, the *La Lorraine*, who true to his word was on the job, it then being after 6 A. M. He came back with the news that his captain was proceeding at full speed (better than 20 knots) to the scene, he also gave his distance from the *Republic's* position as 180 miles. That long stretch was not very promising to a ship in dire distress. I then turned my attention to the *Baltic* who had passed us early in my watch. After a few minutes he answered and stated they had turned about and were proceeding to the *Republic*. All this information was passed to the *Republic*, whose operator, Jack Binns, was hard at work at her key. Then, in turn, I passed on the information to the *New York* and *Furnesia* who were now within range of sc. Having done what I could to obtain assistance from the seaward side, I now turned to the land wire which connected us with the mainland at Woods Hole, Massachusetts. I knew that this was a base for revenue cutters and that the U. S. S. *Acushnet* lay there. Calling that office, I left word for the cutter to proceed to aid the *Republic*. Subsequently I learned that the *Acushnet* in passing out of Vineyard Haven to aid, found a four masted sailing vessel on the rocks and was compelled to stop to rescue her crew. This revenue cutter, therefore, did not reach the *Republic*.

After doing everything possible to get aid to the sinking liner, I proceeded to take several messages from the *Republic*. Captain Sealby sent full details of the situation to his owners the White Star Line. The wireless signals from the *Republic* were very weak considering the distance between us, and Binns told us that he was



STATION MSC

Showing the tall masts, guyed heavily against the ocean winds, the wooden operating building through which so much radio history passed, and the transmitting and receiving table. A ten-inch spark coil is at the extreme right, and next to it a battery of Leyden jar condensers, connected across an open spark gap

working off his storage batteries. The ship's dynamo was under water. This accounted for the fact that none of the ships rushing to the rescue could hear his signals, for on the reduced power of the batteries they were out of his range. For several hours we acted as a relay station for the frequent interchange of messages between the captains of the various vessels involved. The CQD had been received about 6 A. M. Since I was alone there was nothing to do but wait until my relief, Mr. E. T. Edwards arrived at eight o'clock. Upon his arrival we got Mr. A. H. Ginman, the operator in charge of the station on the job and we also called Mr. Cowden, the other operator. From that time on all four of us were busier than any operators since radio was invented. One held down the wireless circuit, another the land wire to the mainland, a third started the engine and kept it running.

THE RESCUE

SEVERAL hours had elapsed since the first call of distress had reached us. A dense fog prevailed and seemed to be so general that all the vessels concerned were enveloped in it. The vessel which had rammed the *Republic* turned out to be the Italian freighter *Florida*, unequipped with wireless. She had managed to grope her way back to the scene of the collision and although badly crippled herself, she took 1,400 of the *Republic's* passengers off safely. The *Baltic* and other rescuing vessels were now in the vicinity of the wreck, but owing to the fog were unable to locate the distressed ships. The story of the ultimate rescue of all has been told by Alfred M. Caddell in the April number of this magazine. Suffice to add here, that the *Baltic* eventually reached the side of the *Republic*, as did the *New York*, *Furnesia*, and several other vessels. The passengers were re-transferred to the *Baltic* which proceeded to New York. The *New York* stood by the *Florida* and escorted her into New York, where she was safely docked. The *Furnesia*, together with the revenue cutters *Seneca* and *Gresham* attempted to tow the *Republic* into shallow water, but failed. Forty eight hours after the collision the big liner sank. The only casualties were caused by the impact of the ships. Two passengers were crushed to death in their berths amidships on the *Republic*, while four sailors in the forecastle of the *Florida* met a similar fate. The remainder of the hundreds in danger were safely on their way home.

During the forty-eight hours that the events just chronicled were occurring, we, at Siasconset, were deluged with radiograms and telegrams. The news of the disaster had leaked out and the newspapers, shipowners, relatives of passengers were demanding news from us. We gave the right of way to the ships involved. Between times, we answered, as best we could all the messages coming in over the land lines. We sent hourly bulletins to the newspapers, sent reassuring messages to relatives, and gave general information to the steamship line as to the progress of events. For 72 hours we slugged away, each taking his turn at either the wireless, the land line, or the engine. It was necessary to run the engine constantly, something the water cooling system of the kerosene engine had not been designed for. The water supply was only obtainable from a deep well so it was hard work for the engine tenders to draw water and refill the engine water tank. In turn, whenever possible we would snatch an hour or two of rest.



THE OLD JAIL—NANTUCKET

Which succeeded in amusing rather than terrifying the wireless operators who were handling traffic at MSC, the famous old station of the Marconi Company

During those three days we found that we had handled 22,000 words in that small station. Not an inconsiderable amount of work for any telegraph office with greater facilities than ours. The newspapers we had served not only showed their appreciation in their columns but sent

us substantial checks. These aggregated a good sum and we could not help but remember the old adage about the ill wind.

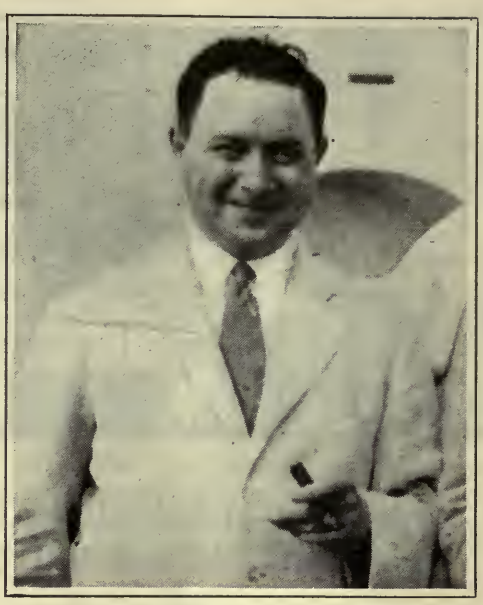
The episode just described was the first time that a ship in distress had utilized wireless to save life at sea. It brought home to the world in such a forceful, dramatic manner that wireless was a necessity, that within a very short period laws were enacted that compelled ships not only to carry wireless, but to carry not less than two operators in order that a constant watch might be kept. Those laws are international to-day. The maritime nations of the world gathered in convention in London (1912) and made a treaty which has been the base of radio regulations in every civilized country. Binns, the operator in the ill-fated *Republic* arrived in New York to find himself a hero, and proclaimed in every newspaper printed.

SIASCONSET DEVELOPED REAL RADIO MEN

SIASCONSET through this publicity became well known generally, but to the old-timers in the radio field it was even better known as a training school for wireless men, and some of the operators who at one time or another passed some of their days there are well known in the radio field to-day.

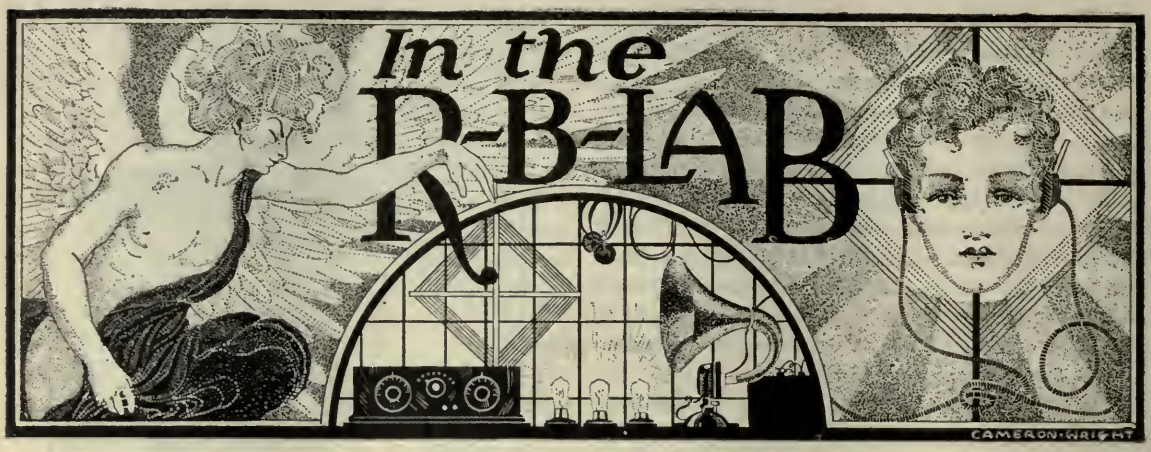
At that period in the history of wireless telegraphy there were no schools for training personnel. The company selected operators from the ranks of the commercial telegraph and cable companies, especially the latter. Cable men were familiar with both the Continental and the Morse codes, therefore able to take the messages from the ships in the Continental code and then handle it on the land wires in the Morse code, and vice versa. When they joined the Marconi Company's service they were invariably sent to a shore station to break in. At that time there was no governmental regulation of wireless and consequently licenses were not required to operate a station.

So well known was Siasconset as a training center, that the Marconi Company of Canada sent a number of their men there to break in. Mr. A. H. Ginman, who now has charge of the English Marconi Company's extensive interests in the Orient was manager for a great many years at Siasconset. He was the dean of the old-timers. He taught the fundamental principles of radio to many of the men who have reached prominence to-day. Young David Sarnoff, now the Vice-President and General Manager of the Radio Corporation of America, received his early training at this station. After commencing his career as office boy at the head office of the Marconi Company he was sent to SC as an operator. I particularly welcomed Sarnoff. He was so enthusiastic about radio that he stood a great part of my watch, voluntarily, and thereby allowed me to play tennis and otherwise enjoy the summer advantages of Nantucket! Other radio men to spend a portion of their time there were the late E. T. Edwards, later superintendent of the Eastern division, Jack O'Neill now an official of the Federal Telegraph Company, John C. Cowden, now supervisor of the Radio Corporation, Charles J. Weaver, now superintendent of the R. C. A., Algernon Cruttenden, assistant traffic manager of the Radio Corporation. Many of the operators of that time will remember the lovable late Neil MacIntyre, who helped pass many pleasant hours at SC. Matt and Tom Tierney, Oxenham, Charles Burgess, and many others passed through the mill at SC. The call letters MSC have been deleted from the official lists of radio stations, but it is indelibly listed in the memories of those who spent their youthful radio days on old Nantucket.



DAVID SARNOFF

Now Vice-President and General Manager of the Radio Corporation of America. Mr. Sarnoff received much of his early radio training while a junior operator at station MSC, exchanging messages with the ships entering and leaving Atlantic Coast ports



A HOME-MADE RECTIFIER FOR CHARGING A AND B BATTERIES

FIGS. 1 to 5 inclusive show an attractive and efficient battery charger built by a reader, Mr. F. H. Horning of Toledo, Ohio, from specifications given in the November and December, 1923, issues of RADIO BROADCAST. Revised data on the building of the rectifier is herewith presented for the benefit of our many interested readers.

The charger is designed for the standard Tungar five ampere rectifying tube with potentials supplied by a step-down transformer operating from 110 volt 60 cycle alternating current. Reference to the circuit diagram, Fig. 4, will show that the transformer has three windings, primary, a filament lighting secondary (Sec. 2) and a higher voltage charging secondary (Sec. 1). The primary is wound on one leg of the core with 495 turns of No. 16 double cotton covered wire. The filament winding is placed next to the core on the opposite leg and consists of nine turns of No. 9 double cotton covered wire. The charging secondary is wound over the filament lighting winding, with 230 turns of No. 12 double cotton covered wire. Adequate insulation in the form of two layers of empire cloth or tape should separate the secondaries, and the core from the primary and filament lighting windings.

The core is rather a variable factor, for different grades and sizes of core material will be conveniently available to different fans. Many enthusiasts will have cores already built up which can be adapted to the charging rectifier. In the October number of the RADIO BROADCAST Lab Department, empiric and theoretical data will be given for building and designing small transformers, showing how the number of primary and secondary turns may be determined, for any purpose, in reference to the size of the core and the core material (the two variable factors with a given applied voltage and frequency). However, many enthusiasts will be content to build up a core in accordance with stated specifications, and they are referred to Fig. 5 which is reproduced from the original December article. The sizes given are for the ordinary grade of core iron which is easily secured from dealers in sheet metals. The core should be built up to a height of 1 $\frac{3}{4}$ inches.

What the Lab Offers You This Month

—How to build a home-made rectifier for charging A and B batteries.

—How to change over several types of three-circuit regenerative sets to one using a stage of radio-frequency with reversed feed-back stabilization, tube detection, and regeneration.

—How to increase the effective range of your portable voltmeter.

—A suggestion to the owner of a home laboratory.

—Hints on radio operating and construction.

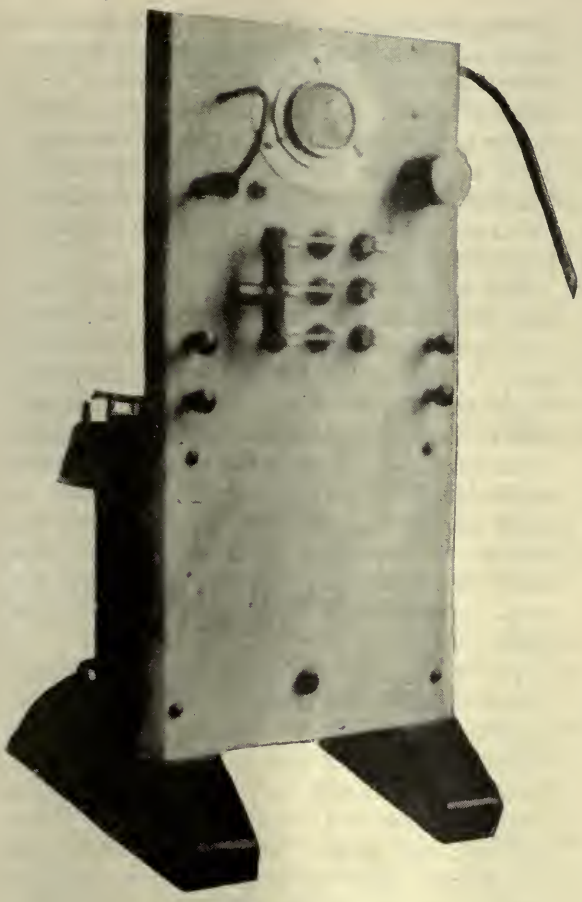


FIG. 1
A neat panel style storage battery charger built by a reader of the Lab Department

If silicon steel is obtainable (which is by far the better material) the core need be built up to only two thirds this height, or the dimensions affected in any other way so that the cross section area will be two square inches, rather than three square inches as specified for the less efficient material.

For more detailed descriptions of the manner of core construction and winding, the reader is referred to the December Lab Department already mentioned.

The following bulk materials will be required in making up the transformer:

Twenty pounds of core iron, or fifteen pounds of silicon steel.

Three pounds of No. 16 D. C. C. wire (primary).

One half pound of No. 9 D. C. C. wire (filament secondary).

Three pounds of No 12 D. C. C. wire (charging secondary).

All connections behind the panel should be made with nothing smaller than No. 9 wire.

The three pole double throw switch, S, makes the operation of the charger particularly convenient, for the battery and the filaments are permanently wired to the panel. Throwing the switch to the right connects the battery to the set. When thrown to the left, the receiving apparatus is disconnected, the battery is placed in the charging circuit and the 110 volts is turned on.

A charger constructed according to the specifications here given should charge at from five to eight amperes, be very silent, and, with the exception of the bulb, exhibit little heating.

This charger may be adapted to charging storage B batteries according to the directions given in the article by Mr. Bouck in the July RADIO BROADCAST.

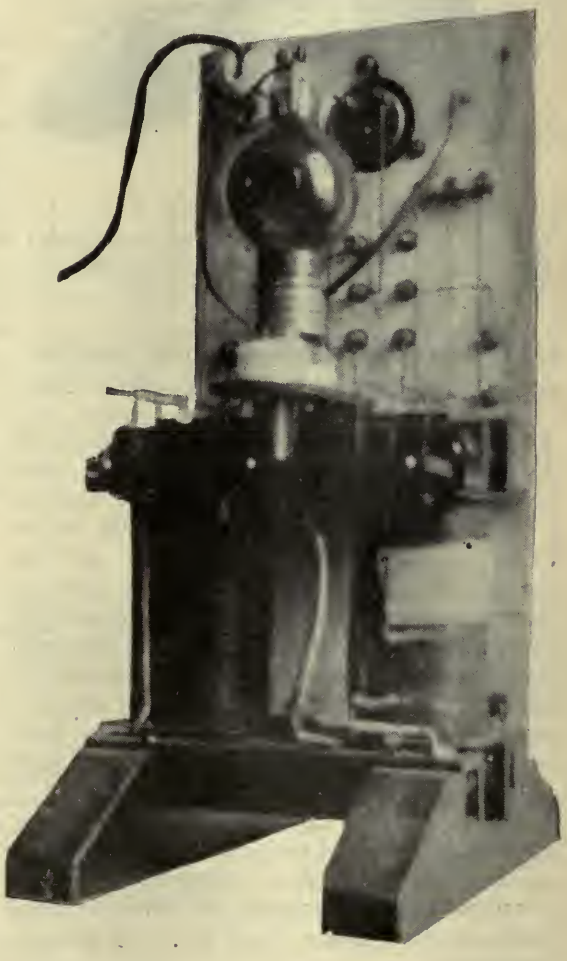


FIG. 2
Behind the panel of the home-made bulb rectifier

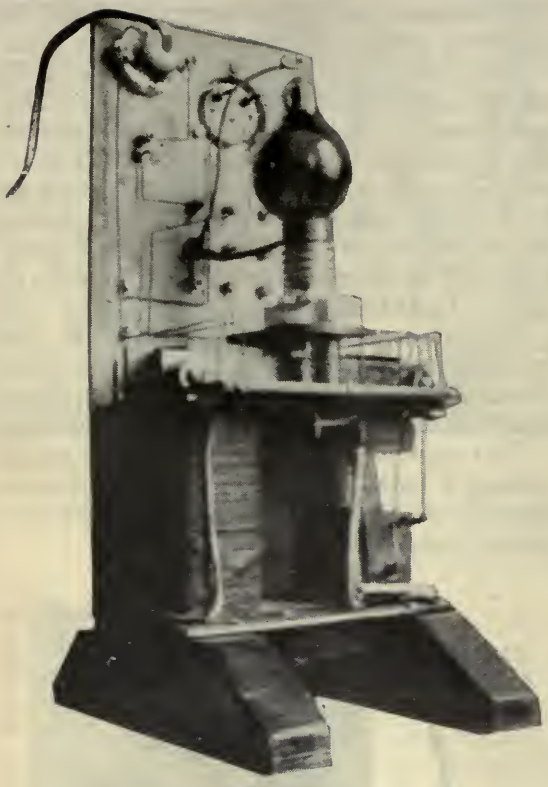


FIG. 3

Meter and fuse are at the top of the panel. This charger may be used for charging storage B batteries, as explained in the August article by Zeh Bouck

A STANDARD TUNER IN A NONRADIATING STABILIZED R. F. CIRCUIT

MANY readers have built three-circuit receivers utilizing manufactured coils marketed under various trade names, such as "The Trans-Continental", "The All Wave Tuner," "Ambassador," etc. These coils are characterized by three windings, a primary (generally semi-periodic or untapped), a secondary, and a rotating tickler. While receivers made up from these coils are comparatively efficient, they are inferior to receivers employing a single stage of R. F. amplification, and, regardless of the semi-tuned primary, are often disturbing radiators.

Sets of this type can be made over, with the addition of an extra coil and tube, into much more efficient apparatus employing one stage of radio-frequency amplification with reversed feedback stabilization, bulb detection and regeneration.

The circuit is shown in Fig. 6. The discerning enthusiast will comprehend that the additions of the new coil and tube are the only variations from the circuit with which he is already familiar. The tickler coil is still the tickler coil in the detecting circuit, the secondary remains the secondary with the conventional connections, and the primary is still the primary only that now it is also the output or plate coil of the R. F. tube.

The additional coil, L, is wound on a three inch form with 100 turns of about No. 22 or 24 insulated wire, tapped at the 60th and 80th turns. (This coil can also be purchased, both singly and attached to the tuning and tickler unit.) The taps compensate for antenna variations, and in operation should be experimented with. A permanent connection is made to that tap which gives the closest approach to identical readings on the two condenser scales at mutually resonant settings (causing both condensers "to tune the same").

The extra coil is mounted at the primary end of the standard tuner by means of a small right-angled bracket. This arrangement is illustrated in photograph Fig. 7. At first glance it may appear that there is no coupling whatever between L and the primary. However, the axes do not intersect—the added coil is mounted a little below the center of the main tuning unit, and sufficient feedback is generally effected to prevent oscillations in the R. F. circuit when the connections to L are in the right direction. In the preliminary operation of the receiver, it may be necessary (it's a

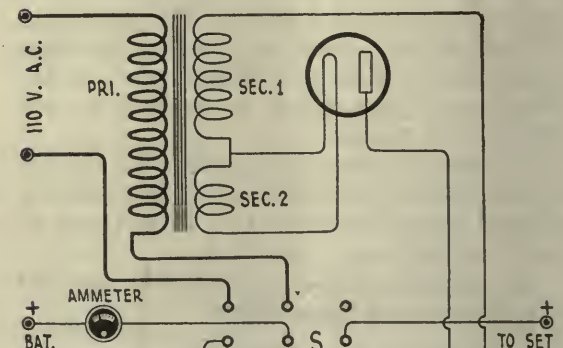


FIG. 4

The circuit for the charger. The set and battery are wired permanently, charge and discharge being controlled by the three-pole double-throw switch

fifty-fifty chance) to reverse the antenna-grid and ground-filament connections.

In a few cases, with very high plate voltages and a particularly active tube, it will be necessary to increase the coupling between the antenna coil, L, and the primary. This is easily done by tilting L upward—bending the bracket.

When testing for oscillations in the R. F. circuit, the detector tube should be made to oscillate by increasing the positive tickler coupling, and the condenser C1 twirled at various settings on C2. If the R. F. circuit oscillates, a beat-note will be produced. Oscillations, if any, will be manifest on the higher frequencies (lower waves).

Both condensers are forty-three plate variables—having maximum capacities of .001 mfd. The remainder of the circuit and values hold no mysteries for the readers familiar with the three circuit, tickler regenerator.

Figs. 8 and 9 are photographs of the complete receiver shown in the circuit diagram. The set tunes more sharply than the three-circuit regenerator, and is quite superior to its predecessor in sensitivity. Both these qualities, however, are capable of improvement through the elimination of the binding-posts and other metal fixtures which are prodigally distributed about such manufactured coils. This very prevalent and inefficient practice increases the $\frac{R}{E}$ ratio—or less technically, the effective resistance of the circuit. This cannot be overcome by regeneration, and results in loss of selectivity and sensitivity.

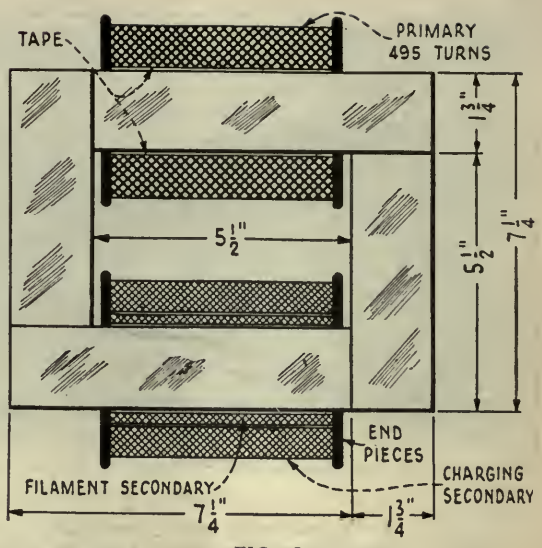


FIG. 5

Showing how the core is built up of iron strips and how the two windings are placed. The primary and secondary windings are shown cut away on the side nearest the observer, so as to show the iron core over which the turns of wire are actually made

INCREASING THE RANGE OF A VOLTMETER

IN MANY cases if the range of a small portable voltmeter could be doubled, tripled, or quadrupled, its value to the owner would be increased as many fold. This is one of the easiest things in the world to do, and may be accomplished by the beginner without resorting to mathematical calculations or expert assistance.

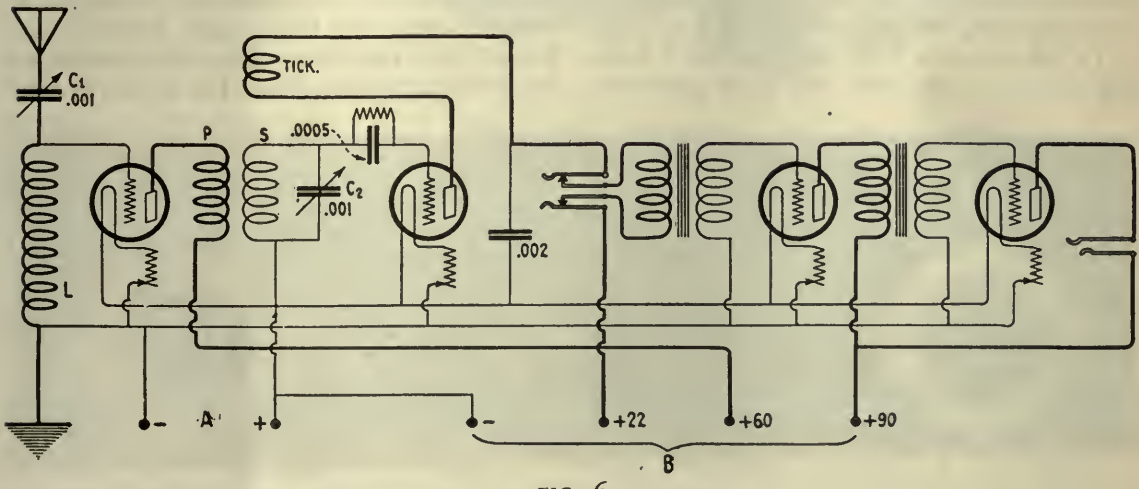


FIG. 6

The circuit for the reversed feedback R. F. receiver. The first tube, and inductance L are the only additions to the standard tickler feedback three-circuit regenerator

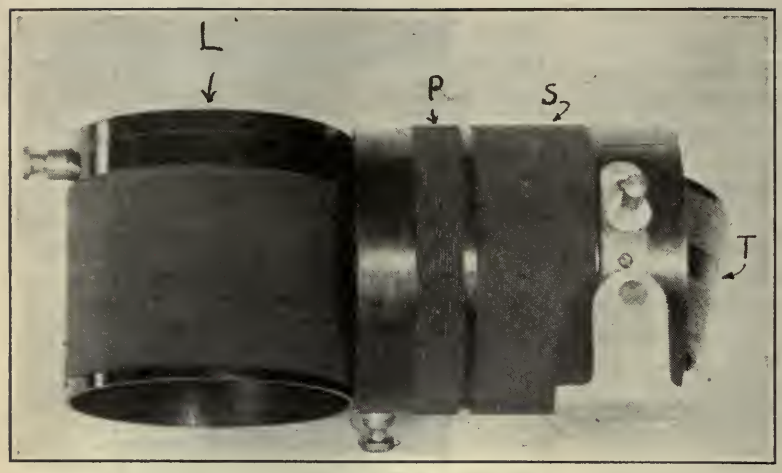


FIG. 7
A "Trans-Continental" commercial coil unit, with the extra winding adjusted on the primary end

The voltmeter is a current operated device. The gradient of the controlling force (a coiled spring) and the flux density of the permanent magnets are so arranged that the needle deflection is strictly proportional to the current passing through the windings, and even scale graduations are possible. Hence, if the current is halved, for instance by doubling the resistance of the circuit (Ohm's Law), the reading on the voltmeter will be just half the voltage applied to the resistance circuit. More specifically, refer to diagram 10. If the external resistance R equals the resistance of the voltmeter, the reading on the voltmeter will indicate one half the voltage applied to the terminals A and B. In the case of the specific demonstration, the meter would read 55 volts.

To get down to brass tacks, place a fairly high resistance in series with your voltmeter, and apply a voltage within the original scale of the instrument and which has already been measured. If the meter now reads 1-10th, 1-16th, 7-8ths, 3-13ths etc. of the original voltage, it will always show a similar fraction of any applied voltage. In the case of a ten volt meter, the extra resistance should be about 1,000 ohms for half voltage—a telephone receiver for instance. The Bradley-Ohm, with a 10,000 ohm minimum resistance makes an ideal variable resistor for higher range meters. Being variable, it is possible to secure any desired even fraction of the original scale.

Experimenters may count on an original meter resistance of 100 ohms to the volt. Thus if it is desired to halve the reading on a fifty volt meter, 50 times 100, or 5000 ohms should be added.

BUILDING YOUR OWN LAB

OUR addition for September is probably the most useful suggestion we have yet made to the proprietor of the growing laboratory—a Stevens Workchest, type 3015. This is made by the Stevens Company, New York City, and sells for $11.00. It is a most desirable substitute for the infinite and inefficient array of cardboard boxes, cigar boxes, baking powder tins, and tobacco boxes that clutter up the average amateur lab. The saving in time



FIG. 8
Front view of the completed four-tube set. A perhaps better design would dispose of the dials closer to one end, with the filament controls and jacks at the other

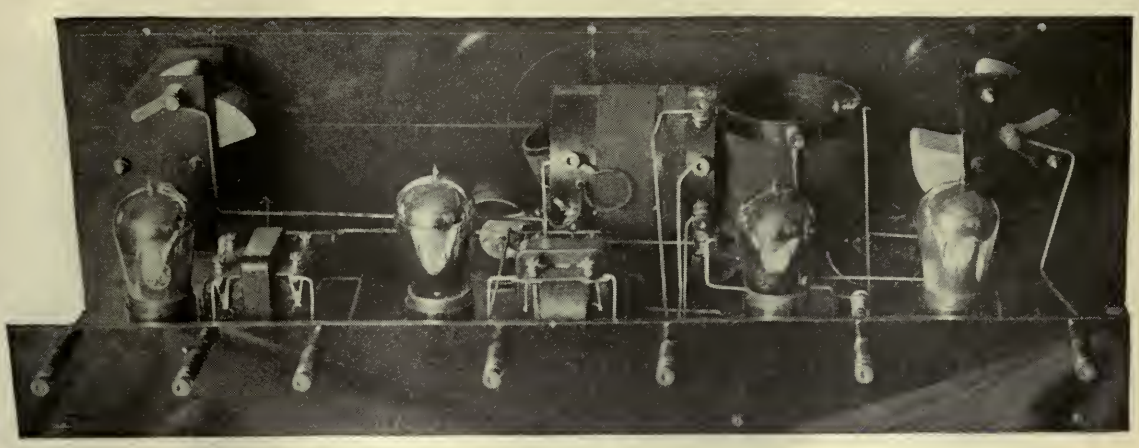


FIG. 9
Behind the panel, again showing the right-angled mounting of the coils

and labor effected by this systematic cabinet is best appreciated by the fan who is at present handicapped by the aforementioned collection of boxes—the haystack that hides the needle for which he is ever hunting.

These cabinets are made in various types, but number 3015 is probably best adapted to the needs of the radio experimenter. In the R. B. Lab, the large lower drawers contain the most used small tools, such as wire-cutters, pliers, screw drivers, scriber, oil stone, six inch square, folding rule and dividers, as well as the equally necessary and often employed fuses. The upper and smaller drawers are individually given over to resistances, condensers, jacks and jack washers, insulating strips, metal ends, binding-posts, miscellaneous, wood-screws and machine-screws. These last two drawers are divided into compartments by close fitting pasteboard boxes. The machine-screw drawer separates 6-32, 8-32 and miscellaneous nuts and bolts, while also providing a compartment for washers.



FIG. 11
The September addition to the growing lab. A cabinet that will save the experimenter time, profanity and labor

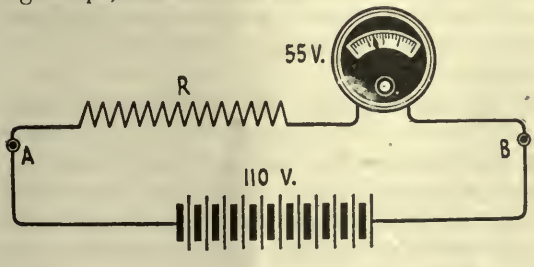


FIG. 10
How to halve the reading on a voltmeter by doubling the resistance of the circuit. Following out this principle, a twenty-volt meter can be made to measure potentials up to one hundred, or even much higher voltages

One drawer should always be left for a temporary miscellaneous receptacle, into which all odds and ends, bolts, nuts, washers, etc. are thrown when cleaning up and rebuilding. The contents of this drawer should be assorted into the proper places once a week.

The Workchest represents a fundamental neatness and system which, in the long run, contributes similar qualities to radio design and construction.

Radio Broadcast's Laboratory

The Story of an Attempt to Improve the Quality of Radio Apparatus for Home Use and Home Construction as Well as to Bring About a Point of Contact Between the Manufacturer and the Public He Serves

By ARTHUR H. LYNCH

STUNG again! I guess I'll leave radio alone for good!" How often have we heard that expression! The unfortunate part of it is that in many cases the resolution was carried out and so radio has actually lost some of its most enthusiastic devotees. Usually, the reason behind the resolution was nothing more serious than the action of some unscrupulous or uninformed dealer selling apparatus which could not live up to the claims he had made for it.

Those of us who have followed the radio business for any length of time know that this difficulty is not new, nor is it likely to die very shortly. In "the old days" of wireless there were those who, by their mail order catalogs and magazine articles, created a demand for a lot of almost worthless junk. And so it was that when the craze for broadcast receiving sets came into being a comparatively short time ago, it was very evident that the same danger of slightly dishonest practices was greatly increased.

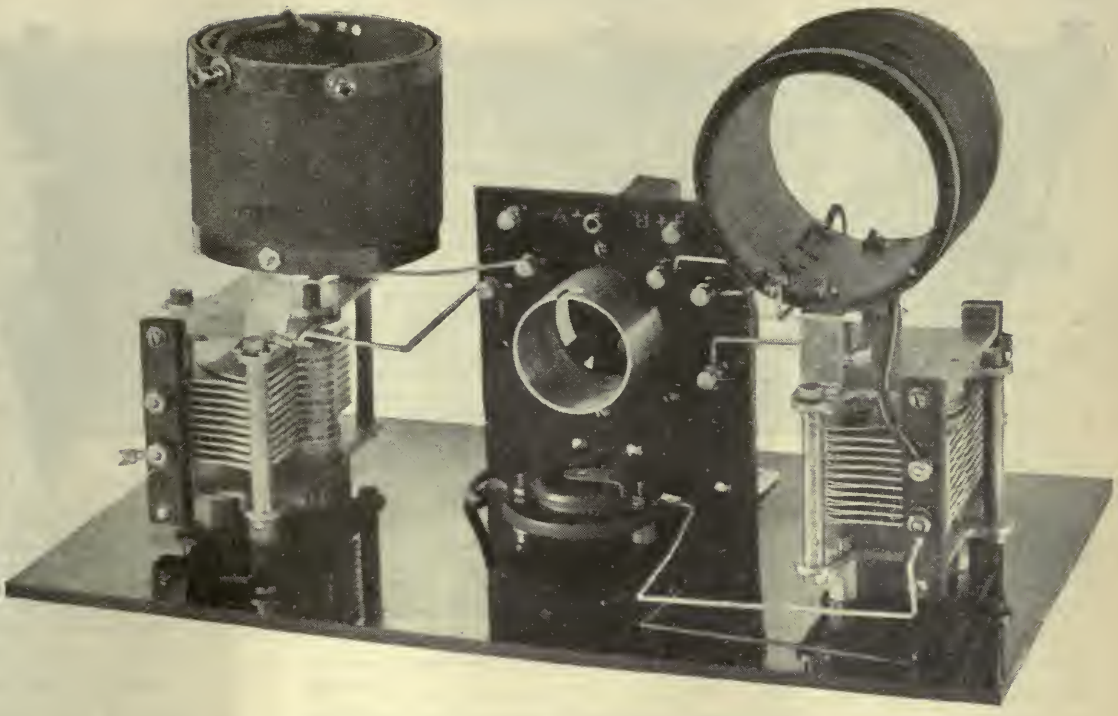
For the lasting good of the business itself as well as to identify ourselves with a policy of absolute reliability, upon which we could feel that exaggeration and statements of a misleading nature would not appear, this magazine determined to try every piece of radio equipment, in its final form, before bringing it to the attention of our readers through our text pages. We decided to test in our own laboratory, under actual operating conditions, radio apparatus appearing in the advertising section of Radio Broadcast.

This policy has worked out particularly well. We have been able to build up a reader confidence which we treasure very highly. We have been able within the past two years to secure the co-operation of many advertisers in cutting out the false and exaggerated claims sometimes made for their devices and have proved to them that they can do a greater volume of business by confining their statements to the truth than was possible when it was the practise to carry on most of their descriptions with a generous helping of superlatives.

A READER SERVICE

SUCH campaigns are not easy to win and we had considerable opposition, especially among those merchants whose business seemed to be flourishing. We felt sure that there would be a reaction when enough purchasers had been deceived, willfully or otherwise. The unreliable dealer or manufacturer then could not long succeed. We were criticized more than once for daring to say such a thing to some of the manufacturers whose business we knew could be saved and made permanent if they would cease taking a tremendous profit from the sale of poorly designed and inefficient apparatus and give the public an even break. We have seen several of those who persisted in taking too large a profit spend most of that profit in an attempt to get back some of the business they lost, by dashing into extravagant advertising campaigns that proved almost fruitless, because the people to whom they desired to sell their goods had not received quite fair treatment and could not be led to believe that their statements—which were actually true—could be relied upon. In some instances, the merchant suffering from such a setback had sense enough to change the name of his company when he changed his method of business. Several such revived merchants have done a tremendous business at a fair profit.

We have always held that the most important person in the radio business is the person who spends his good money for radio apparatus. If it were not for the man who buys there would be nothing to sell, since we thought that a great number of our readers were among those who bought, we figured that it would be well for us to do everything in our power to see that the readers of Radio Broadcast were kept informed of facts and not fed on half truths.



THE BEST SINGLE TUBE RECEIVER WE KNOW

Which was first described in this magazine last November, with slight modification in succeeding numbers. Some two dozen different models of this set have been made up under the Laboratory's direction. Readers of this magazine have shown tremendous and justified enthusiasm over this excellent set. It is the famous one-tube Knock-out

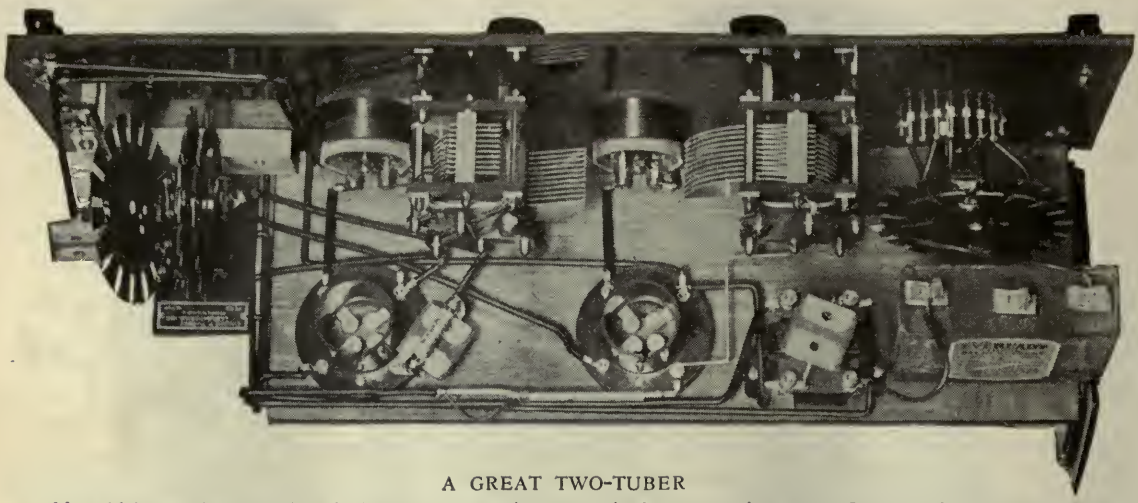
To follow this policy, it became necessary for us to do a great deal of testing. The staff of this magazine has spent many, many nights testing tubes, transformers, coils, and all manner of parts, to say nothing of about every type of receiving set, in an effort to present, through these pages, nothing but the truth.

In carrying on this work, we came across a situation which is at once serious and hardly just to the purchaser and the reader.

Certain radio authors, whose technical how-to-make it articles have been printed by many periodicals, are known to receive regular retainers from manufacturers, presumably in return for publicity these writers give their circuits. The authors then are paid by the interested manufacturer and the periodical publishing their work.

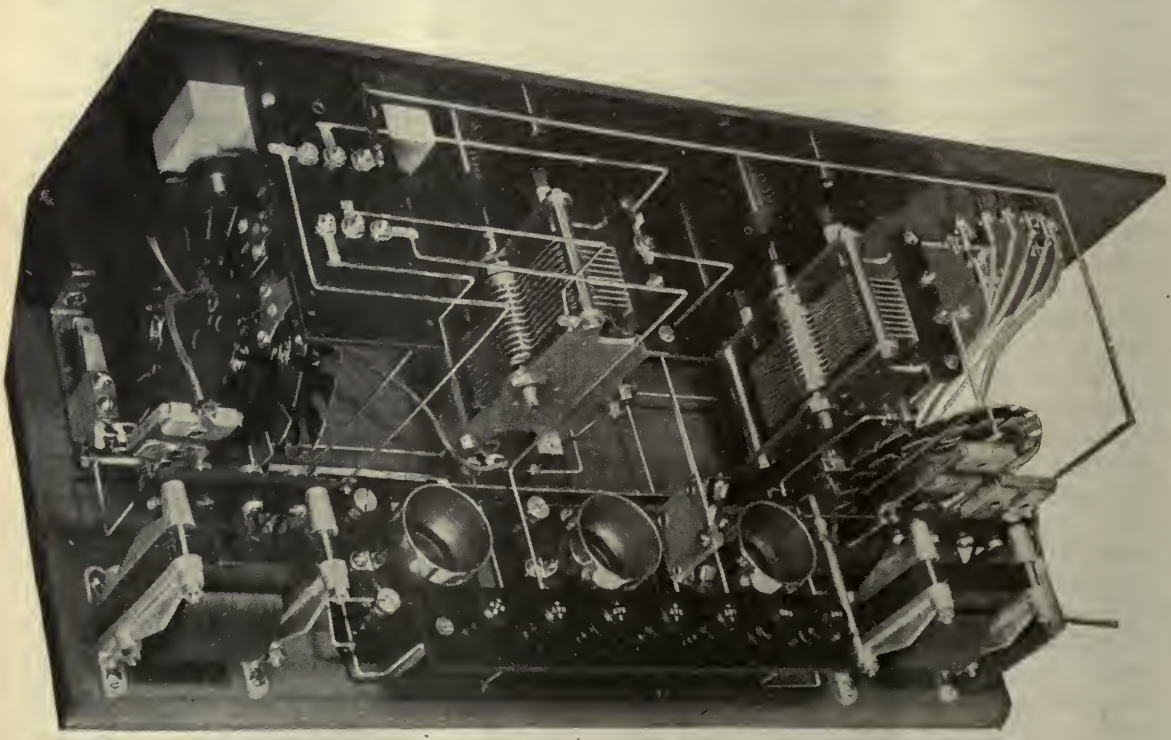
In instances of this sort, it is very difficult to draw the line between the good and the bad, because some of the authors who are so subsidized are really conscientious and think more of their good names than the few dollars they may get for a "puff" of a few thousand words written for the sole purpose of unloading what might easily be called junk. Many such articles have been received by this magazine for publication, but they have never appeared. We have our own ideas about radio receivers for the use of the public. When we publish articles by independent authors they are articles which are agreed upon before they are written. Where there is any possibility of a receiver or piece of apparatus of any particular type operating more satisfactorily because the parts from which it is made have been selected and are thought to be better than the regular run of parts of the same make, we purchase a set of parts from regular stock, build a similar unit and check the results obtained from one against the other.

Work of this kind requires a great deal of labor and consumes much more time than is generally believed and it is anything but inexpensive—but, in the final analysis, it pays and pays well. Can you imagine the thrill we get from receiving hundreds of unsolicited letters, after the publication of technical information concerning some new or improved circuit, with which we have labored months? The thrill the broadcast artist receives from the mail he gets after a performance that



A GREAT TWO-TUBER

Is this, which combines tuned radio frequency, capacity-neutralized, regeneration, and reflexed audio-frequency amplification in a system that is at once easy to build, easy to operate, extremely economical, and selective. It compares most favorably in selectivity with the best super-heterodynes, to say nothing of its ability to operate a loud speaker. This phenomenal receiver was described in the April, May and August numbers. It was developed by Walter Van B. Roberts, of Princeton, and we have spent months and much effort to reduce it to its simplest form



WHEN YOU WANT TO DANCE

The Roberts with an additional stage of audio fills the bill. This is only one of a number of receivers which we have made employing this circuit. All work splendidly and the mechanical arrangement has formed the chief difference in them

meets with public approval is nothing compared to the thrill we get. We're not merely turning out a lot of radio hodge-podge in an effort to fill a certain number of pages, we're telling you the story of our own experiences with different kinds of apparatus and we get as much fun out of tinkering with radio circuits as any of our readers.

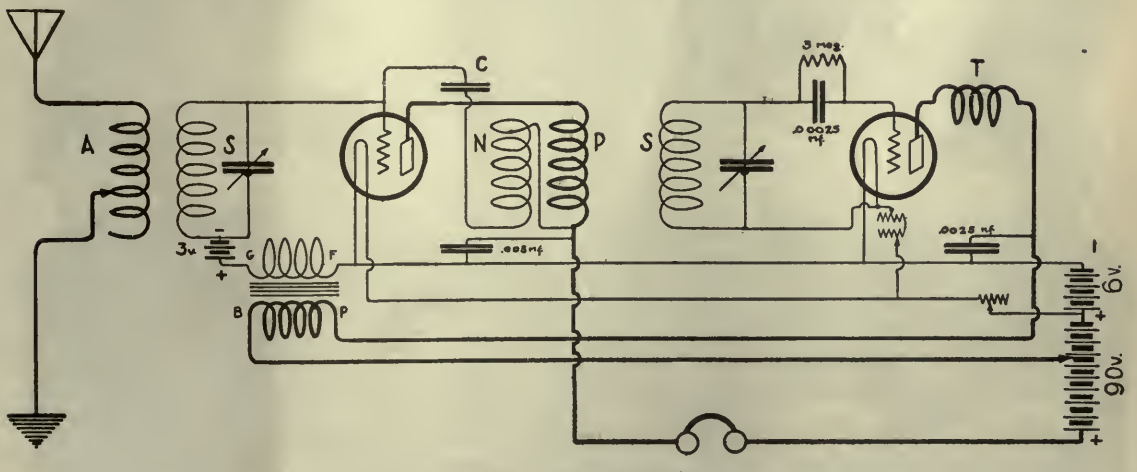
All Honor to Royalty

Tube for tube, ampere for ampere, volt for volt, and dollar for dollar, RADIO BROADCAST's Four-Tube Knock-Out is the best receiver for home construction we have ever seen. It is a combination of the famous Roberts circuit and a push-pull amplifier. A complete description of this receiver written by John B. Brennan, editor of The Grid, appears in this number. A photograph of one of the best lay-outs of this circuit is printed on page 383 of this number. This receiver is the result of a series of experiments during which more than a dozen trial sets were built, which is the process which always occurs when the laboratory is developing a receiver to be described in our pages. Every effort is made to refine the work and by careful tests make certain that the descriptive material is absolutely reliable and accurate.—THE EDITOR.

SERVICE TO MANUFACTURERS

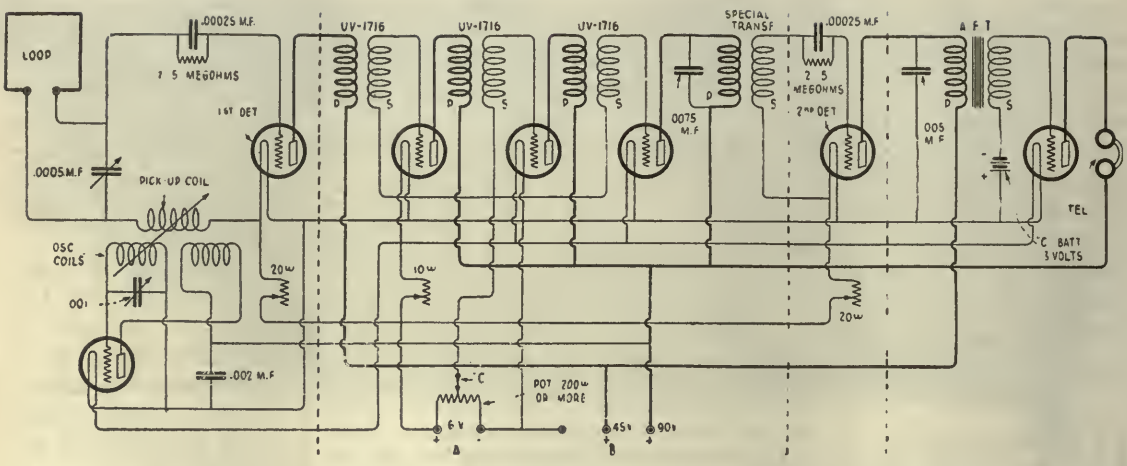
IT IS practically impossible to carry on a lot of experimental work without running across little kinks here and there that would be of value to the entire industry, if they were brought to the attention of interested and progressive manufacturers. By keeping in close touch with such manufacturers we are able to keep them informed of our work and are frequently able to suggest devices of a very efficient nature that might be merchandised in large numbers, at a fair profit. Many instances of this kind have occurred within the past few months and several more are under way. Our services are as free to any responsible manufacturer as they are to our readers; we make no charge for our work and play no favorites. We want our readers to be able to procure the best possible radio equipment at a fair price and will not leave a stone unturned in our effort to bring about this result.

There have been instances, within the past few months of manufacturers, who have been in financial distress before they took our offer of co-operation seriously and who are now doing a very fine business. We believe that the manufacturer who is willing to play the game with the fellow who has money to spend for good radio equipment deserves serious consideration and we want to be of as great assistance to him as possible. We have no time for the man who is merely trying to "clean up." And this service is free of all strings. The people who take advantage of it need not even be among our advertisers. We want our readers to be able to get the best and if the best happens to be the product of a non-advertiser,



THE ROBERTS CIRCUIT

Which was originally described by Walter Van B. Roberts, who developed it, in this magazine for April and May. As can be seen, the circuit is very simple, and when properly built up produces results so far beyond any other combinations using two tubes that radio constructors everywhere are finding it immensely worth their while to build it. This circuit is one of several sponsored by RADIO BROADCAST in an effort to give the broadcast listener a sensitive, economical, and efficient receiver to take the place of radiating single-circuit regenerators



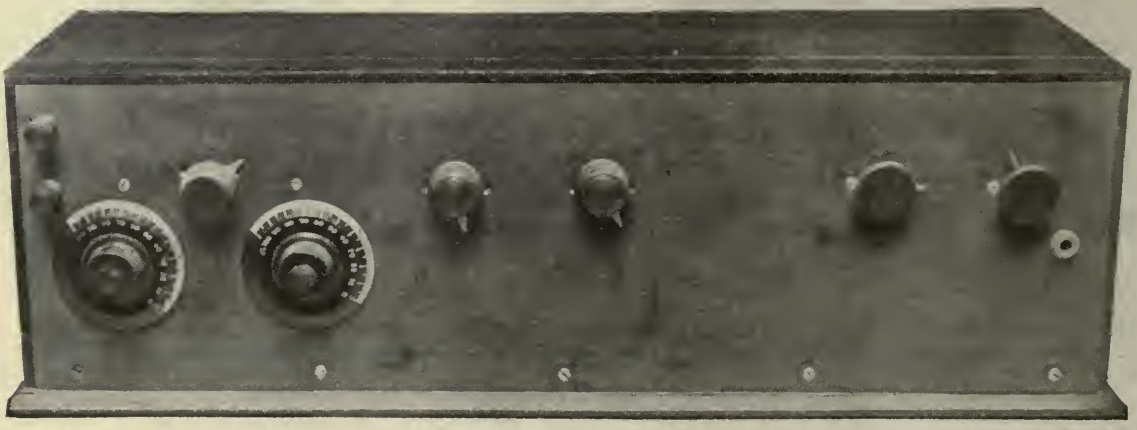
SOME SUPER-HETERODYNE HISTORY YOU MAY NOT KNOW

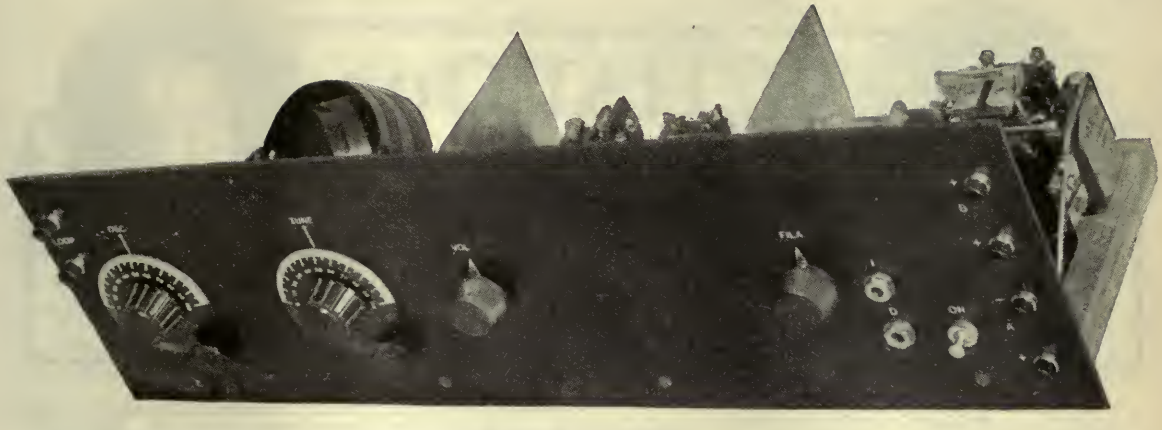
The super-heterodyne illustrated and its accompanying diagram appeared in this magazine for November, 1923. This was the first practical transformer-coupled super described in any magazine. The design is excellent, and those who have since capitalized on the super, have not greatly improved this design. There is little doubt that the great popularity of the super is due to the impetus given by the descriptive articles first printed by Radio Broadcast.

The UV-1716 transformers used for the intermediate-frequency amplifier coupling are now difficult to procure and it was for this reason and at the suggestion of this magazine that other manufacturers brought out transformers to replace them.

There is no more complete, practical, and easily understandable information on the super than can be gleaned from the following list of articles by authors who are authorities, and much of whose work has been done in close coöperation with Radio Broadcast.

February, 1923: *A Supersensitive Long-Range Receiver*, Paul F. Godley.
August, 1923: *A Practical Super-Heterodyne Using 199's*, Walter Van B. Roberts.
November, 1923: *How to Build a Super-Heterodyne Receiver*, George J. Eltz, Jr.
December, 1923: *Using What Junk You Have in Building a Super*, George J. Eltz, Jr.
January, 1924: *A Simplified Super-Heterodyne*, A. J. Haynes.
March, 1924: *Shooting Trouble in the Super*, A. J. Haynes.
September, 1924: *The Super and Its Intermediate-Frequency Amplifier*, A. J. Haynes.
July, 1924: *The Story of the Super-Heterodyne*, Edwin A. Armstrong.
September, 1924: *The Super and Its Intermediate-Frequency Amplifier*, A. J. Haynes.





FRONT PANEL VIEW

Of the simplified super-heterodyne. A large number of these sets have been built by readers and are giving great satisfaction in all parts of the country. Captain Jack Irwin has one of these receivers aboard the RADIO BROADCAST COVERED WAGON

we feel, that we would not be serving our readers best if his products were not given attention in our columns.

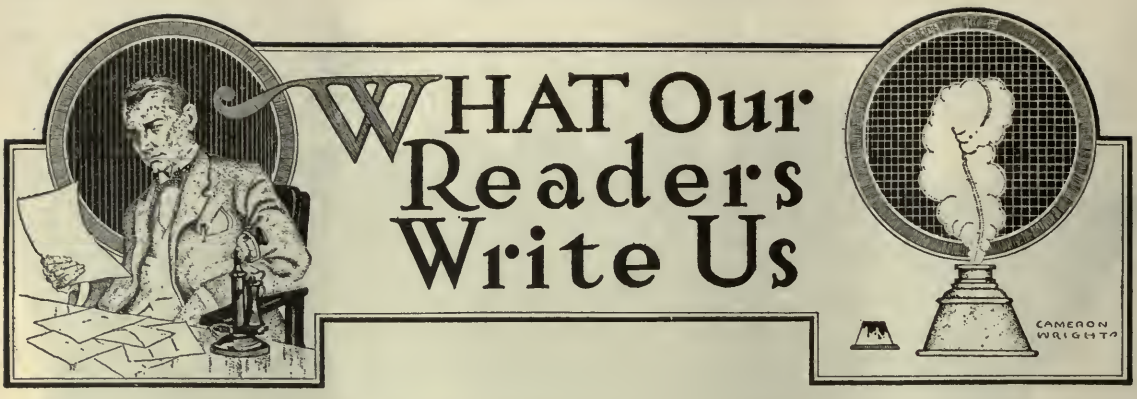
In co-operating with one manufacturer in this fashion, we were lead to believe that he would place devices on the market that we recommended to our readers. He did so. For a time he maintained the good quality we had insisted upon. Then the quality began to fall off as the demand increased. He can not now advertise in RADIO BROADCAST at any price and his devices are not mentioned in our pages.

RADIO BROADCAST'S Laboratory is more than a laboratory, it is an honest attempt to serve those who find interest in the radio game and those who are making their living by honestly trying to serve those who are interested. The radio business is growing and growing very rapidly. There is plenty of room for more and more radio apparatus of quality. The more people there are who are satisfied with their receivers the greater the business will be for everyone, including ourselves. We are doing our best to increase the number of satisfied radio fans.



THE INS AND OUTS OF THE SIMPLIFIED SUPER

Which was the first to appear with a specially designed transformer for the intermediate-frequency amplifier. There are but four controls and once the filament rheostat and potentiometer have been set, only two controls—the condenser in the oscillator circuit and the condenser across the loop—are actually used. This receiver is the first of a long line of supers and when properly built is hard to beat. Since the publication of the Haynes article describing it in RADIO BROADCAST for January, 1924, many similar articles have appeared in other publications. If you really want to know who is responsible for the great popularity of the super, try to find some sound information about it in any other radio publication prior to the dates given on the preceding page



Wanted: Chorus Girls

A GREAT tempest in a newspaper occurred in New York recently when WHN lent itself to broadcast an appeal by a certain theatrical producer for "fresh" chorus girls who aspired to life under the permanent wave. There were those who thought, and delayed not in expressing themselves, that to use radio thus in invading homes with an appeal of that sort was nothing short of criminal. And there were those who did not take the matter very seriously, and trusted to the judgment and balance of the girls and their mothers. The two letters below discuss both sides of the subject.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR.

The First Amendment to the Constitution prohibits Congress from "abridging the freedom of speech," and surely this includes broadcasting. Even when advertising is broadcast it should not be censored, unless we are to censor advertisements in the Sunday papers and in weekly periodicals.

Yet scores of mothers have appealed to prohibit a broadcasting station in New York City from announcing that a theatrical producer will give tryouts to girls who aspire to be actresses. Do the mothers actually think that their daughters will be tempted by the unseen spokesman of the devil and will depart the home in order to earn their own living? If the opportunity of thus giving pleasure to countless multitudes appeals to the daughters, surely the mothers, who brought them up, have only themselves to blame.

G. N. B., Montclair, New Jersey.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR.

Twice a day, during the morning and in the middle of the evening, an appeal has been broadcast from a New York station for girls with "good figures, pretty faces, and neat ankles" to appear arrayed in bathing suits on a theater roof where they are to be photographed as entries in a contest, in which 116 will be chosen as members of a chorus for a Broadway musical comedy. It is said that several hundred respond to the invitation every day.

There is no doubt about the legal right of a broadcasting station to lend itself to such a scheme. But this is a question of morality and of good taste, not of law. The greatest blessing of radio is at the same time a great danger, and surely such an appeal to the public, in the privacy of their homes, suggests that society approves of the life of the chorus girl. The bad influence which results from this will appear in children's thoughts if not in their actions. It is surely another case of misplaced emphasis, by which the younger generation decides that the chorus girl (as previously it had decided that the movie actress) is a more admirable member of society than is the social worker or the missionary. We have had enough publicity for the acting profession, with the sordid details of their life, without this, the latest and most degraded form of it.

B. R. D., Cold Spring Harbor, New York.

The Busy Wordsman

THE peculiar imagination of those self-appointed and highly enthusiastic souls who take unto themselves the task of naming this new radio circuit and that, is—to judge by the results before our eyes every day—never at rest. The quiet observer on the radio sidelines is growing more mystified and befogged every day. We have little sympathy with the eager chaps who do the naming, but indeed we don't envy the task of him who compiles the next dictionary, and, honestly enough, tries to put in the radio terms.

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

Some years ago a fat and weighty volume issued from the press under the name of Dr. Mencken, who gave us the benefit of his research in the field of the American language. If this learned critic considers revising his work he will be greatly perplexed when he comes to deal with a large and recent addition to our vocabulary.

Probably it is safe to say that most radio terms are Greek, at least to many of us. But our intelligence is wantonly insulted and perspicuity needlessly violated in he case of the word commonly used to describe an overabundance of the other (ἕτερος—was it not the New England essayist who defined heterodoxy as the other doxy, that is, *not* my doxy?) kind of power: and from the prefix we conclude that the other kind of power is presumably Latin.

And if ever an inventor comes upon a still greater su, ply

of the other kind of power, we must expect, as a description of it, some such linguistic atrocity as hyper-super-heterodyne.

ALEXANDER VAN SANTVOORD, New York.

"Lord, What Fools These Mortals Be"

RADIO BROADCAST for January contained a letter written by N. A. Brown which bemoaned the failure of radio dealers to use intelligence in the ordinary course of merchandising. Here is another wail from Pittsburgh about the dealers there, who, apparently, are too busy to bother with any except those who spend great quantities of radio money.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

I should like to give three cheers for N. A. Brown, whose letter about radio dealers I read with great interest in a recent issue of RADIO BROADCAST.

All Mr. Brown says is true, but he did not go far enough. My first set was an amateur home made crystal set. It did very well as a starter. Later, I bought a high priced crystal set which worked very well indeed and did all and a bit more than might have been expected of it. Then Mrs. Wife and I decided we wanted to wander in realm of long distance receiving. Unfortunately, I am no Rockefeller, due to a money loving landlord, hungry life insurance companies, and a few others operating along similar lines. Therefore, a moderate priced tube set was the best I could afford. I wandered into a score or more of department and radio stores. I got scant attention from the clerks when I mentioned that $50 was my limit. They were so gol durned anxious to sell $250 and $350 sets that they didn't have time to talk to me about mere $50 outfits. Yes, they would sell such sets, that is, the parts to build them. But what I wanted was a set all ready-made. Everybody seemed particularly anxious to sell parts, but no one appeared at all eager to sell moderate-priced built sets.

Finally, I went in to an old established reputable electrical house where the clerks answered me civilly, strange to say, and listened to me long enough to find out what I wanted. I told them I knew the cheaper priced sets would not reach out to Europe, Asia, or Africa, but I did hope to get out as far as Cleveland—300 miles away. I bought a set for $39.50, and got satisfactory results from it.

I now find that the department stores handle this set as do some of the other stores I visited in vain. All this leads to the question: why do radio dealers try to force high priced sets on customers able to buy only those of moderate price? I think that if the dealers would as cheerfully sell those of moderate price as the costly ones, they would do far more business and in the end, the profits from the sale of several cheaper sets would equal the profit from the sale of one of the more expensive ones which they failed to unload on one of us poor devils.

When I get the money to do so, I expect to buy the best on the market—perhaps a $500 or $600 set with all the frills ever made, but I can't stand the pressure now. There are lots like me, I am sure.

W. C. M., Pittsburgh, Pa.

Broadcasting on the Pacific Coast

WE FREQUENTLY do not realize the influence of the newspaper outside its especial function of gathering and printing news and merchandising it to the public. Not a few newspapers have entered heartily into broadcasting, and their influence is a great factor in elevating the standards of program excellence. The letter which follows contains some tributes to newspaper broadcasters on the West Coast which are apparently deserved. Which reminds us that it is certainly desirable for the radio listeners to pass around more considered bouquets than they are in the habit of doing. The broadcasters want your opinions, and two cents invested in a stamp is not much to spend. Carl Dreher wrote in "Pity the Poor Broadcaster", (June) you recall, that "they may broadcast beautifully for weeks, and nothing is thought of it, but let there be a two-minute difficulty, and a score of listeners who never thought of giving them a word of praise, let fly with both fists."

Editor, RADIO BROADCAST,
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

I was interested in reading Mr. Winfield Barton's article in a recent issue of RADIO BROADCAST about the place of the newspaper in broadcasting.

For six months past I have listened regularly every night two to four hours on the main stations on the Coast from Los Angeles to Edmonton, Canada, and unhesitatingly state that the best station on the Coast is the Los Angeles *Times* (KHJ). The managers of that station apparently have a definite purpose in view and carefully arrange their programs not only to cover entertainment, but educational and instructive features well calculated to appeal to all classes of listeners. And they cover the field with remarkable consistency, with the result that no single evening's broadcast but leaves the listener-in realizing that he has been benefited as well as entertained. Whether or not the *Times* is benefited financially is unknown to me, but as the object of the managers of the station is to benefit and entertain the masses as a whole, I should say that they have made a great success of their efforts.

And the second best station on the Coast, according to the evidence of my ears is KLX, the Oakland (California) *Tribune*, with CKCD, the Vancouver *Daily Province* third. You may ask, how about KGO, the new General Electric station. That is a wonderfully equipped and powerful station with splendid programs of a certain high class, but the people in general do not especially care for them. They are not interested in cantatas, radio dramas, or operatic singing. When listening-in with me, visitors often ask me to shift from KGO to KHJ, KFI, or KPO, and are better satisfied with what they receive.

E. M. B., Gold Beach, Oregon.

WHAT Makes the Wheels Go 'Round", the instructive and readable technical serial by Walter Van B. Roberts, is unavoidably omitted from this number because of lack of space. Mr. Roberts' next article, in RADIO BROADCAST for October, is more than usually interesting and deals with the functioning of the vacuum tube in oscillating circuits. It should interest every radio enthusiast.

The How and Why of the Radio Broadcast Covered Wagon

A Famous Radio Man Is Traveling Across the Country on a Mission of Radio Aid and Radio Exploration—All the Knock-Out Receivers Are On Exhibition

By CAPTAIN JACK IRWIN, U.S.A.S.R.C.
Formerly Radio Editor, New York Herald-Sun Syndicate

COINCIDENT with the first appearance of the RADIO BROADCAST COVERED WAGON, converted into a mobile radio laboratory, came the opening of the National Democratic Convention in New York City. The first orders I, as the pilot of the wagon, received from the Editor were directions to cover the radio features of the convention.

As my orders were very vague and I was instructed to use my own discretion, I thought I would give the natives and visitors on Broadway a treat and broadcast Senator Pat Harrison's opening speech from the wagon. Undoubtedly I provided them with a treat, but not the one I had in mind. I had just tuned in WEAF on our super-heterodyne when an unmistakable voice wanted to know "how I got that way." New York's finest was giving me my "on your way."

I will say this, however, that the large crowd that had gathered round the COVERED WAGON resented his zealousness more than I did. As the convention progressed I was to discover that the New York police force developed such an interest in the proceedings that I was seldom requested to "move on."

One of the objects of this COVERED WAGON is to provide entertainment for readers of this magazine. After delivering the broadcast reports of the convention for two weeks it is obvious that if entertainment was the sole mission of the expedition the result has been most successful. Wherever the car parked in a very few minutes it was surrounded by interested listeners. Glancing out of the wagon occasionally, I would find fans pushing their way through the throng to learn the type of apparatus used and the make of the loud speaker. During the two weeks that the convention was in session it is safe to say that tens of thousands grouped themselves round our "rolling laboratory."

THE ITINERARY AND PURPOSE OF THE TRIP

FOR the period of the convention we used one of the super-heterodynes built in the RADIO BROADCAST LABORATORY, employing a small collapsible loop and a power loud speaker. This receiver gave such volume that it could be heard for several city blocks, even above the roar of traffic, yet always with wonderfully clear quality. So clear was the reproduction that it was often amusing to find skeptical persons searching for a gramophone or some other hoax.

The Story of the "Covered Wagon"

THE "Covered Wagon" has been a-planning for a number of months and most radio men who have known of it are highly enthusiastic. Briefly, several months have been spent in preparing a truck with a canvas covering which greatly resembles the covered wagon of days gone by. Inside the brown canvas top is a copy of every receiver designed and built in the RADIO BROADCAST Laboratory. The pilot is Captain Jack Irwin, one of the best known men in radio and a true pioneer. He and the Wagon have started across the country on their way to California. He will stop in the large cities, and this town and that, exhibiting the Knock-Out series of receivers and the super-heterodyne, will coöperate with radio clubs in reducing interference from "man-made static," and advise and aid radio fans along the way in how to get the best results from the receivers they have, or help them decide what receiver is best for their locality. The receivers are aboard the wagon, so it will not take long in the proving. The story of Captain Jack's journey will appear month by month in this magazine. Watch for his national radio observations.—THE EDITOR.

The convention is over, and the writer is now on his way to California, In the quiet camps to come I feel sure my sleep will be disturbed by the shout of "ALA-AA-BAAMA votes 24 for Underwood." With the scattering of the delegations, it was but the work of a few days to load the remainder of the laboratory equipment on the wagon and pull out on our original mission

The COVERED WAGON is now equipped with the most complete outfit of receivers ever installed on an automobile. One each of the Knock-Out receivers developed in the RADIO BROADCAST LABORATORY is included in the equipment. In other words we carry a one tube, two tube, three tube, and a four tube receiver, while the super-heterodyne alluded to above will provide us with a "kick." With such an array of sets we will be able to ascertain for any of our readers just what type they will require to obtain the results they look for in any given locality. It is to assist those so situated that this wagon will tour the country. Other objects will be the elimination of unnecessary interference, so far as persuasion and preaching such radio gospel will prevail, also to ascertain, for the information of our readers, just what sets should be carried on an automobile tour to any of the National parks. We hope to visit all of them in turn. This last mentioned object will undoubtedly provide valuable information for those in doubt as to what to carry. We can conceive of no greater disappointment to a radio experimenter than to pack a weighty set into some inaccessible region only to be disappointed with no results.

There will be many other less specific objects in view in undertaking this journey. What I look forward to most is discovering for myself what radio is doing for the people in the so-called "wilds" of our country. Those of us who live in cities know that radio has become amazingly popular and almost indispensable. I want to learn first hand just how far radio keeps a real farmer amused and informed. Is he a radio brother of the man who has spent, say, eight hours in a city business house and several hours more coming and going in crowded transportation? In other words, are rural, surburban, and urban "radio bugs" all alike?



THE COVERED WAGON

Outside of the RADIO BROADCAST offices in Garden City, Long Island. Captain Irwin is standing by the front wheel. The picture was taken just before the WAGON started on its transcontinental trip

The chief impression I anticipate is reiteration of the wonderful effect radio is producing in our daily contact with each other. And so I go, fully armed with my car load of "n'everything" into the various camps of neutrodyne, heterodyne and every radio dyne! Many of my friends envy me my trip after seeing the arrangements made aboard the wagon for my comfort. I have crossed this continent a number of times in a Pullman car, and like many of you, detest the experience. I have also crossed by airplane, and enjoyed that even to wishing to duplicate the air trip. However, I can candidly say that I have never started on any journey with prospects of all the comforts than I do upon this COVERED WAGON trip. Built on a standard chassis is a house eight feet long by five wide and six feet three inches high. By dropping an extension on the back and extending the telescopic rear curtain I obtain another three feet of space when in camp. The wagon is fully equipped with a complete camp outfit. In fact everything that a comfortable bungalow possesses is there—even to a two-burner gas stove! The latter is a most ingenious affair supplied with fuel from a large Prestolite tank slung out of the way under the floor of the car. To make camp and "turn in" requires no more effort than to steer into some parking place and go to bed!

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM JUNE 14 TO JULY 18 INCLUSIVE

CALL LETTERS	LOCATION	KILOCYCLES	WAVE-LENGTH	POWER (Watts)
KFAJ	Boulder, Colo.	1150	261	100
KFCL	Los Angeles, Calif.	1270	236	500
KFQM	Austin, Texas	1120	268	100
KFQN	Portland, Oregon	1060	283	5
KFQO	Russell, Kansas	1150	261	10
KFQP	Iowa City, Iowa	1340	224	10
KFQR	Oklahoma City, Okla.	1200	250	10
KFQS	Manitou, Colo.	1220	246	10
KFQT	Denison, Texas	1190	252	10
KFQU	Holy City, Calif.	1280	234	100
KFQV	Omaha, Nebraska (portable)	1300	231	100
KFQW	North Bend, Wash.	1210	248	50
KFQX	Seattle, Wash.	1290	233	250
WBL	Anthony, Kansas	1180	254	100
WDBX	New York, N. Y.	1290	233	5
WDBY	Chicago, Ill.	1160	258	500
WDBZ	Kingston, N. Y.	1290	233	5
WEBA	Highland Park, N. J.	1290	233	15
WEBC	Superior, Wis.	1240	242	10
WEBD	Anderson, Ind.	1220	246	10
WEBE	Cambridge, Ohio	1210	248	10
WEBJ	New York, N. Y.	1100	273	500
WFBH	New York, N. Y.	1100	273	500
WNYC	New York, N. Y.	570	526	1000
WTX	Chicago, Ill.	1120	268	10

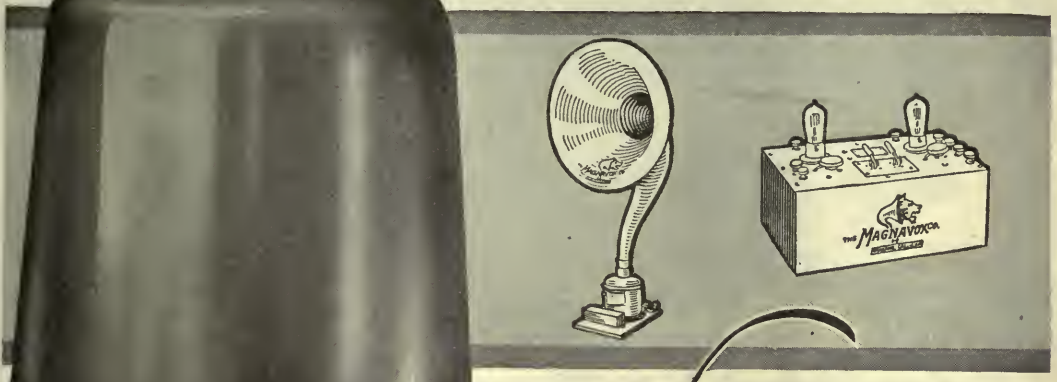
LIST OF BROADCASTING STATIONS DELETED JUNE 1 TO JUNE 30

CALL	LOCATION	CALL	LOCATION	CALL	LOCATION
KDYX	Honolulu, T. H.	KFNH	Springfield, Mo.	WIAJ	Neenah, Wis.
KDZQ	Denver, Colo.	KFOF	Marshfield, Oregon	WJAT	Marshall, Mo.
KFAF	Denver, Colo.	KFOH	Portland, Oregon	WJX	New York, N. Y.
KFAJ	Boulder, Colo.	KFOP	Dallas, Texas	WKAY	Gainesville, Ga.
KFAN	Moscow, Idaho	KFOV	Sioux City, Iowa	WLAJ	Waco, Texas
KFAU	Boise, Idaho	KGN	Portland, Oregon	WLAK	Bellows Falls, Vt.
KFCY	Le Mars, Iowa	KZV	Wenatchee, Wash.	WMAB	Oklahoma City, Okla.
KFDA	Baker, Oregon	WABA	Lake Forest, Ill.	WMAJ	Kansas City, Mo.
KFDO	Bozeman, Mont.	WABN	La Crosse, Wis.	WNAN	Syracuse, N. Y.
KFDV	Fayetteville, Ark.	WABS	Newark, N. J.	WNAQ	Charleston, S. C.
KFFO	Hillsboro, Oregon	WABV	Nashville, Tenn.	WNAS	Austin, Texas
KFFQ	Colorado Springs, Colo.	WBBF	Atlanta, Ga.	WNAV	Knoxville, Tenn.
KFFV	Lamoni, Iowa	WBBO	Rogers, Mich.	WNJ	Albany, N. Y.
KFFZ	Dallas, Texas	WBBQ	Pawtucket, R. I.	WOAP	Kalamazoo, Mich.
KFGV	Utica, Neb.	WBBS	New Orleans, La.	WOK	Pine Bluff, Ark.
KFHB	Hood River, Oregon	WCAM	Villanova, Pa.	WPAT	El Paso, Texas
KFHF	Shreveport, La.	WCAS	Minneapolis, Minn.	WQAD	Waterbury, Conn.
KFHX	Hutchinson, Kansas	WCM	Austin, Texas	WQAW	Washington, D. C.
KFJV	Dexter, Iowa	WDAO	Dallas, Texas	WRAA	Houston, Texas
KFLH	Salt Lake City, Utah	WFAF	Poughkeepsie, N. Y.	WRAH	Providence, R. I.
KFLP	Cedar Rapids, Iowa	WFAJ	Asheville, N.C.	WRAY	Scranton, Pa.
KFLR	Albuquerque, N. M.	WFAQ	Cameron, Mo.	WSAG	St. Petersburg, Fla.
KFMS	Duluth, Minn.	WFAT	Sioux Falls, S. Dak.	WSAT	Plainview, Texas
KFMU	San Marcos, Texas	WGV	New Orleans, La.	WSAW	Canandaigua, N. Y.
KFMY	Long Beach, Calif.	WHAB	Galveston, Texas	WWAC	Waco, Texas
KFMZ	Roswell, N. M.	WIAF	New Orleans, La.	WWAF	Camden, N. J.
KFNC	Corsicana, Texas	WIAI	Springfield, Mo.		

TOTALS

Number of U. S. broadcasting stations	546
Number of Canadian broadcasting stations	44
Number of Cuban broadcasting stations	34
Number of Mexican broadcasting stations	4





Now a ★ MAGNAVOX Radio Tube

INTO the design of this new Tube have gone over two years' research and experiment along original lines, culminating in discoveries which made possible an entirely new principle of tube construction.

One trial convinces the most exacting user that the Magnavox will replace ordinary tubes to great advantage in any receiving set.

Magnavox Radio Tubes and other Magnavox Products are sold by reliable dealers everywhere

THE MAGNAVOX COMPANY

New York Oakland, Calif. San Francisco

Canadian Distributors:
Perkins Electric Limited, Toronto, Montreal, Winnipeg

Magnavox Radio Vacuum Tube Type A is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Highly recommended also for detector use.

This tube is not critical of adjustment either as to plate or filament. Filament consumption one quarter of an ampere. $5.00

9R

★ Tested and approved by RADIO BROADCAST ★



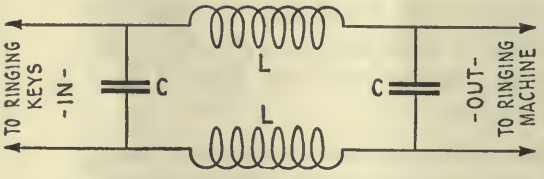
QUESTIONS AND ANSWERS

QUERIES ANSWERED

How Can I Make A Filter Unit to Eliminate Interference From Telephone Ringers? *J. L. C.*, Salem, Mass.
Can Six-Volt Tubes Be Used Throughout in the Roberts Set? . . . . . *H. E. Z.*, Lincoln, Nebraska.
What Is the Formula for Calculating the Wavelengths of Coils? . . . . *S. B.*, St. Louis, Mo.
How Can I Sharpen the Tuning of My Knock-Out Reflex? . . . . . *J. A. C.* Albany, N. Y.
Give Me a Circuit Applying the Roberts Neutralizer to a Straight Two-Stage Radio-Frequency Receiver . . . . . *H. E. S.*, Porterville, Calif.

MAKING A FILTER UNIT WHICH ELIMINATES INTERFERENCE

IN HIS article on Man-Made Static appearing in the May issue, Mr. Van Dyck shows on page 44, Fig. 1, a circuit for eliminating the troublesome interference caused by telephone ringers. Herewith is given the data for constructing one's own unit at a comparatively low cost. The materials needed are: 1 base-board, 4 binding posts, 2 1500-turn honeycomb coils, 2 1 to 8 mfd. condensers, and sufficient heavy insulated wire for connections. The drawings in Fig. 1 are self explanatory. They show the placement and wiring of the parts. Any condenser within the range stated may be used advantageously. This same fundamental circuit may be used for eliminating the interference caused by motors, etc. Of course the values of the parts differ with the type of motor whose interference is to be eliminated. Your local electrician should be consulted to insure the proper design and construction of the unit.



C- 1 TO 8 MFD. CONDENSERS
L- 1500 TURN HONEYCOMB COILS

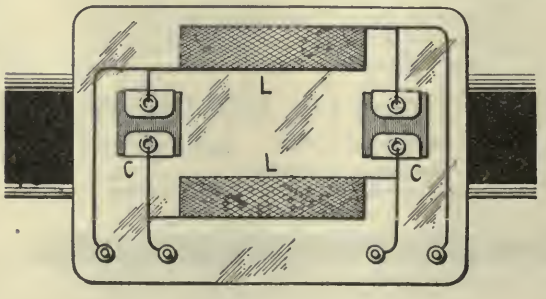


FIG. 1

USING 6-VOLT TUBES IN THE ROBERTS SET

THE question has been asked: "Can 6-volt standard tubes be used throughout, in the Roberts set?" Our answer is, "Yes." The reason for the original arrangement was primarily economy of operation. By using the UV-199 tube, a saving of .19 amperes is effected equalling about one watt. When other tubes are to be used, the only change necessary is to replace the filament strips with a standard rheostat of the proper value for the tube to be used.

HOW TO CALCULATE THE WAVELENGTH RANGE OF COILS

OFTEN the question arises as to how many turns of wire should be wound on such and such a form to secure a certain range of wavelengths. The mathematical formula for this problem would no doubt answer, but its use might result in incorrect, and lengthy calculations. This kind of business, we can leave to the engineers, especially since we can arrive at the same conclusions more quickly and easily.

The method is this: Supposing it is desired to know how much wire is needed on a spiderweb, honeycomb or bank-wound coil to respond to the 200-600 meter wavelength. By referring to the chart on page 485 of the April 1924 issue of Radio Broadcast we see that a No. 50 Duolateral type coil shunted by a 43-plate condenser tunes from 220 to 690 meters. Now, if we arrange these and other parts as in B. Fig 2, we will have a wavemeter with which we can calibrate or at least determine the maximum and minimum wavelength settings of the coil to be measured. To explain Fig. 2: B comprises the standard No. 50 coil, 43-plate, .001 mfd. variable condenser, buzzer and battery. A switch may be included to control the buzzer. This circuit is a miniature transmitter, the wavelength range as stated above, being controlled by the variable condenser. In A, we have the listening circuit. *X* is the coil to be measured. Ordinarily for this wavelength range, the number of turns for this coil



Greater Distance
on the loud speaker

Send for the 32-page illustrated book giving latest authentic information on drilling, wiring, assembling, and tuning 6 and 8 tube Ultradyne Receivers.

50c



ULTRADYNE KIT

Consists of 1 type "A" Ultraformer, 3 type "B" Ultraformers, 1 Tuning Coil, 1 Oscillator Coil, 4 matched fixed Condensers.

The Ultraformers are new improved long wave radio frequency transformers, specially designed by R. E. Lacault, Consulting Engineer of this company and inventor of the Ultradyne.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. Ultraformers are guaranteed so long as this seal remains unbroken.



$26

No ordinary standards of distance can be applied to the Ultradyne Receiver. The "Modulation System" of radio reception, used exclusively in the Ultradyne, completely revolutionizes all previous conceptions of range.

The "Modulation System" is the latest development of R. E. Lacault, A. M. I. R. E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Radio Research Laboratories.

This "Modulation System" is a decided departure from the detector arrangement used in all other Super-Heterodynes. It causes the incoming signal to modulate the oscillations produced locally just as the voice modulates the carrier wave of a broadcasting station. Provides greater rectification and produces greater signal strength which is far more noticeable on weak signals.

In addition the Ultradyne incorporates every good feature of all types of Super-Heterodyne receivers.

Write for descriptive circular

PHENIX RADIO CORPORATION
5-7 Beekman St. New York City

★ ULTRADYNE
The Improved
SUPER-HETERODYNE

★ Tested and approved by RADIO BROADCAST ★

should approximate the number of turns used on the standard coil in the transmitter or wavemeter circuit.

To operate, set the buzzer going and turn the condenser dial C, to one half its full scale reading, 50 or 90 according to the type of dial used. Then, listening in on the A circuit, closely couple the two coils together, adjusting

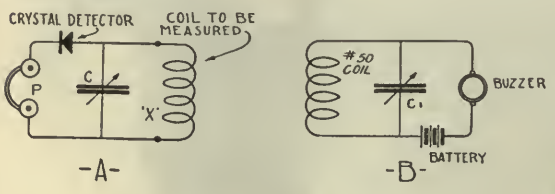


FIG. 2

the crystal detector for the signal. Rotate the condenser C for maximum signal strength and note its position. It should read very nearly like C1. If its reading is higher, this indicates insufficient wire on X; if the reading is lower, there is too much wire on X. The correct point can be ascertained by removing or increasing the number of turns on X until equal readings on both condensers are obtained.

SHARPER TUNING FOR THE KNOCK-OUT REFLEX

WHERE the addition of an extra control is not an objectionable feature, the reflex can, in many cases, be made to tune more sharply by winding the primary of coil unit T1 to about 40 turns tapped every 5 turns. In the original winding, this primary constituted an aperiodic circuit which responded to all wavelengths brought into resonance by the secondary and condenser. With the tapping arrangement, the primary circuit can be roughly adjusted to the wavelengths of the incoming signal, resulting in sharp tuning when the secondary circuit is brought into resonance with it. For experiment, a small variable condenser of about .00025 mfd. can be used either in series or parallel with the primary circuit. See Fig. 3.

And, while we are on the subject of Knock-Out reflexes, just a word about the crystal failing to act. We have received many inquiries asking why reception of signals still continues when the contact is lifted from the crystal. The

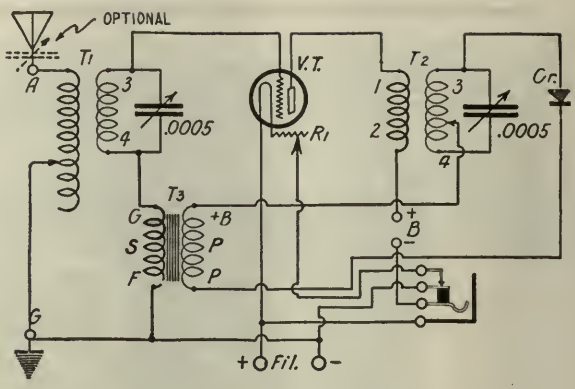


FIG. 3

answer is that the tube is acting as a partial rectifier, preventing the crystal and reflex audio transformer from giving any beneficial reflex action. This condition is due to any one of the following things:

1. Use of soft tube as an amplifier.
2. Poor composition of socket which provides an effective grid leakage resulting in detector action.
3. Poor reflex audio-frequency transformers.
4. Defective and poor crystals.

We have found it necessary at times to change crystals until a satisfactory piece was found. This resulted in sharper tuning, good quality and plenty of volume in the one-tube Knock-Out receiver.

NEUTRALIZING TUNED R. F. AMPLIFIER RECEIVERS

THE popularity of the novel neutralizing scheme employed by W. Van B. Roberts has become such that many experimenters are interested in its various applications. In Fig. 4, we show one of its many possible applications to the multi-stage, tuned radio-frequency amplifier circuits. Here is shown two stages of neutralized radio-frequency with a regenerative detector. The constructional details of the coils and neutralizing capacities have been explained in the April and May numbers by Mr. Roberts.

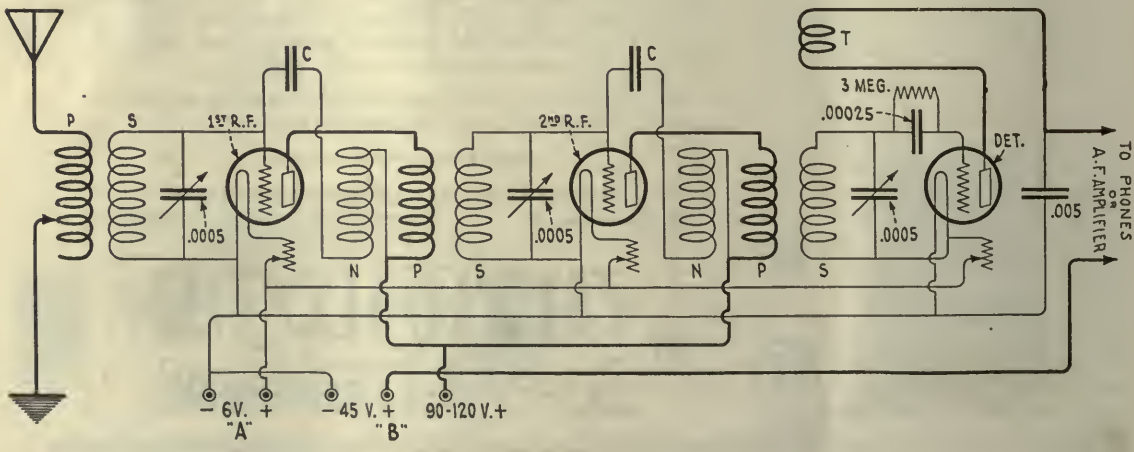
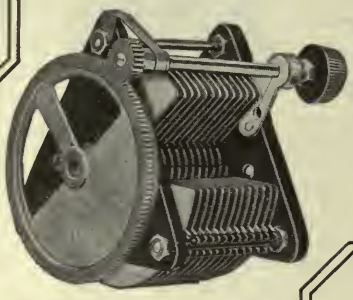


FIG. 4

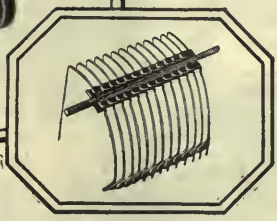
"THE CHOICE OF RADIO EXPERTS"



Balanced Vernier Gears Promote Extreme Selectivity



Brass Plates Soldered Together to Minimize Losses from Resistance



Capacity 500 MMF.

★ **Price $5.00**

Designed for PRECISION

The outstanding feature of a GENERAL RADIO condenser is PRECISION.

PRECISION in a variable condenser gives you the *sharp tuning* and *low losses* which mean *greater selectivity, signal strength and range.*

Balanced ratio gears with accurately machined teeth provide a *perfect vernier adjustment.*

Heavy brass plates of the rotor and stator groups are correctly spaced and *soldered,* thereby reducing resistance losses to a minimum.

This method of soldering makes the whole condenser assembly more rugged and assures the perfect alignment of plates which keeps capacity values constant.

Type 247-H 500 MMF., with vernier - - -	**$5.00**
Type 247-F 500 MMF., without vernier - - -	**3.25**

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GENERAL RADIO Co

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Cambridge, Mass. U.S.A.

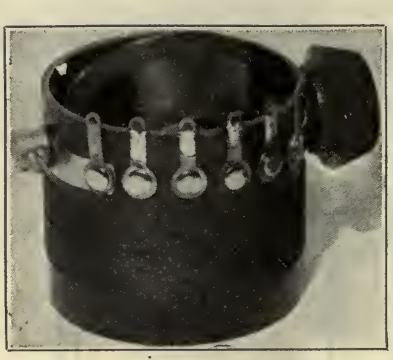
GENERAL RADIO Co

Cambridge, Mass.

Ask Your Dealer or Write for Our New Instructive Folder "Quality Condensers"

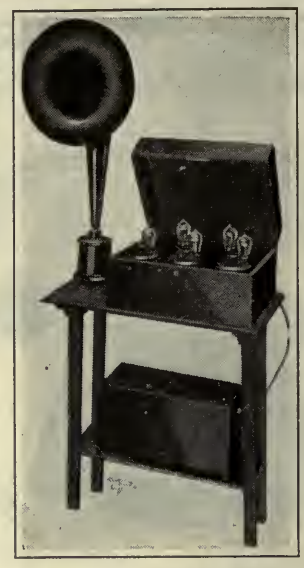
★ Tested and approved by RADIO BROADCAST ★

New Equipment



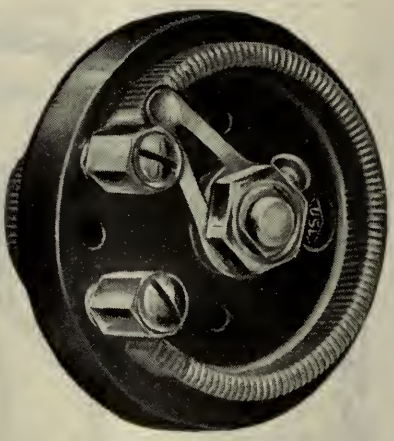
OSCILLATOR COUPLER

A simple, compact and efficient instrument primarily designed for use in superheterodyne circuits. The rotor is arranged to obtain maximum coupling variation and to reduce the loading effect. Made by Silver-Marshall, Inc., 105 South Wabash Ave., Chicago, Ill. Price $2.50



THE DYNERGY RECEIVER

With two radio, detector, and two audio is put out with a device which supplies the A, B, and C battery voltage from your lighting current. Made by the Dynamotive Radio Corp., 47 Ninth Ave., New York City



U. S. L. RHEOSTAT

Featuring the renewable and adjustable spring contact especially designed for smooth action. Bakelite is used for the base and knob of this new rheostat which merits very favorable consideration. Made by the United Scientific Laboratories, 92 East 10th St., New York City



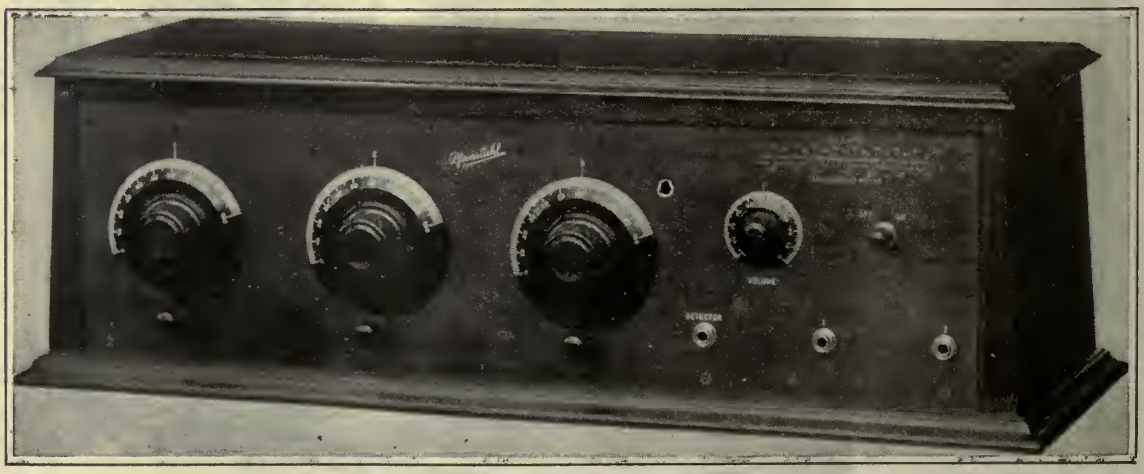
A MEDIUM FREQUENCY TRANSFORMER

Designed to meet the requirements for amplifying frequencies of the order of 30 kilocycles. By shielding, the reaction between stages has been greatly reduced. Made by the General Radio Company, Cambridge, Mass. Price $5.00



KORKER RADIO TOOL

A novel radio tool which combines a busbar bender, an eyelet shaper, a wire stripper, a wire cleaner and scraper, an awl, a reamer and a countersink all in one instrument. The blade is reversible. Made by Korker Products Co., 46 Lexington Ave., Brooklyn, N. Y. Price 50¢



THE PFANSTIEHL RECEIVER

Offers a well balanced circuit obtained without introducing appreciable losses. A five-tube set, which produces reception of excellent quality. Made by Pfanstiehl Radio Service Co., Highland Park, Ill. Price $150



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Among Our Authors

HENRY J. Peck, who painted our rural cover this month, is doing most of his work at Warren, Rhode Island, until the snow begins to fly, and the artist colony again gathers in New York.

I. R. LOUNSBERRY has held an operator's and radio station license for eleven years and so is by no means new to radio experimenting. He writes from the laboratories at Mamaroneck, New York, that "at the age of twenty six, I can safely say that my business is radio and radio is my hobby. There may be some exception to the latter, because, since I have recently been married, there is a lot of work to be done around a certain new bungalow."



H. J. PECK

C. J. LEBEL is a junior at Massachusetts Institute of Technology and is spending his "vacation" working at the Lynn, Massachusetts, plant of the General Electric Company. He is a radio experimenter of some years standing, whose especial hate is radiating receivers. In the odd days between terms at Cambridge and arduous vacations, he may be found at his home in New York City.

AN ORATOR during the war recited 'Your Flag and My Flag' with such feeling that I ended in the job of chief radio electrician aboard the U.S.S. *Utah* for three years," writes W. J. Purcell from Schenectady, where he now is radio engineer in charge of the General Electric broadcasting station WGY. "Many interesting, yet futile early radio years I spent trying to get distant stations with coherers and electrolytic detectors," he concludes.



W. J. PURCELL

OF SOFT speech and shy manner is John B. Brennan, editor of The Grid in RADIO BROADCAST, and author of "Radio Broadcast's Knock-Out Four-Tube Set" in the present number. He is excellently qualified to write about the Roberts circuit, for his daily duties involve replying to many enthusiastic questions on this extraordinary circuit. Although much of his time is spent in the calm of the Doubleday, Page gardens where the RADIO BROADCAST Laboratory is located, when he is behind diagram or pliers, results have an odd way of appearing.

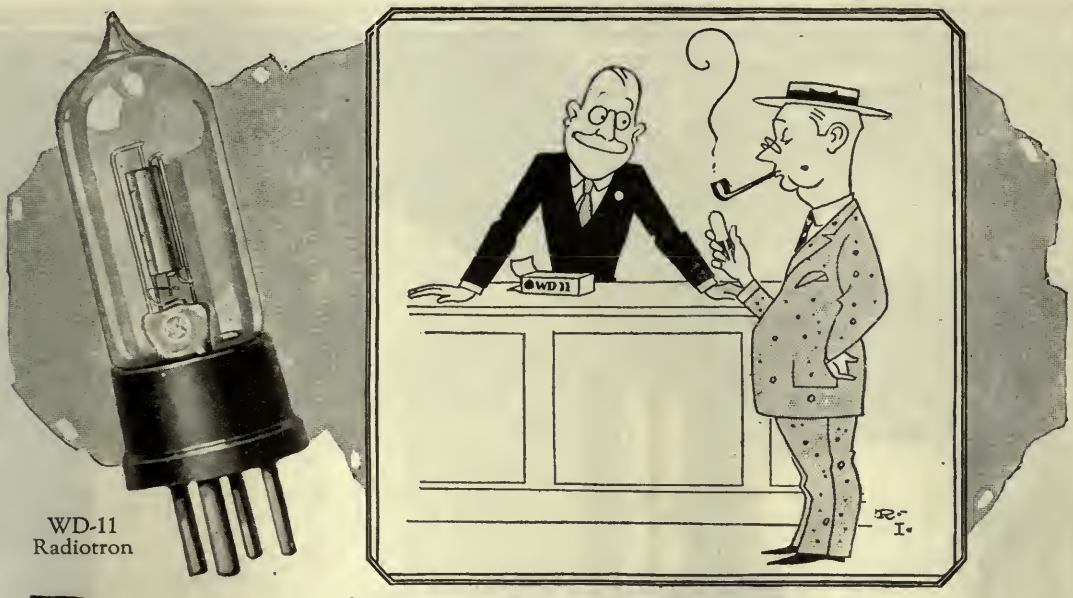
GENIAL J. H. MORECROFT, whose duties as professor of electrical engineering at Columbia University and President of the Institute of Radio Engineers are not too arduous to prevent him from writing that interesting and thoroughly authoritative review of matters radio for us each month.



A. J. HAYNES

MY PRESENT interest is keeping cool with Cal, or John W. Davis, or anyone else who can produce the desired result," writes A. J. Haynes, who has recently left on a five weeks' fishing and canoe trip through Northern Maine. He is Vice-President of Haynes-Griffin Radio Service, Inc., New York City. He is considered an authority on the superheterodyne.

FEW radio men, or indeed few men at all, have had the experiences in the air that Captain Jack Irwin has, whose "Historic Days at a Famous Wireless Station" appear in this number. It was in 1909 that the dirigible *Akron* which Walter Wellman was preparing for a voyage which he hoped would be more successful than that of the *America* (whose fortunes were described in this magazine last month) caught fire while in the air. Irwin, in New York at the time, was the sole member of her crew to escape. Captain Irwin has started on his transcontinental tour with the "Covered Wagon" and an article from him each month will tell of radio conditions as he finds them on his trip.



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—Roger B. Whitman, *Staff Photographer*

RADIO—WITH DR. LEE DE FOREST

In his home at Spuyten Duyvil, New York. Dr. De Forest, whose patent on the audion three-element tube dates back to the early days of wireless, is one of the pioneers in the art. A four-tube reflex receiver is installed in the panel at the left in the photograph. The panel doors are opened to show the receiver and loud speaker, which is about five feet high. The broadcast programs come through the grill near the ceiling

RADIO BROADCAST

Vol. 5, No. 6 October, 1924

Meet J. Andrew White, the Most Famous Announcer in Radio

The Man Who Calmly Announces Knock-Out Blows When Fifty Thousand People are Too Excited to Think—How the First Fight—Dempsey-Carpentier –was Broadcast

BY MYRA MAY

SEVERAL years ago, a worried young business executive sat in his office and considered his hard lot. Business was rotten, the slump of 1921 had hit the sales of every concern but had been particularly hard on the few existing radio companies. The worried young business executive, Major J. Andrew White, lit a cigarette and idly picked up the morning newspaper. His eye was immediately attracted to an account of the forthcoming Dempsey-Carpentier fight. It was the topic of conversation everywhere. As Major White read the preliminary story of the bout, he had a sudden idea. Nightly for months, he had been experimenting with radio telephone reception from the three low power pioneers which were droning "one, two, three, four" and grinding out scraps of phonograph music. He had speculated often on the possibilities of introducing radio telephony to the nation at large—but an important event was needed for that introduction.

"This whole country has become interested in the Dempsey-Carpentier fight," Major White reasoned. "Now why can't my radio be tied up with it? Why can't I send this fight broadcast?"



MAJOR WHITE AT THE MICROPHONE

There were only about one thousand objections to this brilliant idea. Few dreamed the broadcasting was possible. Even if they did, they knew that July, a month of bad static, would be a dangerous month to experiment on a large scale. Everyone who thought of it at all, felt that the limited day-range of wireless was so small that the signals would not travel far enough to make broadcasting then worth while. And no

one would put up the money to try out his quixotic scheme. At least $15,000 was necessary to build the high towers and install a station at Boyle's Thirty Acres in New Jersey, where the fight was to take place.

BROADCASTING: A CRAZY IDEA

"YOU'RE crazy," Major White's friends told him. His enemies said the same thing behind his back. Nevertheless, entirely on his own initiative, he began to work out plans for transmitting the fight round by round to skilled receiving operators—mostly amateurs—throughout the country.

At this time, Major White was acting-president of the National Amateur Wireless Association. To pick up the Dempsey-Carpentier encounter, he selected certain members of the association, perhaps two hundred and fifty in all, who would secure halls or theatres, hook up their sets, install loud speakers and give the crowds the chance of hearing the fight direct from the ringside.

"When I approached the Radio Corporation of America for an appropriation for my 'foolhardy plan', no one was particularly anxious to be identified with my scheme, much less to contribute to it. But there was one man, David Sarnoff, who was willing to give me a chance. Through his influence, the company gave me $1500 for my gamble," Major White confides. "With that precious fifteen hundred, I started on a career of frenzied finance. You've heard of that farmer who made two blades of grass grow where one grew before? Well, his work was child's play next to mine; my simple little task was to make $15,000 grow where $1500 had grown.

"In reconnoitering Boyle's Thirty Acres for the best place to build my station, I saw the radio towers of the Lackawanna Railroad reared high over the surrounding country. In a flash, I saw my station. I finally secured permission from the railroad company to use their towers on July the second.

"My next difficulty was that I had no transmitter. But such a little detail did not worry me. In casting around among the electric companies, I located a continuous wave ship transmitter at the General Electric Laboratory in Schenectady. Then I hunted up a kind friend who owned a tug and he promised to bring the General Electric set down the river to Hoboken.

"Just about this time when everything seemed to be going nicely, some of our amateur operators got 'stage fright'; the number diminished steadily and out of two hundred and fifty prospective agents, our loyal band had shrunk to about ninety. The day of the fight was only about ten days off. I had been working night and day since April, getting everything in readiness. Associated with me, were four men who devoted as much time to my 'foolhardy plan' as I did, chief among them was J. O. Smith, now of the sales force of the Radio Corporation.

"Interest in the broadcasting of the fight had at last been awakened. Our office force was swamped with telephone calls, and a steady stream of telegrams. We were still in doubt as to whether we would even get the space for our transmitter, but we proceeded along the supposition that we would. Fortunately about a week before the fight, the railroad company turned over to us the end of a hallway in a railroad yard building and there we installed our improvised station.

PUTTING DEMPSEY AND CARPENTIER ON THE AIR

OUR amateur receiving operators were scattered in different cities from Maine to Washington (D.C.) and as far West as Pittsburgh. These men showed fine courage; they took large assembly halls and secured loud speakers. At that time, phonograph horns were our most up-to-date loud speakers. Smith and I worked after office hours until about two or three in the morning, testing our set. Announcements were sent to our opera-

"1—2—3—4 . . .

Sometimes they wish it were more," do the thousands and thousands of radio listeners all over the country who have heard Mr. White broadcast one or all of the great sporting events where he has presided, calm voiced and observing, over the receptive microphone. Mr. White has been active in radio since 1911. During most of that time, he was editor of the Wireless Age, and an officer of the Wireless Press, Inc., a subsidiary of the Radio Corporation of America. He was the chief announcer for the Radio Corporation group of stations, of the Democratic National Convention in New York, and is in great demand as announcer whenever there is a sporting or other event of national prominence to be broadcast.—THE EDITOR.

tors to be in readiness for the tests and then to telegraph us what they heard. The results were discouraging. Their return messages told us of the few scattered words that had been audible and indicated that our fight broadcasting would be equally unsatisfactory. But things couldn't continue this way, our luck must change! It did. Our set began to work the night before the fight.

"Smith and I were worn out from lack of sleep and worry over the event. It had seemed that every imaginable objection had been put in our path. The eleventh hour, however, brought the final objection that threatened to ruin our whole project and send it into failure. The American Telephone and Telegraph Company refused to allow us to connect our radio set to a land wire from Boyle's Thirty Acres to Hoboken where our station was located. That was too much. This was the end, I thought. Then I took fresh courage. I couldn't back down at the last minute and disappoint the operators who were counting on my support. After some frantic scrambling around, I at last secured a high speed telegrapher.

"We arranged that I was to describe the fight from the ringside, blow by blow; my telegrapher was to take it down on the typewriter and give it to Smith to repeat into the radio transmitter at Hoboken. Our operators throughout the country, would then receive from the Hoboken station and give the account to the crowds, through the loud speakers.



JACK DEMPSEY AND MAJOR WHITE

The champion is being initiated into the mysteries of radio at his training camp before his fight with Carpentier which Major White announced—the first fight ever to be broadcast

A GONG MOVED THE RINGSIDE TO HOBOKEN

AT THE last minute, in a very pessimistic frame of mind, I decided to put a gong in our Hoboken station. 'At least the gong will be audible and the operators will know when a round ends and another begins,' I thought. I was placed next to the press box, right at the ringside. Putting up my equipment, I proceeded to describe the preliminary bouts and the big fight round by round. It was a boiling hot day, the hottest day in history, I think, and I was right out in the glare, with the sun beating mercilessly on me for more than four hours. My throat was hot and dusty my voice was tired, but I talked on and on, giving minute details of each blow. I had no time to ask my Hoboken station whether they were getting the fight clearly, I simply droned on and on, trusting to luck that the transmission was distinct.

"At length came Carpentier's knockout. 1-2-3-4-5-6-7-8-9-10. With a terrific bang, the four hundred telegraph operators at the ringside, flashed the news to their home papers. Simultaneously, every sport writer at the field frantically phoned his office the news that Dempsey retained his title. Our current was nearly used up. I calmly described the knockout and then remarked 'Dempsey is still champion of the world.' Tired but satisfied with my afternoon's work, I tried to communicate with my Hoboken station to get a check-up on the audibility of the transmission. The line was dead!

"There I was. For four hours, I had talked steadily under that hot sun, in the fight arena dust, giving the best that was in me. And now when I tried to find out the results of my work, the line was dead. I had visions of having spent the afternoon in vain, of having worked night and day from April to July and then having my whole 'foolhardy plan' come to nothing, of having to face my cynical friends with their 'I told you so's', of having to admit that I was licked and of having to break the unpleasant news to the Radio Corportaion that Mr. Sarnoff had lost his gamble.

"Utterly discouraged, I tried once more. After several minutes' wait—and it seemed hours—an answer finally came back from the Hoboken station.

"'What', I demanded breathlessly, 'was the last thing you heard?'

DEMPSEY IS STILL CHAMPION OF THE WORLD

THOROUGHLY casual, the telegraph operator replied, 'Dempsey is still champion of the world.'

"My whole afternoon's description had been heard. I had won the gamble!

"Then came a stream of telegrams and more than four thousand letters. The receiving operators were wildly enthusiastic; they had heard everything. Functioning indifferently well, the loud speakers had brought the blow-by-blow account clearly to the auditoriums. The crowds who heard the radio descriptions knew the outcome sooner than those who had depended on any other means of communica-

The Vision of Better Americanism that Sports Broadcasting Has Given to Me

By J. ANDREW WHITE
(Written especially for RADIO BROADCAST)

I AM often asked why I specialize in sports.

The answer is—I don't.

The Democratic Convention is a notable exception, and I good-time myself occasionally by directing informal programs of the midnight frolic variety.

But the descriptive broadcasting I do for the sport classics is of a distinctive character, and that makes these events linger longer in the minds of listeners.

Incidentally, that goes two ways. The pleasantest recollections of radio I hold, too, center upon reporting athletic conflict, not so much because of enjoyment of the thrill of combat—I really don't get much pleasure out of viewing the events themselves, the work is hard and the concentration a terrific strain—but because of the sense that something has been accomplished when it's all over.

It means a whole lot more than entertaining the public. Opinion is moulded, and with it, character, and even spiritual betterment, along with the physical.

Sounds funny to deal with sport broadcasting that way, but let me show you—

This morning's mail, for instance, held two letters which particularly caught my attention.

One bears the signature of a nationally known banker, and his message to me is, that he used my fight description of the night before as an object lesson for his twelve-year-old son—to impress upon him how in dealing with the public one must be uncompromisingly conscientious and that this was an example of observance of the most rigid standards of impartiality and lack of prejudice.

The other letter was written by the head of the greatest industrial enterprise in America. It is just a note of congratulation and approbation, but there is much to be read between the lines.

Now I don't know either of these men, probably never will meet them. But when an industrial giant who controls a billion dollar business takes time out of a busy life to listen to my description of a sporting event and is impressed sufficiently by it to write me in complimentary vein, certainly it is a fair assumption that he will turn a sympathetic ear to any proposals for athletic recreation among his thousands of employes. And that is good for industry and humanity.

As for the banker-father who used the sport broadcasting to impress upon his son the principles of square dealing and integrity, that certainly needs no comment.

See what I mean? I could multiply these examples a hundred times. Entertainment of course is the primary object of tying-up radio to sporting events, but it can be seen from these two instances that the thing goes much deeper. Never in the wildest flights of imagination could I have anticipated, at the inaugural of broadcasting, the tremendous power for good which radio has become in this field alone.

My correspondence is filled with letters from old folks and those of gentle nature—a high percentage of them women, and there are many clergymen, too—but the letters I like best are from the youngsters. I feel that I have done something when I arouse their enthusiasm over sports, for I am just old enough to have escaped the current conception of jazz, petting and hip flasks as requisites to recreation, and young enough to appreciate the greater joys we found in the cultivation of athletic skill and how the girls of my time shared these views with us and found plenty of vent for their enthusiasms.

Mature people enjoy a thrill—to younger ones excitement is a necessity. And somehow I can't get over the idea that those thrills which accompany a contest for athletic supremacy are the real ones, after all. If radio reawakens that idea, and I am instrumental in putting over the revival in interest—well, that is a big enough broadcasting mission for me.

tion. The first time radio had been used for news, it had justified itself.

"Several days later, I met Tex Rickard, who had promoted the fight.

"'I've been wanting to see you,' Tex began, 'I understand your description of the fight was the sensation of the afternoon. They tell me even the gong was audible.'

"Considering that the gong had been right in the Hoboken station, I was much amused that he should have commented on it."

Major White is always experimenting with something new. He is an explorer at heart. He loves adventure. He likes the thick of the fight. A picturesque figure he is, who even in this mundane, placid world, manages to inject thrills and hair-breadth escapes.

His escapes began 'way back in his 'teens. Most young boys climb trees and play baseball and get their thrills vicariously from their reading. They are always following the dauntless hero of a "series" who goes to the North Pole to drape an American flag over his discovery, or who fights lions in Africa, or something fierce in the Wild West, or who seizes the telegraph when the ship is sinking, sends out a s o s which saves the lives of the passengers and crew. But Andrew White had scant time for reading about rescues; he made them.

AN OFTEN-HEARD-OF, SELDOM-MET NEW YORKER

HE IS one of those often-heard-of but seldom-met real New Yorkers. Born and bred in the Metropolis, he has spent most of his life in Manhattan. In spite of the charge that big town boys can not enjoy the youthful pleasures that the country lads have, Andrew White managed to crowd every variety of sport into his childhood. He was an expert swimmer. During the summer at Long Beach, Long Island, he helped the volunteer life corps. It was not until he was twenty that he had his first narrow escape.

"As I patroled the beach," he relates, "I noticed six people swimming out toward a dangerous section of the ocean bed. At this point about three hundred yards from shore, the ground sloped abruptly; there was a strong surf and an undertow powerful enough to drag a hapless swimmer out to sea. I hallooed to the people to warn them, but they only saw me wave and did not hear my message so they supposed I was simply sending a friendly greeting. They waved back and swam lazily toward the danger zone.

"I plunged into the water and when I was near the little group, shouted my warning. Four of them immediately turned back; the other two, a man and a girl were winded. They were being swept steadily out to sea. I had not brought the life rope or a belt with me. I was not equipped to cope with drowning persons. Nevertheless I made a grab at the girl. Turning hysterical in this perilous moment, she threw her arms around my neck, nearly choking me and dragging us both down. When we came



A CHOIR BOY
Was Andrew White in the days of his youth

up again, I ungallantly shook her until she was limp and then slung her over my shoulder. Thus impeded, I battled the surf and undertow as I slowly swam in. Her companion, a big man of about two hundred pounds, swam beside us. The water, never very calm, was

particularly rough that day and with a great effort, I pushed forward. To add to my difficulties, the girl over my shoulder fainted and her dead weight was an additional burden.

"We had gone perhaps fifty yards when the big man suddenly gasped, 'I'm all in'. By this time, one of my assistants who had seen our plight, had hooked his belt to the life line and was swimming toward us. I shifted the girl over to one shoulder, then I hoisted the big man onto the other. I swam a few yards until I was exhausted; then we all went down together. After a few seconds, I would again adjust my pack and the three of us would drift ahead. My assistant was swimming steadily closer. The huge holiday crowd on the beach, watched our little drama with breathless interest.

"Suddenly just within about one hundred yards of shore, I had the doubtful pleasure of seeing my assistant wave a distress signal, turn back and swim in. It seemed to me that for hours, I struggled through the undertow and surf, fighting my way every inch. Repeatedly when I was exhausted, the three of us would go down together; then, struggling to the surface, we would progress a little further. All the while the big crowd on the beach watched us as dispassionately as though they were witnessing an exciting moving picture.

"I have no idea how long I wrestled with the surf, but at a moment when I was thoroughly exhausted and felt that I could go no farther, the amateur life guards swam out with the rope. At last, help was in sight. With the man and woman clinging to my shoulders, I grabbed the rope and scores of people on the beach began pulling us in. Their enthusiasm overbalanced their judgment, for so vigorously did they pull, that they sent us to the bottom. I would struggle to the top and just as I was about to breathe, the crowd would give another mighty heave and down I would go to the bottom again. The man was exhausted and the woman had fainted. Four times, I worked my way to the top only to sink to the bottom. Finally I left the man and girl safely clinging to the rope, while I made for shore. I had ceased to have any feeling; numb, I swam on, when out of the crowd on the shore, a young man in flannels jumped into the water and swam out to help me. I found out later that he was Tom Thorp, the famous Columbia football player.

"As I staggered to shore, I had only one ambition—rest. My legs seemed to have turned to jelly, they no longer functioned, and wearily I lay on the sand. Then someone brought me the bad news that no one knew how to resuscitate the girl I had rescued. I spent the next quarter hour bringing this girl back to life. When she was once more conscious, she threw her arms around my neck and kissed me. Can you imagine anything more embarrassing to a young man of twenty than to be kissed right in sight of thousands of visitors swarming on a beach?"

AUTOMOBILES, MINING, AND RADIO

WHEN Major White completed school, he started work in an automobile factory. He was helping build Vanderbilt Cup racers. Next to the draughting board where the designs for the engines were made, White had a cot. Day and night, he slaved over his blue prints and when he was too weary to work more, he slept a few hours. The young automobile engineer hoped to establish his reputation by the wonders this racer would accomplish. He had devoted all his energy, all his enthusiasm to building this engine; he had sacrificed his rest, his recreation, but he was content. He was confident that the racer would win the cup.

On the morning of the race, Major White was feverish with excitement. His engine was going to win the race and establish him as a master builder. The automobile was proudly driven out to the speedway and then the unexpected happened! A loud noise. Three cylinders blew out. That afternoon, Major White, haggard from lack of sleep, saw another automobile race on to victory while his car, the repository of so much work and so many youthful ambitions, lay abandoned in a ditch.

"I was disappointed but not discouraged," he says. "The very next year, I was on the job, determined this time to design a winning engine. We can't expect a lucky break the very first time and after a defeat it is up to us, to show twice as much spirit, added to the experience our failure has brought us."

Several years later, we find Major White selling mining machinery. He is still injecting thrills and hair-breadth escapes into his life. Let him tell you about his fall down a mine shaft in Arizona.

"I was examining a safety device on a bucket for hoisting ore out of the mine," he narrates. "The hoist force had all knocked off for lunch and only a group of curious Mexicans were gathered around the entrance to the mine.

My Spanish was sketchy yet when I got into the bucket, I flattered myself that I had told a Mexican laborer very correctly and distinctly that I wanted to see how the catch worked. Evidently my Spanish was not up to specifications for the Mexican misunderstand. Releasing the winch drum, he sent me hurtling down the mine shaft. Down and down that endless shaft I fell. Strangely enough, I was very calm.

"'What an odd way for a man to end his life,' I thought. And I philosophized over life's vagaries. 'There may be an obituary paragraph back in a New York paper,' I decided. I wondered who would tell my mother. I recall that I shrugged my shoulders and murmured, 'Well, goodbye, old world.'

"Then the bucket stopped. It dropped into a pool of very dirty, black mine water. That water undoubtedly, saved my life. Very much shaken and a little bruised, I cautiously crept out of the bucket. Up top, hubbub reigned. The Mexican, frightened at what he had done rushed for help. The mine foreman believed that I lay dead at the bottom of the mine. Nevertheless a relief expedition was organized and came down to collect my remains. I was chilled from lying in the water but very much alive, which considerably surprised the relief workers."

Attracted by the new science of wireless, Major White had been studying the subject. He believed that it was the coming electrical marvel and wrote some articles, amplifying his opinion. These came to the notice of the British Marconi Company. When one of their representatives, Mr. Godfrey Isaacs, brother of Lord Reading, came to the United States, he felt the need of institutional publicity and arranged that Major White should enter the employ of radio to convince the world of wireless' limitless possibilities. Since 1911, the major has been associated with the radio world.

While he was vice-president of a Radio Corporation subsidiary—The Wireless Press, Inc.—he conceived the plan for the first broadcasting, as we know it, that was ever attempted. His success with the Dempsey-Carpentier fight convinced the big electrical companies that radio broadcasting was the coming means of communication. They decided to build permanent stations with regular program schedules.



NEAR A MINE-SHAFT
In Arizona, where Major White had at least one exciting experience

In the fall of that same year (1921) Major White, meanwhile, again experimented with the wonderful new broadcasting. He fitted up a station at the Electrical Show and transmitted a series of concerts and the World Series being played at the Polo Grounds. Since that time, he has been a necessary adjunct to sports. A big prize fight, a World Series, a football game is not complete without Major White to describe the event in his own delightful style. The father of practical radio broadcasting, he is still its most prominent relative.

THE STORY OF A GREAT SUCCESS

IS that of Powel Crosley, who in several short years has made his name one to conjure with among the many manufacturers of things radio. Myra May has written an interesting story about this interesting man, which will appear in an early number of this magazine.

Is Radio Making America Musical?

Good Music is Heard Near and Far—How a Bloodless Revolution is Occuring in Musical Taste and Appreciation

By CHARLES ORCHARD, Jr.

"WHY has Europe more musical appreciation than America?" Time and again we hear this query—the answer is simple. Musicians are not made by a few years of study, but are created only by generations of intimate association with good music. For generations, Europeans have been intimately accustomed to the best of music—in homes, the schools, in the churches and the theatres. Even in the smaller towns there are excellent bands and orchestras, choral societies, and even operatic organizations—organizations which are supported in only the larger cities in America. The European hears on all sides good music intelligently played—he is fairly steeped in it.

Heretofore, Americans, except those living in the larger cities, have been denied the priviledge of hearing the best in music performed by accomplished musicians because worthwhile productions cost an enormous amount. Thousands of earnest students of music and music lovers in small towns and rural districts have never had an opportunity of enjoying the advantages to be had in the large cities.

There are traveling organizations which perform some of the better class of musical works; and many of the foremost artists appear as soloists in many of the very small towns—but these appearance are few and far between, and they fail utterly to reach the rank and file. Unfortunately, it is this element that must be reached and converted before America can equal the musical attainments of Europe.

For years musical educators have been striving toward this end; but because of the inaccessibility of those most needful of assistance, no marked progress has been made.

It is a theory of long standing; for ages people have contended that, if music is available without physical and mental effort and exertion, children will refuse to practise the technical exercises so necessary to a finished performance on a musical instrument. It has been contended that the comparison of a child's accomplishments with those of a finished musician are so discouraging that the child should never be allowed to hear a virtuoso play. I remember that, when I had studied the piano for about four years, I was very anxious to go to one of John Powell's recitals. My father laughed at the idea. "Why, boy," he cried, "you'll be so discouraged that you'll never touch a piano again." But I went, and I learned that there was something in playing a piano other than merely striking the right key with the right finger at the right time. There were sensations to be aroused, stories to be told, pictures to be painted—and, executed in the subtle language of tones, they were much more appealing than in the more obvious language of the story-teller or the painter. I learned that pleasing sounds were merely a means and not an end in music. Music took on an entirely different aspect; and I went to work with far more interest and intelligence.

BROADCASTING CAN BRING THE BEST TO YOUR FIRESIDE

TO-DAY, by means of radio, symphony orchestras, operas, oratorios, vocal recitals, and performances on all the solo instruments are accessible to those in even the most remote rural districts. Broadcasting stations scattered over the entire continent nightly offer much of the best in music in all its forms, performed, in general, by very good musicians.

There is no longer any reason why there should be a drought of musical knowledge and appreciation in America since radio has developed into its present state. Such artists as Anna Case, Freda Hempel, Fritz Kreisler. Claudia Muzio, Mary Garden, Mengelberg, Friedman, Zimbalist, and many others, have used radio as a means of promulgating their art, recognizing the unusual opportunities offered by this vehicle. The well known lecture-recitals of Walter Damrosch on the Beethoven symphonies have been given, by

means of radio, to thousands of interested listeners, who otherwise would probably never have had that privilege. Instructions in vocal and instrumental music even, have been given over the radio.

Theodore Thomas, one of the most potent forces in musical development in America, has said, "Popular music is familiar music." America's wholesale lack of interest in good music is due primarily to its astonishing lack of familiarity with good music. And radio, by making good music familiar, will do more to popularize good music and make America a truly musical nation than any other known means.

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WHERE RADIO HELPS CHILDREN

BY A musical America I do not mean a nation of performers on musical instruments, but rather a nation of music lovers who have an intelligent understanding and appreciation of good music. There are already far too many Helens and Sams who merely hammer away on a piano, saw on a violin, or blow through a cornet; possibly with mechanical proficiency, but usually quite without musical understanding. It would be far better to have a child understand and appreciate good music, understand the subtle language of tones and feel the emotions they delineated, than to have him perform on some musical instrument in an uncomprehending, unintelligent manner. Let that child hear good music, surround him with good music everywhere he goes—in the home, and in the schools and churches. If there is latent musical ability within him, it will surely manifest itself. At least, by close and constant association with good music, eventually there will be developed within the child a love, appreciation, and understanding of good music which otherwise would never have existed.

As an educational force, radio stands preeminent, for it offers to all a simple, inexpensive, and thorough means of accomplishing this end. Radio sets may be had at a price that makes them prohibitive to none; they bring the music of the world into the most inaccessible rural districts and to your very fireside; and offer a constant source of benefit and pleasure.

For the parent who wishes to leave his child a worthwhile legacy, a love and appreciation of good music, let him buy a radio-receiving set, allow his child free use of it, and he will be well repaid in the development of that child's interest in and appreciation of good music.

AN exceptionally interesting article by Walter Van B. Roberts will appear in an early number of RADIO BROADCAST, which no radio constructor should miss.

How to Build a Portable Seven-Tube Super-Heterodyne

A Real Super, of Perfected Design, Using UV-199's and Dry Cells, is Decidedly Portable, and of Simplified Construction so that the Average Builder Can Make It

By McMURDO SILVER

FOR many months, we have waited for a truly portable super-heterodyne that we considered practical. Many designs have been offered to us, and refused. This article, which we believe, is the most complete one on the super-heterodyne ever published in any radio periodical, describes a receiver which we have compared with a mighty good five-tube radio frequency receiver using an outdoor antenna. The "super" described below proved more satisfactory in every way except volume from near by stations. Mr. Silver came on from Chicago to show his receiver to us. He assembled and wired one in our laboratory in two hours, hooked it up, and it worked right off the bat—which is no mean feat for a super-heterodyne. It is an excellent receiver.—THE EDITOR.

THE problem of reducing a standard super-heterodyne receiver to portable form without sacrificing selectivity, sensitivity, or quality of reproduction and at the same time without producing a receiver which could only be built in a laboratory, has occupied the writer for some months. In this article is described the final result of long experiments with supers, large and small, some so disguised that even Major Armstrong himself wouldn't recognize them.

The cost of a super-heterodyne receiver is such that the average builder can hardly own more than one, and it was therefore necessary in designing a set to provide one which would give results equal to a large outfit when used in a permanent installation. The set had to be laid out so that no gymnastic feats would be involved in wiring or assembling it, and after assembly the average builder must be saved from entering into a correspondence course with the editor to find out how to make it work or to find out why certain things had been overlooked. These last conditions automatically eliminated reflexing, which at best is not to be recommended, and small assemblies involving specially made parts. Few builders are machinists and engineers combined. Therefore, standard parts were used throughout, with the smallest

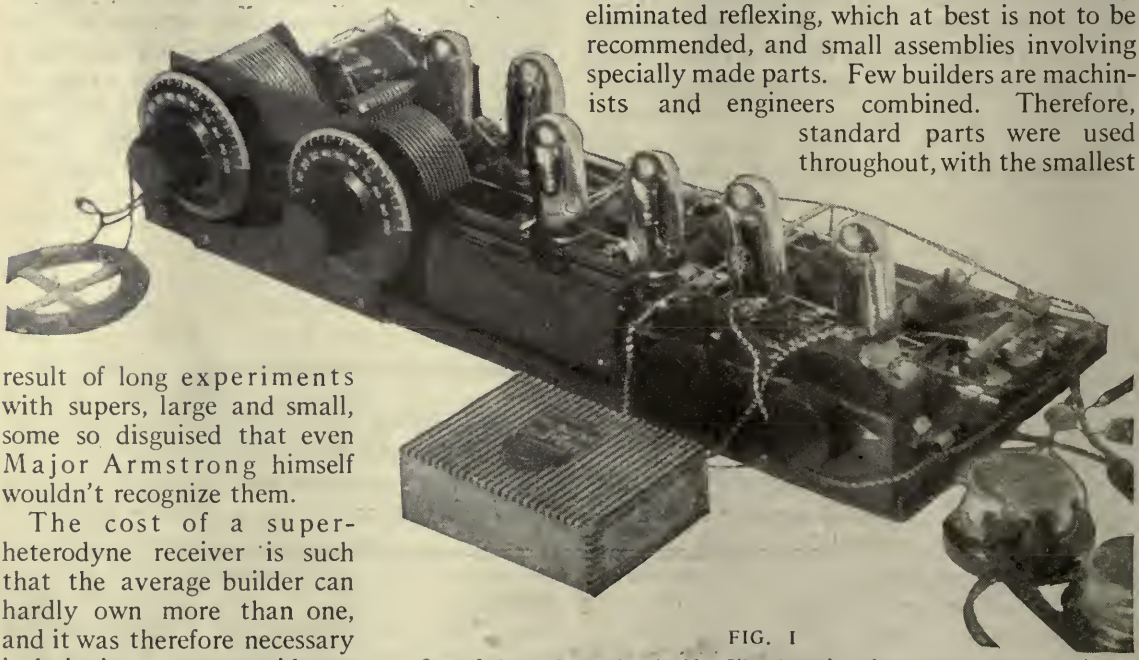


FIG. 1

One of the early models in Mr. Silver's series of super-heterodynes using air-core transformers, which were later abandoned. This experimental method of assembly is excellent for testing circuits, since no large panels are wasted on the first trial

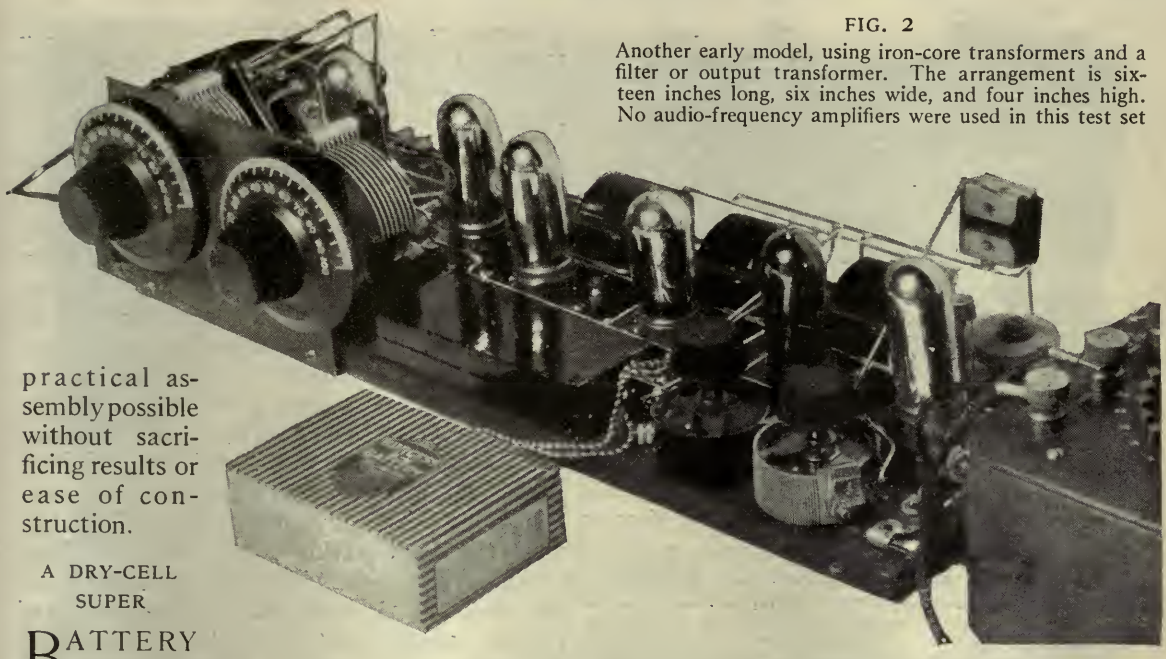


FIG. 2

Another early model, using iron-core transformers and a filter or output transformer. The arrangement is sixteen inches long, six inches wide, and four inches high. No audio-frequency amplifiers were used in this test set

practical assembly possible without sacrificing results or ease of construction.

A DRY-CELL SUPER

BATTERY size and current consumption were of very great importance, and to some extent determined the size of the set. It was possible, by the use of 199 tubes and an ultra-efficient circuit to decrease the B battery current consumption to approximately sixteen milliamperes, as against the average forty milliamperes for an eight-tube 201-A set. This increased the battery life, and permitted the use of four of the small size 22½-volt batteries together with three dry cells for the filaments, which were placed directly behind the set in its cabinet.

In a set of this type, the efficiency must be as high as possible, and the possibilities of trouble very remote. Reflexing being out of the question, it was necessary to use a standard circuit. That circuit was so improved that fewer tubes could be made to do the work of the eight generally considered necessary. These tubes had to operate from dry cells, which meant that a real step ahead had to be made to get approximately the same results out of seven 199's that had been previously obtained from seven or eight 201-A's.

WHY IRON-CORE TRANSFORMERS ARE USED

THE development of the portable was started with air-core transformers in the intermediate amplifier operating at between two and three thousand meters. These were later abandoned, since it was found that even when the most carefully matched set of transformers was used in a specially built circuit, there was variation which rendered the amplifier insensitive, broad in tuning and generally unsatisfactory. In the few cases where it was possible, with specially designed and tuned transformers, to get the amplifier to operate at only one peak instead of the usual two or three, the amplification obtained was only slightly superior to that obtained with iron-core transformers operating at about six thousand meters.

This slight gain, so hard to realize dependably, was not worth while when the lack of stability of the air-core amplifier, especially when used with 199's, was considered. The battery consumption of the air-core amplifier was from 50 to 70 per cent. higher than with the iron-core amplifier, due to the use of a positive grid bias obtained by a potentiometer across the A battery. This positive bias was rendered necessary in order to stabilize the circuit, and is necessary with all practical air-core transformers now made. Its use is contrary to best operating practice, and is unnecessary with iron-core transformers. In the set herein described, a negative C battery of from 1½ to 3 or even 4½ volts is used in conjunction with a potentiometer.

WHY THE POTENTIOMETER HAS BEEN RETAINED

THE potentiometer is not an unmitigated evil, as often pictured, and when used with a C battery to get a fine voltage adjustment,

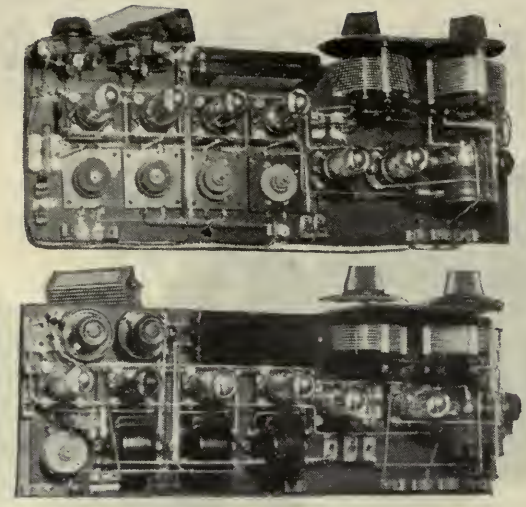


FIG. 3

Two experimental set-ups. Notice the two C batteries, one being used even with the air core transformers, which were especially designed and matched

permits adjusting the amplifier to its most sensitive condition. Often builders do not use the potentiometer in order to eliminate one control. Omitting it is like omitting the tickler control on a regenerative set—a large percentage of amplification is thrown away for simplicity of control; a fixed tickler adjustment is substantially the same thing. Never do we see a circuit using a fixed tickler, unless it is a freak, yet often where a C battery is used in a radio-frequency amplifier, no potentiometer is included.

HOW THE STANDARD "SUPER" CIRCUIT WAS IMPROVED

IN IMPROVING a standard circuit, two things of major importance were done. The first detector circuit was made regenerative, which gave considerable increase in amplification, as well as sharpening up the loop-tuning condenser. The Rice split-loop method was used, which proved most satisfactory for this type of set. The next step was to improve the amplifier. After considerable experiment, an R.F. transformer unit was developed which eliminated practically all possibility of trouble, and gave amplification with two intermediate stages equal to that which had previously been obtained with three stages. The sensitivity of the set was such that it would still go down to the noise level in nine out of ten locations, and the absence of the third stage eliminated a tube and its battery drain, saved some space, simplified the construction of the set, and, most important, cut out a good deal of noise previously experienced with three-stage amplifiers.

The desirable amplifier is one that will go down to the lowest seasonal noise-level, and



FIG. 4

An eight-tube portable super-heterodyne using iron core transformers sealed in a can below the eight-gang socket. Tests proved the third radio tube to be unnecessary

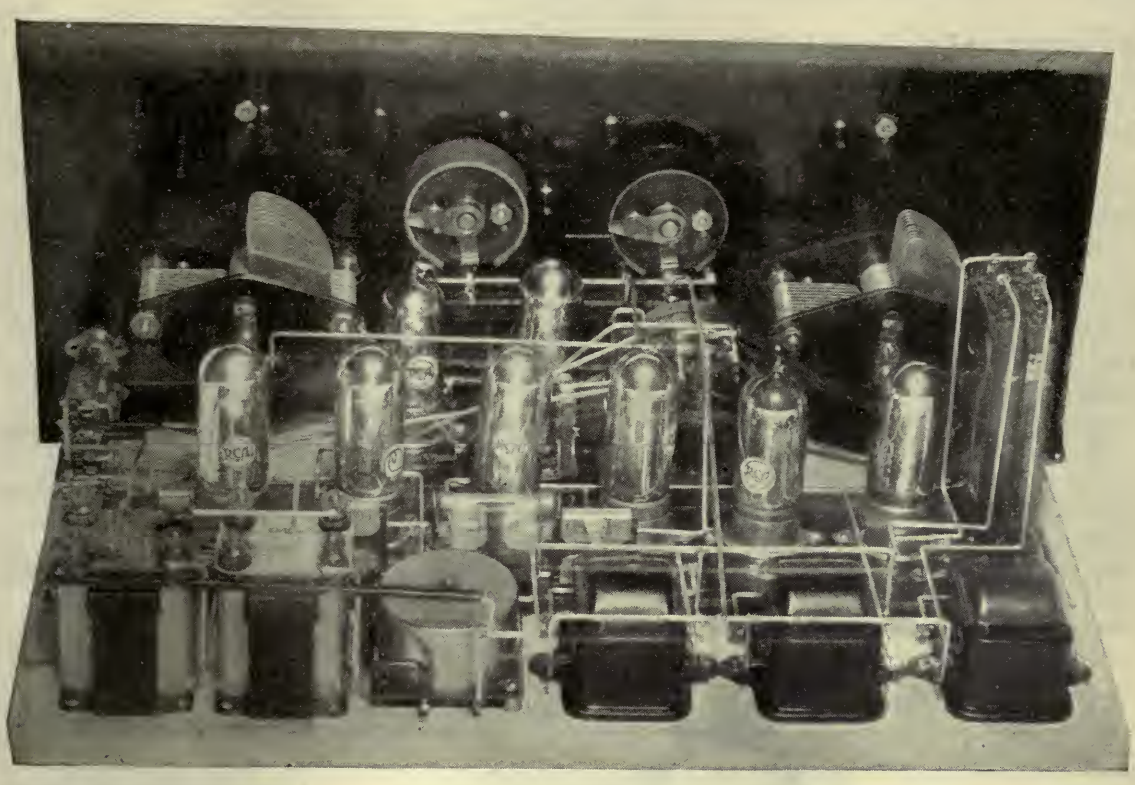


FIG. 5

Rear view of the sixteen-inch super. The wiring of this set is too complicated for general construction. A far simpler and just as effective assembly is described in the text of this article

amplify any signal as loud as, or louder than the noise. Extra amplification will only bring out more noise, and can not possibly bring out a weaker station, for it is bound to be drowned out in the atmospheric rumble, which is louder than it. This is the real limiting factor in distance reception and receiver sensitivity. The two-stage amplifier got down as low as was desirable. Why use more tubes?

Grid condensers and leaks were used on both rectifier tubes, as they were found somewhat preferable to C batteries, from the standpoints of sensitivity, ease of assembly and current-consumption, despite general belief to the contrary.

DESIGN OF THE AUDIO AMPLIFIER

CAREFUL consideration was given to the audio amplifier, and the Jefferson No. 41 audio transformer was chosen for its remarkable curve, the extremely good reproduction obtained with it, and its generally satisfactory operating characteristics.

The seven tubes in the set surely "do their stuff" to use a popular expression, for coast-to-coast reception is quite common with the set during the summer months in Chicago, in many cases with loud-speaker volume. Its selectivity is such that when located three hundred feet from WGN's antenna, in a Ford car, WGN could be entirely eliminated with a six-degree oscillator-dial movement, and any other Chicago stations, and several within a fifty-mile radius, brought in with sufficient volume to be heard above traffic noise at seven in the evening. The same thing happened near WEBH and WMAQ, so the results were not at all freaky. Five miles away from local stations, they could be eliminated with a four-degree oscillator-dial movement, and a five- to ten-degree loop-dial movement. Two stations in the same direction, each about fifteen miles away, operating at 283 and 286 meters were tuned in, with a dead spot between them where neither could be heard. These results bore out the writer's belief that two stages of intermediate amplification were sufficient, for the results were almost up to those of an eight-tube 201-A set, and better on distance in every respect than a standard five-tube neutrodyne using five

201-A tubes and a 150-foot antenna. When it is realized that the super used an 18-inch loop and seven 199's, the full significance of these results will be appreciated.

Photographs are given showing several types of supers built, the first using air-core transformers, later abandoned for fifty kilocycle iron-core types in conjunction with a special filter. The final model, shown in Figs. 8, 12 and 13, is entirely contained in a standard 7 x 18 cabinet, with all parts mounted on the panel or on two small sub-bases. All batteries are placed behind the set, in the same cabinet, or if a permanent installation is to be made, leads may be brought out to larger type B's and six A's in series-parallel, or a small storage battery. The only additional equipment needed, aside from the tubes and batteries, is a loop with a center-tap and a pair of phones or a loud speaker. Following is a list of material needed, which should cost about $55.00, without the cabinet.

2 .0005 low-loss condensers, such as Cardwell, Duplex, General Radio, New York Coil Co., or Silver
2 3″ or 4″ dials, preferably moulded (vernier types may be used if desired)
1 Allen-Bradley, Howard, or Pacent six- or seven-ohm rheostat
1 Howard or similar 150- to 400- ohm potentiometer
3 Binding posts, insulated type
1 Carter three-spring No. 102A jack, or similar
1 Carter one-spring No. 101 jack or similar
1 Carter on-off switch or similar, if desired (not shown in set.)
1 Silver RF transformer unit (specifications for substitution in this article)
1 Silver oscillator coupler (can be constructed—see text)
2 General Radio, Silver, or Benjamin, Na-ald 199 sockets
2 Jefferson No. 41 audio transformers
1 Silver five-gang 199 socket, or five single General Radio, Silver, or similar sockets
2 .5 Mfd. bypass condensers, large type preferably
2 .00025 Micadons, Daven, Meuter, or New York Coil Co., mica condensers with leak clips
2 .002 Micadons, Daven, Meuter, or New York Coil Co., mica condensers
1 .005 Micadon or similar mica condenser
1 Chelton midget or similar .000025 mfd. condenser
Any low-loss small vernier type may be used
1 3- to 5- megohm grid leak, good quality
1 1- to 2- megohm grid leak, good quality
1 7 x 18 x $\frac{3}{16}$ Bakelite or Condensite panel
1 7 x 18 cabinet
wire, spaghetti, screws,



FIG. 6
An early model of the portable super, completely equipped with A, B, and C batteries in the carrying case

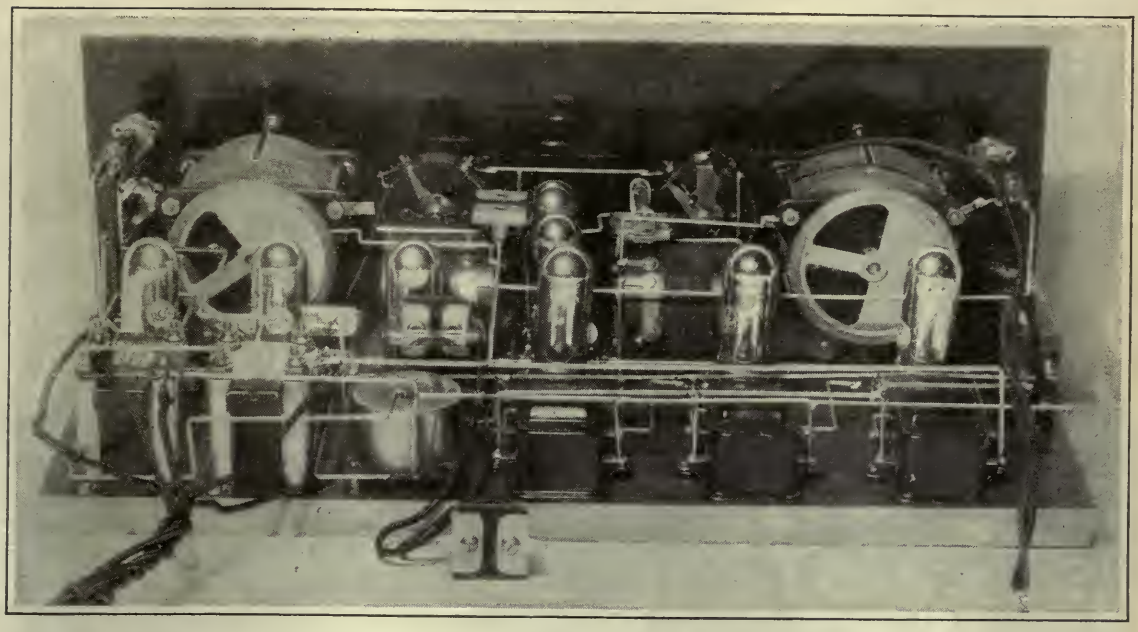


FIG. 7
Rear view of the set shown in Fig. 6. Notice the method of construction and how the flexible battery leads are fastened to the set wiring

solder flat lugs, flexible lead wire and baseboard 7 x $4\frac{1}{4}$ x $\frac{1}{2}$

Tools needed: 1 pair side-cutting pliers, 1 screwdriver, hand-drill with drills, 1 soldering-iron with rosin core solder

It is advisable not to deviate from the rather flexible material list given above, as all the material is of first-class manufacture and was chosen carefully. Small parts, such as sockets, jacks, rheostat and potentiometer may be substituted, although trouble may be encountered fitting other parts into the available space, aside from the question of results.

HOW TO BUILD THE OSCILLATOR COUPLER

THE oscillator coupler may be made by winding two sections separated $\frac{1}{16}$ inch apart on a $2\frac{1}{4}$-inch bakelite or condensite tube, each section containing twenty-eight turns of No. 28 D.S.C. wire. The rotor coil, shown in Fig. 9 as L1, consists of twenty turns of the same wire on a $1\frac{1}{2}$-inch tube, rotatable within the stator tube carrying coils L2 and L3. The range of this oscillator, with a .0005 mfd. condenser is about 150 to 550 meters—more than sufficient for broadcast reception.

The transformer unit may be replaced by two General Radio, Acme, All American or other types of iron-core, long-wave RF transformers and a filter. The results obtained will not be as satisfactory, the assembly and wiring more complicated, and a filter will be necessary.

SUBSTITUTING OTHER PARTS IN THE I. F. AMPLIFIER AND FILTER

SUCH a filter may be made by turning out a wood form $1\frac{1}{2}$ inches in diameter. Three slots $\frac{1}{4}$-inch wide and $\frac{9}{16}$-inch deep are turned in the form, each separated by a $\frac{1}{8}$-inch wall of wood. In the two outside slots are placed 1,600 turns each of No. 36 single-silk enameled wire, connected in series aiding. The center slot is wound with 800 turns of the same wire, and when shunted by a .003 mfd. condenser will tune the transformer to about 30 kilocycles. The outside coils are the secondary, and the inside the primary. This substitution is not recommended, and is mentioned merely for those who want to experiment with equipment they already possess.

HOW TO GO ABOUT THE CONSTRUCTION

THE construction of the set may now be started by laying out the panel with a rule and scriber following the dimensions of Fig. 10. The dimensions are correct, but the drawing is not to scale. Mounting holes are indicated for Silver low-loss condensers and Howard rheostat and potentiometer. If different equip-

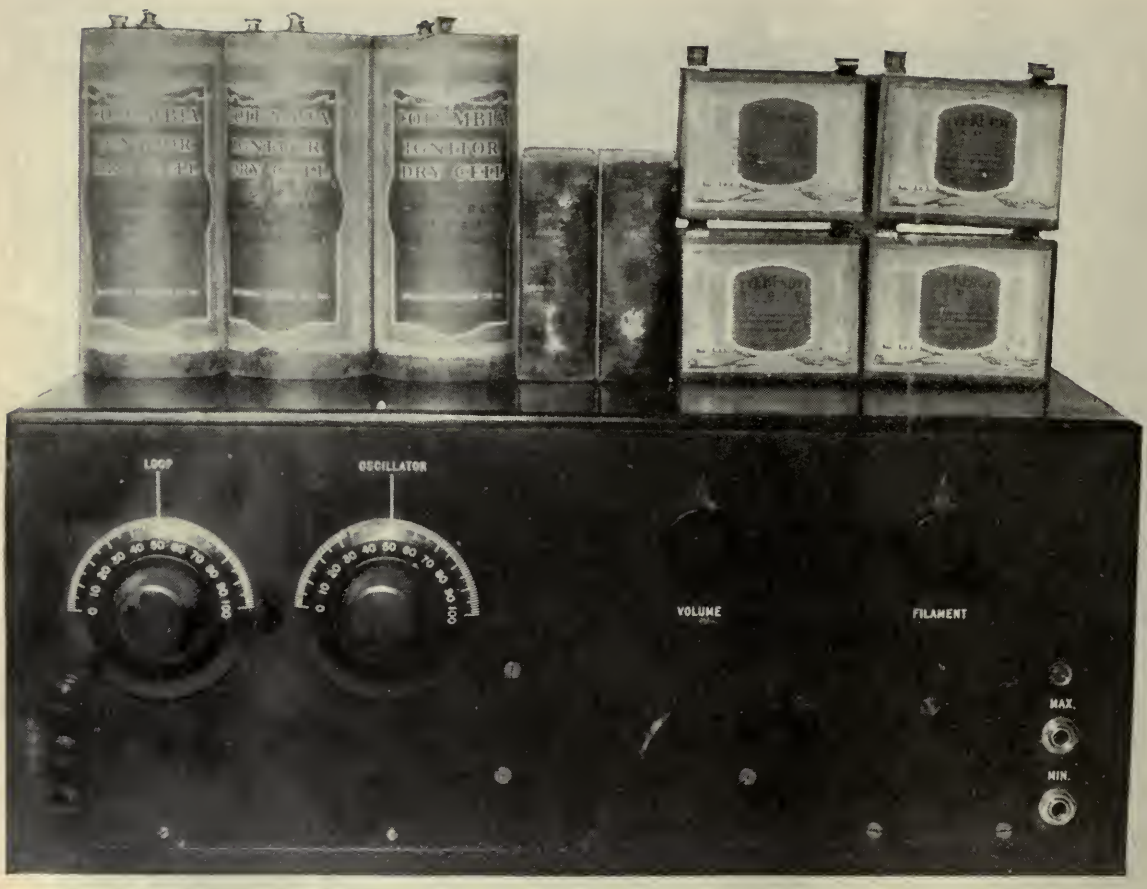


FIG. 8

The final design of the seven-tube portable super-heterodyne. The panel is quite simple and free from a multiplicity of dials. The A, B, and C batteries are placed on top of the cabinet to show just how they fit in the case when inserted

ment is used, the shaft-hole locations should remain the same, with screw holes located from the templates supplied with the parts by the manufacturers. The two holes for the gang-socket marked "X" on the drawing will have to be relocated on a line $3\frac{1}{2}$ inches down from the top, if single sockets on a wood support are used here. The support would be $\frac{1}{2}$ inch thick, 9 inches long, and no wider than necessary to accommodate the sockets. The panel should be grained with fine sand-paper and oil and cleaned with alcohol, if desired.

The baseboard may be laid out in accordance with Fig. 10-A, although it is best arranged by fastening it to the panel with the condensers on and fitting the coupler and two sockets on it for best position—then screwing them down. All wood screw holes should be started with a No. 45 drill, and No. 4 or No. 5 screws used, $\frac{3}{4}$-inch length being satisfactory throughout. Size $\frac{6}{32}$ machine screws and nuts are used, either flat or round head, about $\frac{3}{4}$-inch long to fasten the parts to the panel and lugs to the condensers, etc.

A WISE PRECAUTION

BEFORE mounting any parts, all screws, nuts, etc., should be inspected and tightened, and socket-springs bent up. Lugs should be put on binding posts and tinned. All filament terminal lugs on one side of the gang-socket should be joined together, the lugs on the opposite side also being joined together by bus wire. The base-board with its coupler, by-pass condensers and sockets mounted, should be placed in position, then the gang-socket, followed by the transformer can, audio transformers, binding-posts, jacks, rheostat and potentiometer and filament switch if desired. All wiring that can be done should now be put in place, tinning the wire before endeavoring to make a joint. No soldering

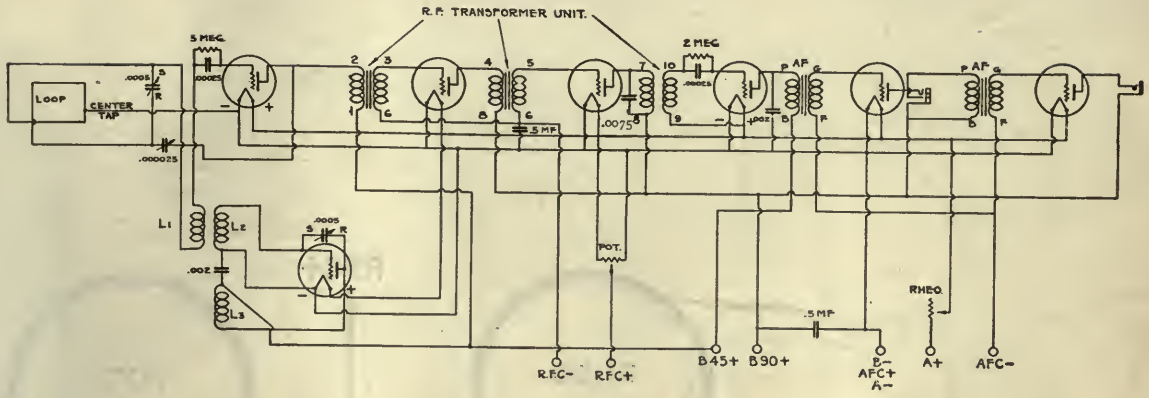


FIG. 9

Circuit diagram of the seven-tube portable super. Note the split loop and center tap as well as the regeneration employed in the first detector tube

paste should be necessary if a well tinned iron is used, and remember that a pound of solder does not make a good joint, if it isn't hot and the joint clean. All mica condensers have lugs fastened to them with machine screws, and are fastened on the wiring, which makes short leads possible, and permits easy assembly. The wiring is strong enough to support the condensers easily. The Chelton midget condenser is fastened to the rotary plate section of the right hand, or loop condenser, with two lugs soldered together. The support is sufficiently strong for all ordinary use.

In the photographs of the set, the engraving over the two condensers is reversed—the left-hand one is the oscillator condenser, and the right-hand the loop condenser. In the photo showing the unwired set, the Chelton dial has been placed on the wrong condenser, but in the view of the wired set it is correctly located.

A WORD ABOUT WIRING

NO BATTERY binding posts are provided, in accordance with the present trend of design. Battery leads, soldered directly to the wiring, are used. This simplifies wiring, and

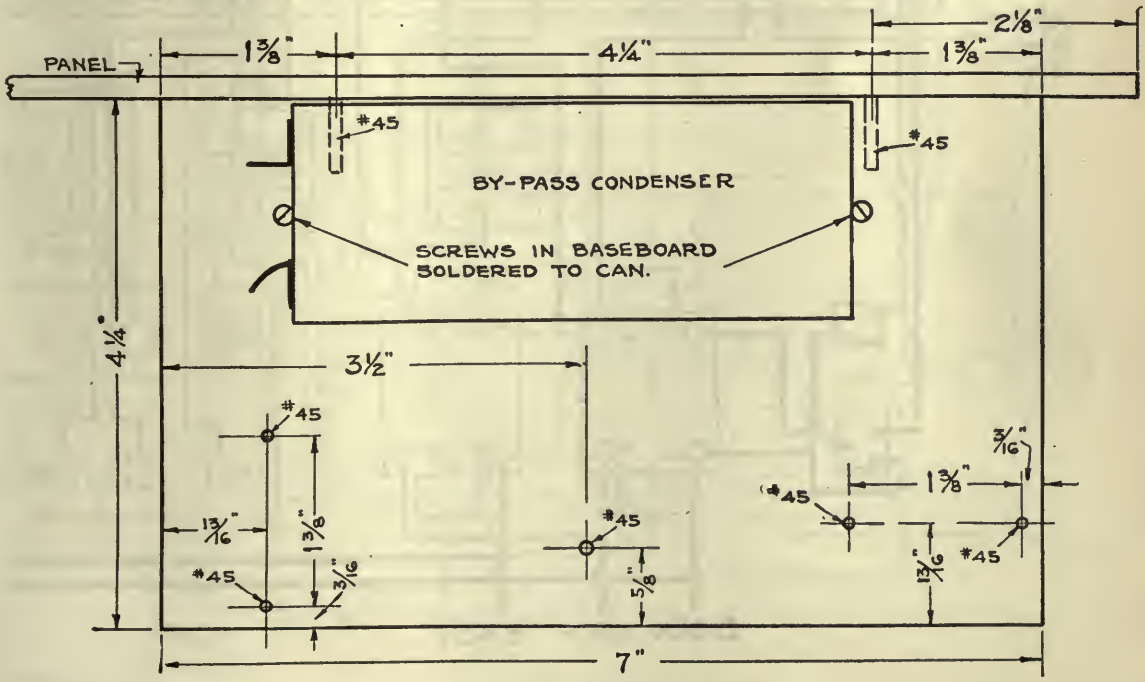


FIG. 10-A

Layout for the baseboard

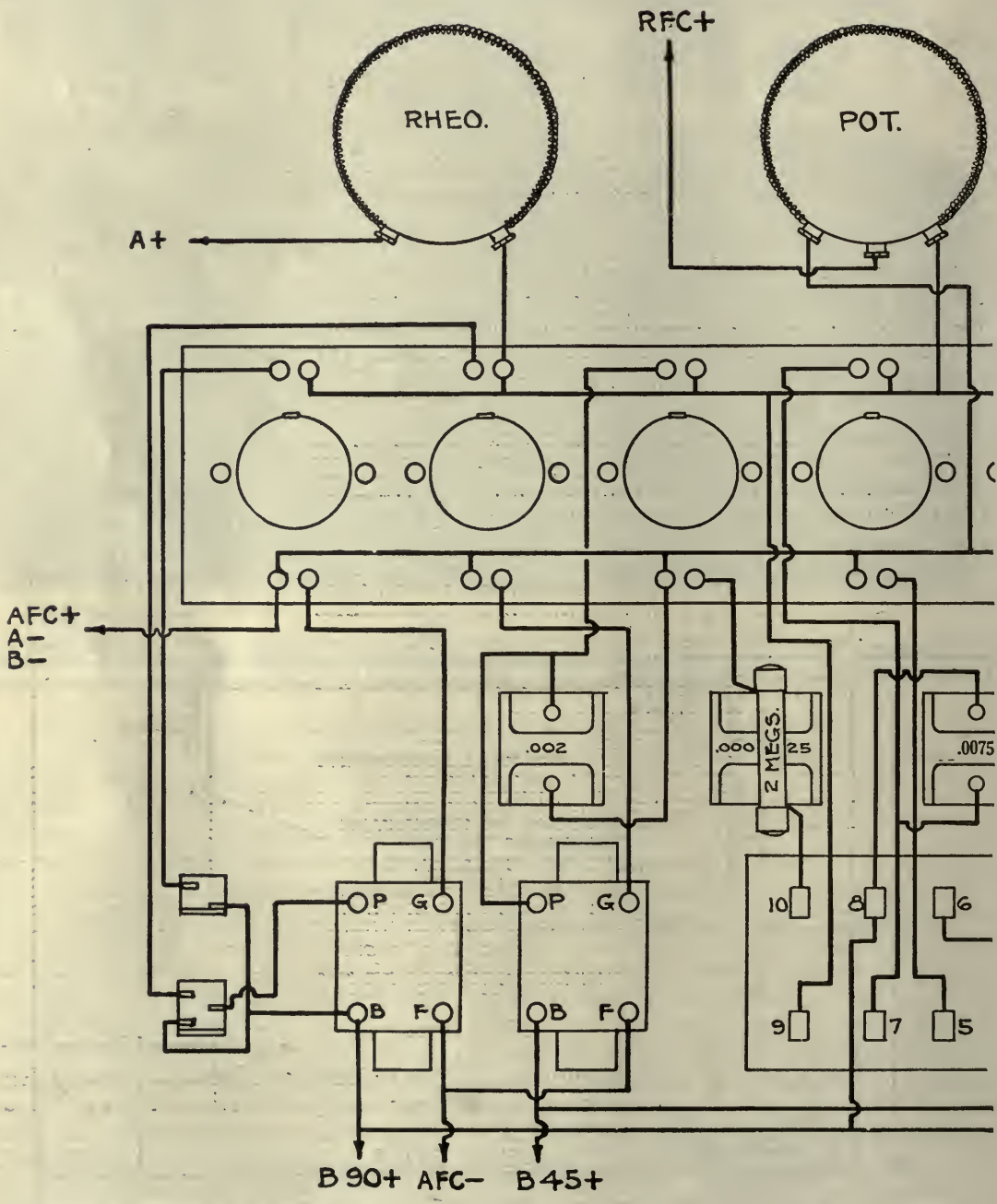
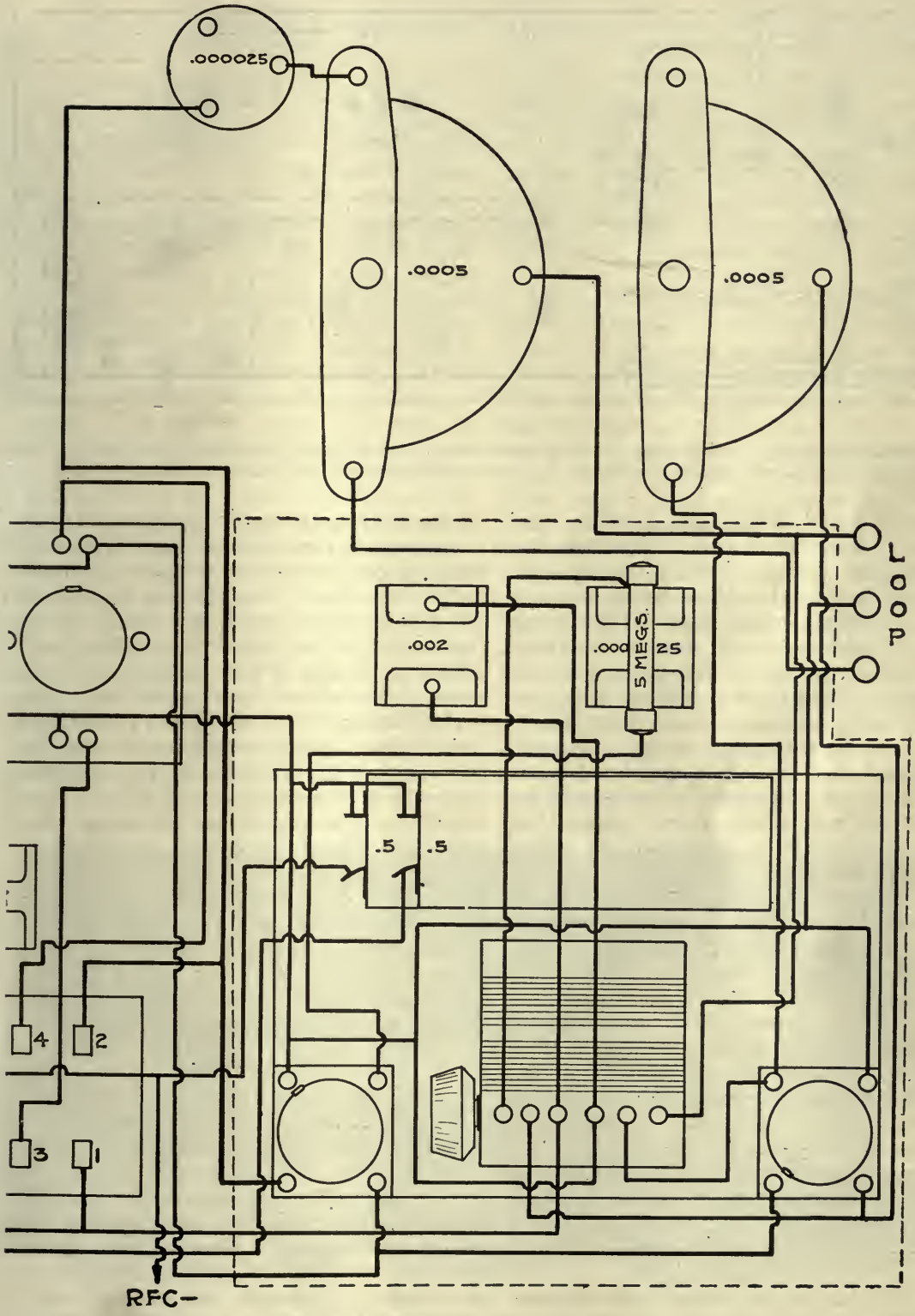


FIG.—
Complete layout for the portable super-heterodyne. In duplicating this—



—10
—set, it is advisable for the constructor to follow the drawing carefully

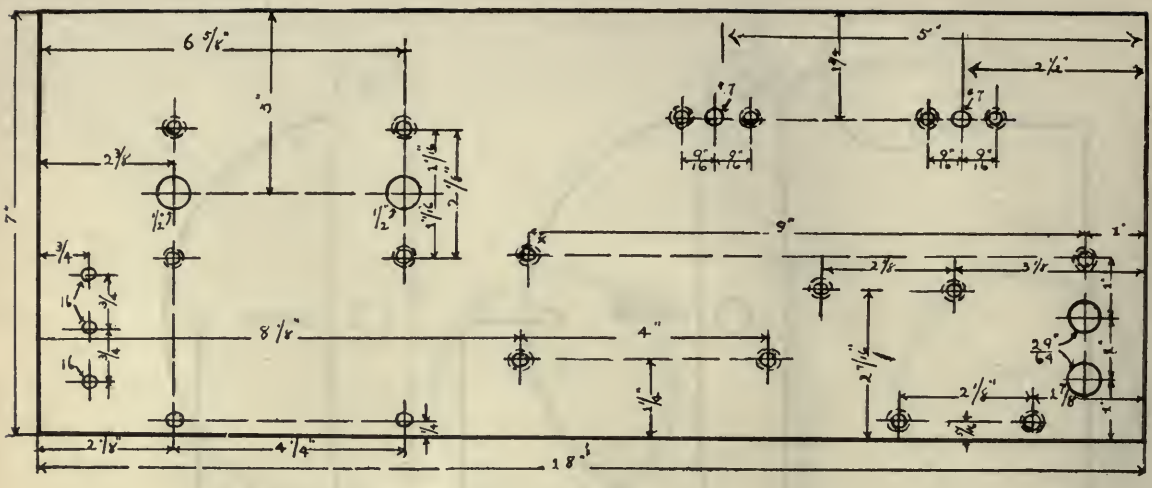


FIG. 11

Dimensions for the panel. The dimensions are given for the apparatus which was used by Mr. Silver, and but very minor changes will have to be made by those constructors who uses other and similar makes of parts

eliminates posts, which are generally unnecessary, since when once connected, the batteries are seldom changed. If desired, posts may be located on the panel, or on a sub panel, but are not recommended. The battery leads, of flexible lamp cord, about three to four feet long, are soldered to the wiring where it terminates in instrument binding posts, in order to relieve the wiring of any direct strain. This is shown in the view of the wired set. These leads may be tagged and braided together if desired, and should be long enough to connect with permanent batteries outside the set when used in a permanent or semi-permanent installation.

The set may be wired with bus-bar, or No. 18 or No. 20 magnet wire in spaghetti. If bus-bar is used, as little spaghetti as possible should be used and all wiring run as direct as possible. In wiring a set, it is best to start by putting in the filament lines, then following with the grid and plate leads, and the balance of the wiring, bearing in mind that all inaccessible connections should be made before the balance of the set wiring covers it. If desired, and it is somewhat of a help to do so, the variable condensers may be left off the panel until as much wiring as possible has been done without them.

THE LOOP

AFTER the set has been wired, the batteries and loop, described below, should be connected to it.

The loop may be any standard type now on the market, the small folding type being recommended for portable use. With any standard loop, a tap must be taken at approximately the center. This tap may be one turn either side of the center, but should be no farther out. If the loop is to be built, it may consist of 18 turns of wire on a 24-inch form, either spiral winding, or squirrel-cage type. If made larger, it may consist of 14 turns on a 30-inch form, spaced $\frac{1}{4}$-inch between turns for best results. The wire used may be standard loop wire, or No. 18 lamp cord, or even solid wire, No. 18, or larger being preferable. If a spiral loop is used, the outside end should go to the binding post on the set leading to the fixed plates of the loop condenser and the oscillator coupling coil. The center tap goes to the binding post connected to the negative filament line, and the other end to the post connected to the rotary plates of the loop condenser and the Chelton midget condenser.

THE BATTERIES

THE batteries required are four small $22\frac{1}{2}$-volt B's, two $4\frac{1}{2}$-volt C's, although only from $1\frac{1}{2}$ to 3 volts are used from one, and three standard dry cells. If a permanent installation is to be made, four large $22\frac{1}{2}$- or two large 45-volt B batteries should be used, with six dry cells in series-parallel. These batteries should be connected to the set, and when the 90-volt plus lead is connected, assuming all other connections to be made, a slight spark should be noticed, indicating that the bypass condensers are charging up. This is entirely

correct, but any other sparking noticed will be due to short circuits in the set.

TESTING THE COMPLETED SET

THE set is now ready for test. A single tube should be inserted in the audio socket at the right hand end of the set, and the rheostat just turned on. The phone plug being inserted, a slight click should be heard as it goes into the last jack. If the grid post of the socket is touched, a slight click will also be heard. The second detector and first audio tube should now be inserted in their sockets and the rheostat adjustment left unchanged. A click or squeal should be heard when the grid terminals of these tubes, or their sockets, are touched. The two RF tubes may now be inserted, and the potentiometer moved from its positive to its negative end, with 1½ volts C battery on the RF tubes. A scraping noise should be heard as the arm is moved over the resistance sector, which becomes slightly louder as the negative end is reached. If the grid terminals of the RF sockets are touched, a squeal or click as before should be heard.

The oscillator tube, at the left end, and the first detector should now be inserted in their sockets. All seven tubes are now in place. The oscillator coupler should be set full in, the Chelton midget, or balancing condenser all out, and the five-megohm leak put in the clips of the first condenser, the two-megohm leak being in the second detector grid condenser clips. The loop condenser should be set at about twenty or thirty degrees, and the oscillator condenser adjusted. At some point a sharp click should be heard, indicating that the oscillator is in resonance with the loop circuit. At this point no signal can be heard, but if an outdoor antenna is used, the set is radiating slightly. This click adjustment is the only setting of the set where radiation is likely to occur, and it is practically negligible, especially on a loop.

An oscillator adjustment about five to ten degrees either side of this click is proper for a given loop condenser setting, and is where a station can be heard. These two points, one either side of the click, will hold over the entire wavelength range of the set, which is from about 200 to 600 meters. This means that each station may be heard at two oscillator adjustments, which is often a convenience, as if interference is noticed on one point, the other may be resorted to.

This click may be reduced in strength, or eliminated, by loosening the oscillator coupling. This should be done on a very weak signal, resetting both loop, oscillator, and possibly balancing condensers for each adjustment of the oscillator coupler. The coupling should be as loose as possible for good signal strength, and when once adjusted, should be left permanently set, as any change in its setting throws off the loop and oscillator condenser logging for stations heard.



FIG. 12

Rear view of the seven-tube set unwired. This clearly shows how the parts are mounted. The small balancing condenser is shown located on the right hand or oscillator condenser, whereas it should be on the left hand or loop condenser The .5 mfd. bypass condensers are placed beneath the two tuning condensers

After a weak station has been heard, the potentiometer arm should be moved from the positive to the negative end. The signal will increase in strength until the amplifier goes into oscillation with a thud or until it squeals. If the amplifier is oscillating, signals will be heard as a squeal, as on a regenerative set, although the same is true if the balancing condenser is set too far in. If the signal is strongest at the negative end, increase the RF C battery to 3 volts, and adjust the potentiometer for best signals.

The balancing condenser should now be adjusted. A weak station is tuned-in on the oscillator and loop dials, and the balancing condenser increased slightly, resetting the oscillator and loop condensers for each change. The limit of capacity that may be used here is when the first tube begins to oscillate, indicated by the signal changing to a squeal or the entire set squealing. This condenser, once set at the highest value possible without rendering the set unstable, should be left set, as it, like the oscillator coupling, reacts on the tuning control calibration.

MORE TIPS ON OPERATION

IN OPERATING the set, always endeavor to use the same rheostat setting—about half to two-thirds on, with $4\frac{1}{2}$ volts, or three dry-cells in series. The potentiometer should be used to control the volume of the received signal, loud-speaker volume being obtained in the second jack, sometimes in the first, with head-phone volume from the first jack. No detector jack was incorporated, as the volume control (potentiometer) will take care of any reduction necessary, and the wiring was simplified by leaving it out.

POSSIBLE TROUBLES AND HOW TO REMEDY THEM

Broad Tuning

DUE to too tight oscillator coupling, improper setting of balancing condenser, potentiometer too far positive, defective grid condensers, or improper tuning condenser connected across can terminals Nos. 7 and 8. Check in order given. The output tuning condenser must be quite accurate, and if the set tunes broadly, it should be adjusted by adding .0005 mfd. condensers in parallel with it, starting with a value .002 mfd. less than recommended, and adding them until maximum signal strength and selectivity are obtained.

Hand capacity effect

This may be overcome by grounding the negative filament lead (center tap of loop) and checking all bypass condensers. Bypass condensers must not be omitted as they are very important.

Squealing

If squealing occurs in radio stages, it indicates improper filament rheostat and potentiometer adjustment and possibly improper balancing condenser adjustment. Defective tubes in radio stages may cause squealing. If the same trouble is found in the audio stages it may be overcome by switching tubes, or reversing the leads to primaries of audio transformers. Connecting .00025 mfd. condensers across audio secondaries and grounding the RF transformer unit can and audio transformer mounting brackets to the negative filament line will help. Audio amplifier squealing should not be experienced, however.

Noise

Noise may be due to defective tubes, batteries, condensers, or wiring. To locate, remove tubes one at a time beginning at left end of set until noise stops, which will indicate in which tube circuit it is. Check connections, tubes, contact of socket springs, rheostat arm, and batteries. Batteries should not be below 80 per cent. of rated voltage. Defective leaks may cause noise or blocking of entire set.

Tubes

Tubes should be shifted in the set for best operating positions. Microphonic noises are generally due to the second detector and audio amplifier tubes. Shifting them should overcome this type of noise. The most critical tubes in set in order are: first RF stage, second RF stage, oscillator, first detector, second detector and audio amplifiers.

Preliminary Testing Circuit

The split-loop circuit may be left out in the first tests if desired, by connecting one end of the loop to the grid or top binding post on the panel as usual, short-circuiting the lower two posts which then run to the other end of the loop, and ignoring the center tap on the loop. This gives a standard non-regenerative detector circuit, and its use will be helpful where it is found difficult to tune the set at first due to its

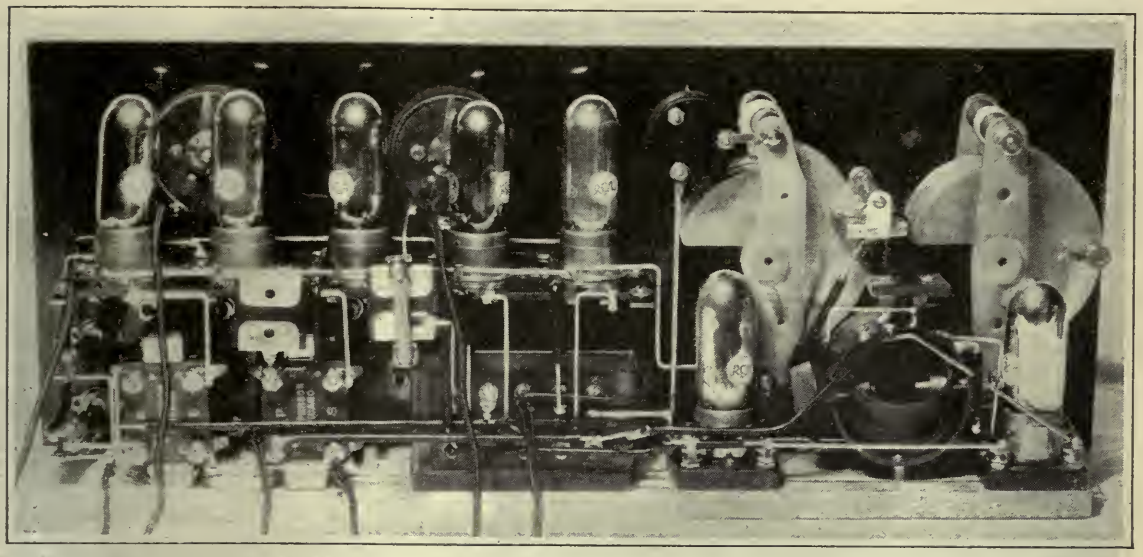


FIG. 13

Rear view of the final set, completely wired, with all tubes in place. Note how the mica condensers are hung on the wiring. The simplicity of this wiring and its accessibility is one of the strongest recommendations for this receiver. It is not advisable to copy the exact wiring as shown in this photograph, for it is preferable to follow that shown in Figs. 9 or 11. Keep the leads as short as possible. In this particular wiring job, six lengths of bus bar and one of spaghetti were used

exceptional selectivity. This type of connection will render the loop tuning condenser quite broad, and will help in locating stations which may not be heard because of the selectivity of the split loop circuit, which would cause the operator to pass over them when unfamiliar with the tuning of the set.

Filament Voltmeter

This is a very desirable addition to the set, since its use permits setting the tubes at the proper operating voltage each time the set is operated, and eliminates the possibility of damaging the tubes by overloading their filaments. Any standard type of meter may be put on the panel in the space between the loop condenser dial and the potentiometer. A better way would be to put in an open circuit jack connected directly across the filament leads of the gang-socket, into which a voltmeter connected to a plug and cord could be plugged. This arrangement would not tie up the meter in one set, but would leave it free to be plugged into as many sets so arranged as the builder might wish. It is of course unnecessary to say that 199 tubes should never be operated with over three volts across their filaments, and they need not be when the set is operating properly.

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ON THE ISLAND OF OAHU, HAWAII

Is the transpacific radio receiving station of the Radio Corporation of America. The photograph was taken from the dead volcano crater at Koko Head. Sixty per cent. of the transpacific message traffic is said to be handled by radio

THE MARCH OF RADIO

By J. H. Morecroft
President, Institute of Radio Engineers

Who Will Pay for the Campaign Broadcasting?

THE Bell Company's intention gradually to build up a group of high-class broadcasting stations, all modulated from one microphone when the occasion warrants, is gradually being worked out. On special occasions, large parts of the company's country-wide network of wires has been tied up for broadcasting control, but the arrangement has been temporary only. The connection between WEAF and WCAP is of course a practically permanent installation, and now we hear that six stations, WEAF, WCAP, WJAR, WGR, WCAE, and WGN, are to be tied together in a semi-permanent network. It may be only a matter of a year or so before this company will have available a nation-wide service for those who have something worthwhile saying, and money enough to rent the broadcasting system.

A very large investment is tied up in such a wire and broadcasting chain. The stockholders have a right to a reasonable return on their money on this investment. Therefore the question of cost of broadcasting must necessarily be met in some fashion by those using it. How are the political campaigns to be carried on by radio? These radio campaigns sound logical and reasonable in so far as conserving

the candidates' strength is concerned, but who is going to foot the bill? Someone is going to find out that it costs money, a lot of it, for the privilege of addressing a million or more listeners. The telephone company cannot afford to give the service for less than cost, and the cost will be pretty high, if the present ambitious plans of some campaigners are carried out.

One thing is sure; when a campaign manager has paid $10,000 or more for the use of the radio channel for an hour he is going to be careful who uses up his time—the days of the cheap ranter and phrase maker are over. For such a costly channel the manager will have to select men with brains who can present their arguments clearly and forcefully. Radio will probably do much good in improving the quality of pre-election oratory, and so give the people a better understanding of what the political issues really are.

We Need a Government Department of Communications

SECRETARY HOOVER is planning to call a general radio conference in Washington sometime in September, according to a press despatch. Representatives from every branch of the radio industry will be invited to the conference and it is hoped that some of the complications about wavelengths and interference which now exist will be straightened out.

We wonder whether this conference can accomplish any more than have its predecessors, which was not very much. Can conferences of this kind satisfactorily solve the radio problems as they arise? Radio conferences are always being held somewhere nowadays; one is about to begin in Europe, and one has just ended in Mexico City.

It is really a question whether or not some extra government bureau is not necessary which would take care of government interests in the entire communication field. Shouldn't there be some office in Washington where all activities of this kind are centralized, headed by a man who knows communications? Wouldn't a communications portfolio, or at least a separate division in the Department of Commerce, headed by an Assistant Secretary, (who should know the economic side of com-



AND IN BERLIN—

Street vendors are selling radio apparatus. Using the loop at the top of the wagon, receivers can be demonstrated under actual operating conditions. The natives appear interested

munication) do more good and develop a more consistent policy than these conferences, which will apparently be called annually? The trouble with these conferences is that they lack continuity and of necessity have very little connection with the preceding ones.

New Privileges for the Radio Amateur

THE radio service of the Department of Commerce made an announcement recently which should be of great importance to radio experimenting in the United States. Official ruling was made that four new wave bands could be used by amateur operators. Wavelengths between 75 and 80 meters, 40 and 43 meters, 20 and 22 meters, and 4 to 5 meters may be used. This means that an amateur may use any or all of these waves, providing his application has been approved by his local Supervisor of Radio. It was further arranged that amateurs who use this new group of wave frequencies do not have to conform to the present quiet hours for the protection of the broadcast listeners, since it will not be possible for them to create any interference. Special amateur stations will not hereafter use wavelengths above 200 meters, the Department has ordered, but they may use a special band between 105 and 110 meters.

This new ruling of the Department seems to show that the able officials of the American Radio Relay League, that active and representative amateur association, have been successful in securing the intelligent coöperation of the Government. The quiet hours which have been enforced on the amateur have undoubtedly greatly limited his legitimate activities and this ruling will open a new field for experiment on short waves where experiment is now most interesting and most productive. There are now some 15,500 licensed amateur transmitting stations in the United States. With a good proportion of these carrying on daily tests in short wave transmission it is entirely reasonable to expect that some productive results will follow.

Observers of radio progress during the last ten or twelve years are quite unanimous in agreeing that amateurs, in America particularly, have done much for the art. Their contributions have been in the improvement of apparatus, in training many operators who are



—Roger B. Whitman, Staff Photographer

A FIVE-FOOT LOUD SPEAKER CONCEALED

In the wall at the home of Dr. Lee De Forest at Spuyten Duyvil, New York. The soft travertine-stone walls, broken by the grill near the ceiling, give no hint of a radio set. Music seems actually to float in the room when the set is in use, giving a totally different effect than the usual one of positive impact when an average loud speaker is used in an average room

now working and improving radio for the Government and for many commercial companies. Trained amateurs are to be found operating and managing broadcasting stations, and in many, many parts of the country selling, explaining, maintaining, and repairing broadcast receivers. It is only because there was a force of well trained amateurs upon which to draw that so many good radio shops have come into being in the last few busy radio years.





THE S.S. "BOSTON"

Immediately after her recent collision with the S.S. *Swift Arrow*, in a thick fog off Point Judith. The *Boston* of the Eastern Steamship Company, a ship newly placed in commission, was bound for New York with a full passenger list. Radio in this disaster again proved its value in the rapid and efficient summoning of aid

In the field of short wave transmission, the American amateur has almost been a pioneer. Who knows but that the great interest the amateur has shown is not pretty directly allied with the trend of present broadcast and code transmission on those wavelengths, both in this country and abroad?

It is good to see that the present disposition of the Government is, as it has been during the last twelve years, to allow the American amateur freedom and liberty of experiment. It is a typical American policy, and the experience of the last decade has shown that policy eminently to be justified.

Tube Bootlegger Caught

JUDGING from recent information, radio tubes bought from bootleggers are no more reliable than certain other goods purchased from those in a similar relation to the law. A newspaper account tells that most of the broadcast listeners in a certain district reported more or less trouble with their sets, sets which should have given no trouble at all. By process of elimination, the trouble was generally located in the tubes which, although purchased in cartons marked Radio Corporation of America, were not manufactured by that company. The bootlegger dealer was located and summoned to court and he will undoubtedly suffer the law's penalty, as he should.

We believe that if these tubes were sold at a reasonable price, there would be no incentive to engage in this illegal traffic. The Radio Corporation, on August 5, announced a reduction in price of all tubes to four dollars. Probably a much greater reduction is necessary before the tube bootleggers' business will become sufficiently unremunerative that his tubes are no longer to be had.

The Dry Cell B Battery and its Cost

BECAUSE the major item of expense in the operation of radio receivers has been the cost of B batteries, we all welcome the reductions in list prices recently announced by National Carbon Company, Inc., the manufacturers of Eveready batteries. B energy was never so inexpensive or reliable as it is to-day. That this is so is due in great part to the ability of the dry battery makers.

So rapidly did the demand grow for B batteries that only the best-equipped organizations could hope to keep up with it. That they have done so, and not only preserved the high quality

of their product but improved it, is little short of marvelous. That the largest of them now finds it possible to pass on to the user a large share of the saving of quantity production is, as the announcer says, "Worthy of much applause from the radio audience."

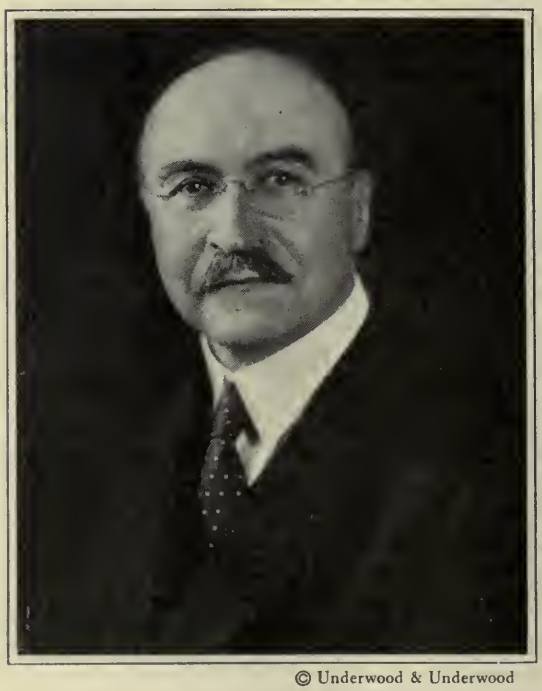
In addition to all this, dry battery research has been continued energetically, and those of us who have multi-tube sets now can buy special heavy duty dry batteries that are as economical under heavy current drains as were the smaller batteries on sets using less tubes. What tremendous economies the vast growth of radio have made possible may be guessed from the fact that the new Eveready heavy duty 45-volt battery actually can be purchased for less than the previous cost of the customary large 45-volt battery.

With the different sizes of B batteries now in the market, or more accurately with B batteries of different size cells—small, medium, large, and extra large—and with sets whose current drains vary all the way from 1 to 30 milliamperes or more, the time has come when it is necessary to fit the battery to the set in order to obtain the maximum of economy and satisfaction. Having chosen the right size dry B battery of reputable manufacture, the user has a mighty efficient and economical source of electrical energy. For many of them it is the only possible one.



THE RADIO BANK

Combining a crystal receiver and a small coin bank, all in a space three and a half inches in diameter. The lower half of the device is a detachable bank which can be taken to the bank offices for opening. It is distributed by the Harris Trust and Savings Bank of Chicago



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DR. L. H. BAEKELAND

Of Yonkers, New York. Dr. Baekeland, president of the American Chemical Society, produced bakelite so generally used inradio work. He was recently decorated with the Order of Leopold by King Albert of Belgium

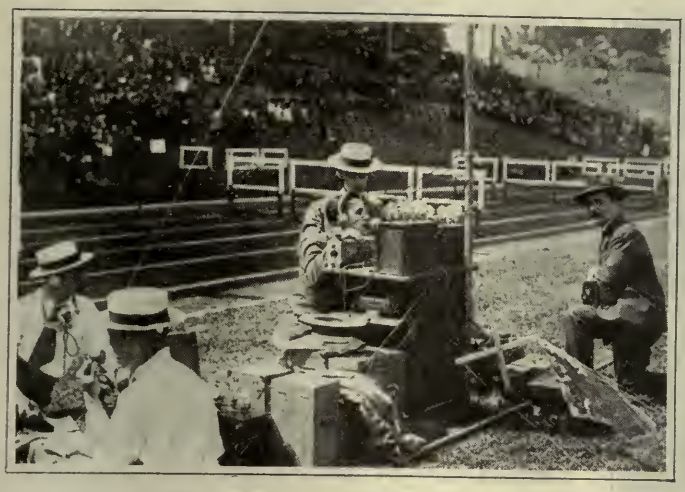
The Inventor of Bakelite Honored in His Native Land

MANY have probably wondered where the name of Bakelite came from; they merely know the material as a very useful radio product, but not why it is called Bakelite.

Dr. L. H. Baekeland of Yonkers, New York, (the same town that claims Armstrong), President of the American Chemical Society, who invented Velox paper many years ago, and after performing that very useful task succeeded in producing this "material of a thousand uses." Bakelite therefore is named after its inventor, who has just received from King Albert of Belgium (of which country Baekeland is a native), the honor of being made Commander of the Order of Leopold.

Help Eliminate the Whistle

WE HAVE a bulletin from the Department of Commerce regarding the whistling beat notes heard in receiving sets, asking the assistance of the listening public in locating their cause. If one's own set is oscillating, of course whistles will occur



BROADCASTING THE OLYMPIC GAMES

At the Colombes Stadium, near Paris. Four years ago, at the last Olympiad, radio broadcasting had just begun in this country, and there was no broadcasting at all on the Continent

every time the set is tuned to a station; there is no trouble here with the radio transmitter, it is in one's own receiver. But whistles are heard when a set is not oscillating, whistles, whose pitch does not change as one's condenser setting is changed. These whistles are due to something outside of the receiving set.

One's neighbor may have an oscillating receiver which is sending out energy at nearly the same frequency as the station to which we are listening. That will cause a whistle. Such a whistle does not stay fixed in pitch very long, as the man with an oscillating receiver is just the kind that is continually changing his adjustments. Possibly two neighbors have oscillating receivers and each is trying to "get" the other, thinking it is a distant station. It's amusing sometimes to note the patience with which each of them waits for the other to say what distant station he is!

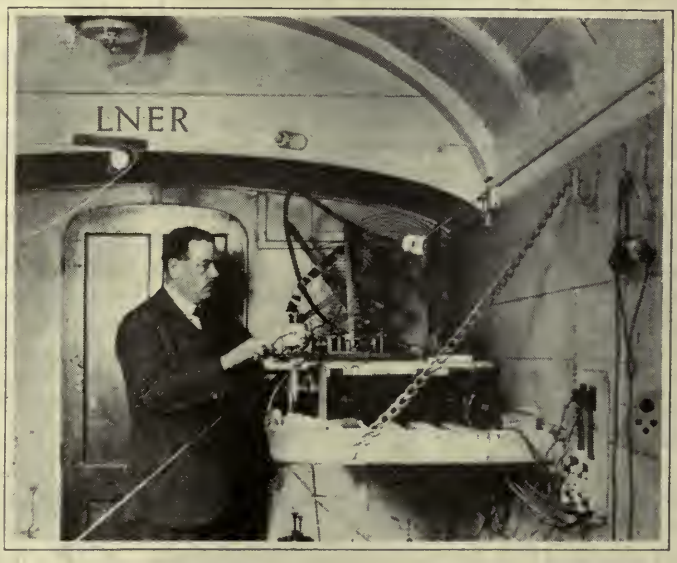
A third source of whistling is that caused by two bona fide transmitting stations sending on frequencies sufficiently close together to give an audible beat note. This note stays constant in pitch as long as the stations are operating. This is the condition which the Department wants to remedy. If the various stations are on their assigned frequencies it should not occur. Any one having definite knowledge of the occurrence of such beat notes is asked to advise the nearest government Radio Supervisor that steps may be taken to put an end to it.

Good Work Well Done

MANY radio societies and associations are coming into being daily, some good and some bad. Few of them can be of any real service to the radio public. It is with pleasure then that we note the first bulletin of the American Radio Association, a nation-wide organization of listeners-in, which is really functioning. Alfred M. Caddell, the secretary of the American Radio Association is the active spirit behind this organization.

This association pledges itself to support any movement for the betterment of broadcasting. The Association will further movements which while not perhaps contributing directly to the good of the isolated listener-in, are movements which he should not hesitate to support.

Among activities of this kind which the



RADIO COACH 6 ZZ

Attached to the Scottish Express from London on the London and North-eastern Railway. Tests in receiving broadcast and amateur signals were made by members of the Radio Society of Great Britain. Several receivers and a transmitter on a wavelength of 185 meters were used, all operating on the inside antenna shown in the photograph. Signals were copied from 6 ZZ 270 miles away



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ROBERT M. LAFOLLETTE

United States Senator from Wisconsin

"This is the first national political campaign in which radio has played its part as a medium of public information. In millions of homes, the proceedings of the two old party conventions were heard as plainly as in the convention halls. Throughout the campaign, more people will catch the voices of various candidates and their spokesmen than have ever before been heard from the platform in American history.

"The consequences of this great stride toward giving the people a first hand knowledge of political debate can hardly be estimated. Undoubtedly, it will serve to minimize misrepresentation in the news columns of the press. The most reactionary newspapers will fear to twist facts which thousands of its readers receive directly by radio."

A.R.A. has inaugurated is that to furnish radio sets to the blind, a movement which has the hearty coöperation of the American Foundation for the Blind. Helen Keller, who recently requested sets for the blind children of New York in furtherance of a scheme fathered by the Lions Club, is going to help the A.R.A.'s radio-for-the-blind movement. This is something well worth while doing.

The A.R.A. has also been active in coördinating the efforts of radio listeners and electric power companies to clear up interference problems in so far as they originate from lighting lines. It has given its hearty support to Roxie's campaign for the disabled soldier sets, and is now starting a campaign to maintain the broadcast channels free from advertising propaganda put forth in the guise of entertainment. It is well worth while to give your support to an association of this kind, for every one of its activities are directed toward the improvement of the radio broadcasting situation.

Another Milestone in Radio Progress.

WHEN announcement was recently made from Chicago that E. T. Flewelling of that city had received an English station using merely a loop and a single-tube receiver, there was much interest in radio circles. When an experimenter receives signals with so little apparatus over so great a distance as that, everyone will agree that an extraordinary radio feat has been accomplished. RADIO BROADCAST congratulates Mr. Flewelling on his remarkable work.

This reception is an interesting and informative example of the work now going on in short waves. Intelligent and active experimenters in most parts of the world are busy finding out just what can be done in this interesting field. Most of these tests are taking place between England, France, and America. Broadcast listeners who cannot tune down to waves below 150 meters have not the slightest conception of the experimental activity in that almost untried band.

When Hertz first sent a wireless signal in his experiments in 1887, he used a small transmitting loop radiating very short waves. It is worth observing that now, practically all of the revolutionary radio work is being done on short waves. So the radio cycle moves.

Answering the editor's letter of inquiry about his experiments, Mr. Flewelling wrote:

It is well known in theory and fact that super-regeneration possesses the unique advantage of amplifying even more than inversely as the square of the incoming wave. This means that our amplification at 100 meters, or 10 meters is really tremendous.

I believe that we are going to enter a new era of radio that will combine such things as short waves, super-regeneration, and better design of apparatus.

We cannot help then coming closer to other nations, and I think that this increase in long distance reception between experimenters in various nations will do much toward a praiseworthy and desirable exchange of international thought.

Mr. Flewelling who is a designing radio engineer, is also an American amateur of the best type, and an active member of the American Radio Relay League.

"From what I know of radio," he said, "I believe that the developments now under way in several countries are such as to make one fairly gasp about the future."

Well, workers like Mr. Flewelling are helping bring the future to the present.

Interesting Things Interesting People Say

S. R. HELMS (Monroe, North Carolina; writing to station WGY): "I am one patient that a doctor prescribed a radio outfit for, and it was the greatest prescription he ever made. It has done me more good than specialists and sanatoriums. I sincerely wish that every shut-in could have a radio set."

JOHN V. L. HOGAN (New York City; consulting radio engineer; speaking of a radio vote taken among listeners to his talks at WEAF): "A tabulation of the returns from more than 5,000 listeners, as to the source of the radio interference they encountered in their receivers was:

First place:

Spark	39 per cent.
Whistles	31.4 per cent.
Cross talks	29.6 per cent.

Second place:

Whistles	43 per cent.
Spark	37 per cent.
Cross talk	20 per cent.

Third place:

Cross talk	60 per cent.
Whistles	22.5 per cent.
Spark	17.5 per cent.

This summary came from the reports of listeners from practically the entire Eastern half of the United States."

W. D. TERRELL (Washington; Chief Supervisor of Radio, Department of Commerce): "The day is not far off when there will not be the slightest excuse for two vessels colliding at sea. Fog, the age-old terror of the mariner, need no longer be feared. With the help of the radio compass and ability to pick up either shore radio compass stations, or other vessels, the modern ship can keep true to her course through the densest fog as well as in clear weather. It is the most wonderful aid to those who go down to the sea in ships since the invention of the mariner's compass itself."

B. G. HUBBELL (Buffalo; President, Federal Telephone and Telegraph Company): "In my opinion, Democracy can live only through the most exacting publicity and clear understanding of the country's necessities. There must be general accord. Already, there are signs of the breaking down of our form of government, largely because of this lack of understanding, and I believe that this new radio science was projected into the world's necessities particularly to furnish an economic and easy method in overcoming this growing lack of political faith. In the present campaign, the Republican candidate will be listened to by Democratic voters and vice versa. A very general and fair minded exchange of political thought will be possible without the heat of political passion. I believe that radio, the greatest of all scientific developments, was brought forth largely to furnish the means of preserving our political structures through easy methods of wide and easy distribution of political knowledge.



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JAMES W. WADSWORTH, JR.

United States Senator from New York

"Broadcasting the proceedings of the Senate is hardly practicable. . . . The spontaneity of debate would be ruined by the installation of a broadcasting device. Consideration would be paid only to the political effects of what would be said on a given subject. Substance would yield to expediency. Our aim must be to limit the activities of the Government here at Washington and get more interest among the people in their community life and government. Radio is a great thing. It has done much for us already, and in the future will do much more as its processes and equipments are perfected. I do not think broadcasting the proceedings of the Senate will contribute anything toward a better understanding of what is going on"

NEAL O'HARA (New York City; humorous writer, in the New York *Evening World*, apropos of the new New York Municipal broadcasting station WNYC): "That broadcasting plant comes under the municipal head of unnecessary noises. It will be in charge of a City Static-Stician . . . Mayor Hylan gave his constituents Civic Virtue. Now he will give them static violence. . . ."

The Case Against the Radiating Receiver

Some Interesting Statements by Those Prominent in Radio About a Serious Menace to Receiving—Why Sentiment is so Strong Against the Radiator—What the Future is Likely to Be

By WILLIS K. WING

"MY RECEIVER will bring in almost nothing but a grand assortment of squeals, howls, groanings, and all manner of other sounds not of this world. What is the matter?" A certain radio enthusiast asked us this question not so very long ago. And there are enough radio fans who are daily encountering the same trouble that it is decidedly worth while discovering what is the matter. "Is the trouble with me, or is the trouble with the set, or what?" he went on to ask. "Sometimes I can get programs beautifully complete and unspoiled, and then suddenly, these unearthly noises begin, and there seems no possible way to get rid of them. Is it all static?"

Radio is a God-given science, and at times involves apparently God-given interference which everyone is powerless to control. Static is more than a name to most radio listeners. "I'll tell you one thing," remarked our voluble radio friend, "if all these unearthly squeals, howls, groanings, etc., are static and can't be stopped, I am going to quit radio until God takes the static away."

Well, we told him that all that "squealed" or "scratched" wasn't necessarily static. We told him that practically all the interference he was complaining about came from thoughtless or unknowing radio neighbors. Then he was interested. His "What, when, where, how?" engulfed us. We told him the trouble was caused by oscillating or radiating receivers. That was a new idea to him.

While everyone grants that radio receivers are not now in their final stage of development, most of them in present use will bring in broadcast programs in good style. But let us qualify that a bit. There is one type which has been with us since the very inception of broadcasting, now nearly four years ago, that is responsible for much of this radio unpleasantness. And that receiver is the single-circuit regenerative receiver.

It isn't that the single-circuit set isn't a good receiver. It is, as a matter of fact, quite sensitive, and has been known to bring in much distance, but its general use has gotten us radio folk into all sorts of trouble. In the main, the single-circuit set, operated by the Jones, the Browns, the Smiths, and the Whites, in every city and town in this country, has brought us to a point where the radio life isn't very liveable for any of us.

The Joneses are interfering with the Smiths, and the Browns with the Whites and no one is really enjoying it. There was a recurrent sentence in "The Tavern" which played on Broadway not so long ago. "What's all the shootin' fer?" Substitute "blooping" for "shootin'", and this same question could well be asked about the present radio situation. Can't something be done about it?

What has been done? What is the situation, technically? What, indeed, can be done? And, most important of all, what is likely to be done?

FOUR YEARS OF THE SINGLE-CIRCUIT

AMERICA was the pioneer in broadcasting. And like all pioneers, she has made her mistakes. When the public, realizing that it could hear voices out of the air by installing a receiver, started to buy radio apparatus, there wasn't a radio manufacturer in the country prepared for the business that flooded him. Back in 1920, when broadcasting began, the simplest and most sensitive receiver then in use was the Armstrong single-circuit regenerative receiver. It was cheap, comparatively easy to operate, and sensitive. So, naturally enough, great quantities of this type of receiving set were made and sold.

Most people then owned either a crystal set whose range was not more than 25 or 50 miles, or they owned one of these single-circuit things (although some three-circuit regeneratives were in use). But this single-circuit affair, by its

construction and connection, is an excellent little transmitting set. The purchaser, who innocently thought he was buying merely a receiver, found out—indeed he was soon told—that his was a sending as well as a receiving set.

Paul F. Godley, one of the best-known radio amateurs, testifying at the Department of Commerce hearing on radio telegraphy, called at Washington for the purpose of decreasing radio interference, in February, 1922, said:

The single-circuit receiver requires the adjustment of but one control, and on that account can be operated by a four-year-old child, or the two-year-old for that matter—and these companies (manufacturing this type of set) feel that we are in the two-year-old class. The more complicated receiver requires the adjustment of three or four controls (and that is not difficult to get on to) to the end that one may provide himself far better results in selectivity than with the simpler type. . . .

It is possible with one of these sets to telegraph 25 or 30 miles with ease. Obviously, if you are going to cover the country with receivers of this type, particularly along the Atlantic seaboard, you are going to have a terrible "mess." In Newark, that exists now. One goes to listen to broadcast programs and one encounters this vast number of "canary birds" that was mentioned in this hearing yesterday. And the thing is only starting.

I should like to call the attention of the Technical Committee for consideration some sort of legislation or regulation which would make it impossible for any one to sell or promote receivers which eventually might nullify the benefits to be obtained from broadcast programs.

Does the Golden Rule Apply—in Radio?

A lot of folk are finding out that human nature is, after all, only human nature They have found that the squealing, single-circuit receiver "owned and operated" by the neighbor across the street can cause them quite as much mental anguish as Willie Jones's saxophone next door did, in the days before radio became a household word. Well, some of the neighbors are being good fellows about it, and discarding their oscillating receivers, or making them over so they don't oscillate. And some are growling to themselves, "Aw, what difference does it make?" Mr. Armstrong, to take one of the most prominent in radio, seems to think it makes a good deal of difference, as this article by Mr. Wing brings out. The cure for the situation is really in public opinion, and when sentiment grows strong enough there won't be a radiating receiver to be found anywhere outside the museums.—The Editor.

ARMSTRONG SPEAKS OUT IN MEETING

LET us see what the inventor of the regenerative circuit himself has to say on this moot question of radiation from receivers. Edwin H. Armstrong, in whose name the regenerative patent is issued, said at the Washington hearings on the White Radio Bill (H. R. 7357) held in March, 1924.

I want to bring to the attention of this Committee a technical matter, one relating to interference, which, in my estimation, is just as serious for the future of radio as any question of monopoly which has been considered. I mean the radiation from regenerative receivers.

I might as well identify myself as the inventor of the circuit which causes this interference. That circuit, on the other hand, has created radio broadcasting. It is the basis of radio broadcasting, and is used in every such transmitting station in the country, and in about 80 per cent. of the receiving stations.

The particular merit of the receiver is that it enables you to build very cheaply a sensitive and selective receiver, but it has one bad property. Technically speaking, it is this: just as you approach the most sensitive adjustment, the receiver begins to oscillate, becomes a miniature transmitter, and it sends out signals which interfere with every other receiver within a radius of a few hundred yards.

In the early days of broadcasting that was not serious; the receiving stations were too far apart; but at the present time, where you have dozens of antennas on the same roof (we have that situation right along in New York City), broadcast reception from any distance is becoming impossible. It's getting worse every day.

Now I have no hesitation whatever in saying if you let this thing go on for another year, nobody will hear anything. What you have got to do in some way, is to prevent the increase of these sets. I do not think there is anything you can do with the sets already out. There is no remedy you can propose that will be practicable. But if you stop adding to the number of these sets, and provide the new ones with mufflers—and by mufflers I mean something very similar to the muffler you put on an automobile to stop the noise of the exhaust—you will stop and prevent this radiation. If you do that, then the sets which are out will gradually disappear, just as the automobiles of five years ago disappeared. The newer models of sets will be in demand because they will be more selective, and sensitive, and these radiating sets will gradually die out.

The manufacturers of radio apparatus would be

very glad to put these mufflers on, but they can't do it as long as the other fellow who is competing with them does not put them on, because then the other fellow would undersell him.

At this point in the hearings, Representative White, of Maine said, "Mr. Armstrong, in that connection, I do not suppose there is a mail that comes to me which does not contain complaints against these regenerative sets. I suspect that is true of all the members of the House who have any correspondence relating to radio."

Every owner of a radio set—and who, indeed, is there who doesn't own one?—knows how widespread complaints are about the radiating receiver. That point is one that requires no emphasis. Last November, when the editors of this magazine conducted the transatlantic broadcasting tests with England, they found in reading the hundreds and hundreds of letters which poured into the office, how widespread was the curse of this oscillating set. When the American broadcasters were quiet, to let American listeners hear the English stations, the air was made positively hideous by the squeals of the little single-circuiters, searching up and down the scale for the English voices. Those tests provided a highly dramatic proof to the great body of American listeners that the single-circuit sets had to go. Just when 2LO, or 2ZY or 5NO, to list some of the English stations which were best heard on this side, were about to be tuned-in, the whole show would be broken up by the noise of some nearby single-circuit set. More work was then out of the question. This report came, without variation, from hundreds. The editors wanted to prove to the radio nation how serious the menace of the radiating receiver was, and there are few who listened then who did not agree.

Let us pile up a bit more evidence—evidence from authority as the logicians say—before we come to remedies, and a forecast of the future.

The Radiating Receiver

"It is possible with one of these sets to telegraph 25 or 30 miles with ease. Obviously, if you are going to cover the country with receivers of this type, particularly along the Atlantic seaboard, you are going to have a terrible "mess." In Newark, that exists now. One goes to listen to broadcast programs and one encounters a vast number of 'canary birds.' And the thing is only starting. I should like to suggest some sort of legislation, or regulation, which would make it impossible for any one to sell or promote receivers which might eventually nullify the benefits to be obtained from broadcast programs."—PAUL F. GODLEY, *of the American Radio Relay League.*

PILING UP THE EVIDENCE

MR. ARMSTRONG had told the House Committee, sitting on the radio bill, that if a "muffler tube" were included ahead of these radiating sets, there would be no radiating, and no further trouble. He meant, of course, that a radio-frequency transformer and amplifier tube should be connected to the antenna circuit, ahead of the regenerative detector. He estimated the cost at about $10 per set.

Mr. Clay S. Briggs, of the Committee, asked Mr. Armstrong if he did not think that the public was vitally interested in buying and using apparatus which will not radiate, and that, therefore, the company which made apparatus not subject to that criticism would be able to sell it to the exclusion of the firm which made the radiating sets.

Mr. Armstrong replied that he did not think that was exactly the case. And he added that "It only takes one man in a group of a hundred to spoil the whole business for everybody. That is where the difficulty is. If ninety-nine fellows say 'Well, I will expend the extra money and not interfere with my neighbors', one fellow can spoil it all by getting the cheaper (radiating) set. I am afraid you are up against the human element. When you have whistling interference, there is no enjoyment for anybody."

Mr. Briggs then remarked, "Of course I can appreciate that clear reception is desired by everybody, but I have known people who have sat down to listen-in on high priced sets, some of them running up as high as $150. I have heard all sorts of groanings, whistlings, and moanings, and they told me one of the reasons for it is, the more powerful set they get, the more they reach out."

"Let me correct a false impression here," Mr.

Armstrong answered, "The mere fact that a man has spent a thousand dollars for a receiving set is not going to prevent a fellow who has spent $25 for one of these radiating receivers from putting him out of business. There is no amount of money you can invest in a receiving set which will insure you against this interference. It is a physical impossibility to guard against that."

The bewildered radio enthusiast must be asking himself by this time, "Well, what is to be done?" What, indeed, is to be done? Several solutions, besides those indicated in the quotations made above were made in the February, 1922, hearings, and in the hearings of March, 1924.

It was suggested that the Government institute a licensing system which should list and license every receiver, prohibiting the radiating type. This has been done in England with what seem to be excellent results. The Government now has the power to license transmitting stations, and it was argued that since the single-circuit regenerator was a transmitter, the Government's course was clear. That, however, has not yet been done.

The Position of the Radio Corporation

"The elimination of radiating receivers is regarded as desirable, and the Radio Corporation of America is sympathetic toward that end. . . . I think that when a receiver radiates into the air, it is a transmitter, and therefore . . . (the Government) has a right to license it.—DAVID SARNOFF, *Vice-President and General Manager Radio Corporation of America.*

ATTITUDE OF THE RADIO CORPORATION

MR. DAVID SARNOFF, Vice-President and General Manager of the Radio Corporation of America made a suggestion which attempted to solve the difficulty in another way. Mr. Sarnoff's statement is especially interesting, because it indicates the policy of his very large and very powerful organization. For a number of years, it should be recalled, the Radio Corporation sold several types of inexpensive receivers which radiated very decidedly.

" . . . with Major Armstrong's suggestions, looking to the avoidance of unnecessary radiation in the air which interferes with the listening public, I am in accord. Aside from this, however, I believe it undesirable, in so rapidly developing and changing an art as radio, to prescribe the "kinds of instruments" which may be used in a radio station.

"The elimination of radiating receivers is regarded as desirable, and the Radio Corporation is sympathetic toward this end. If legislation in radio is to ensue, we favor a clause therein reading substantially as follows:

> That on and after June 30, 1925, it shall be unlawful to manufacture or sell a radiating receiver (a radiating receiver is defined as one which produces audible interference with reception by others in close proximity):
>
> That two years thereafter, or June 30, 1927, it shall be unlawful to use a radiating receiver as above defined, for broadcast reception.

Taking up the question of licensing receivers, Mr. Sarnoff said, "I think that when a receiver radiates into the air, it is a transmitter, and therefore you (the Government) have a right to license it."

Mr. Stephen B. Davis, solicitor for the Department of Commerce, then told the Committee that he thought the prohibition Mr. Sarnoff suggested "would be a prohibition against any receiving set which emitted electrical energy in such a way as to interfere with interstate commerce. I am not trying to give the exact wording, but I think Congress could control the use from that standpoint, and quite as effectively as to control the manufacture."

How is this very real problem going to be solved? H. R. 7357 did not pass at the last session of Congress, but the next Congress may quite possibly pass a measure which will legislate the interfering receiver out of existence. What is the owner of a radiating receiver to do with the set he already has? And what, and most important, perhaps, is the prospect for the present radio listener, and for the prospective radio listener?

AN IMMEDIATE REMEDY

THE technical staff of a reliable radio store should be able to show the owner of a radiating receiver how to reconstruct it by the addition of a radio-frequency muffling tube,

which will effectively prevent radiation. If this appeal is not successful, the technical staff of Radio Broadcast will give the information by mail. Much information, indeed, has already appeared in these pages. Other radio magazines will doubtless aid, as well.

The prospective purchaser should be certain the set he purchases does not radiate. It is a small matter to get reliable technical advice on this score. The inveterate constructor should build no sets which radiate. The most casual glance at the circuit to be built will satisfy him on this score. As a kind of parenthetical remark, no receivers which radiate are described or illustrated in Radio Broadcast pages.

For the layman, be it said that the tide is turning. The realization is growing that single-circuit sets are not desirable. Multi-tube receivers, using sensitive, non-radiating circuits, are becoming increasingly popular. The one-tube reflex set has answered the radio prayers of many who could afford only an inexpensive receiver, but still wanted a sensitive one which does not radiate. The force of guided public opinion is growing stronger constantly and no one who has given much thought to the subject has any doubts that the "blooper" is gradually going out. But that does not mean the campaign should be relaxed. If it is relaxed, stern measures may be taken. If the Government is forced to step in with a licensing scheme for all receivers, as has been suggested from more than one source, the radio listener would undoubtedly lose much of his freedom. And the freedom of radio has been one of its greatest charms.

There can be no better conclusion to this discussion of the radiating receiver than direct quotation of Mr. David Sarnoff's remarks at the Washington radio hearing last March. He said:

> I think the manufacturers will, sooner or later, for their own self-protection, recognize that it is important to bring out a Golden Rule receiver, which does not do anything to your neighbor, which you would not have your neighbor do to you, that is, a non-radiating type of receiver. But in this business, as in other lines of business, there are irresponsible manufacturers, there are irresponsible people, whose concern for the art extends merely to knocking but never contributing anything, and they are going to be making these radiating types of receiver so long as they make money in doing it.
>
> I do not know, and I am not certain in my mind that it is necessary to write a definite provision in a bill about it; it may be a matter of regulation by the Department of Commerce. But I should even go so far as to say that, if the properly constituted authorities of the Government having to do with radio would give this subject sympathetic consideration, and state to the public that a radiating receiver is a transmitter, and therefore subject to license, that they would rapidly disappear.

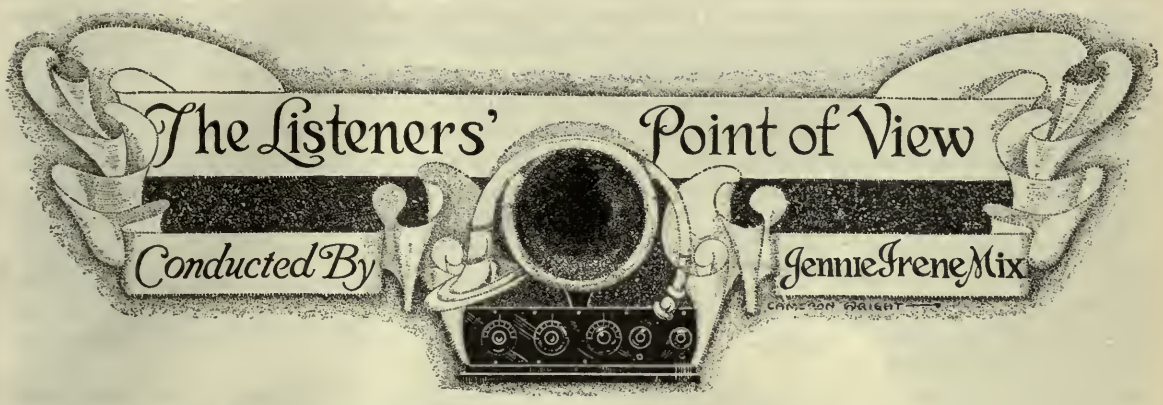
Let's hope they will!

Meanwhile this interference goeth merrily on. Mr. Smith still swears because he gets a sqawk or a squeal, which may come from Mr. White, just across the street. And Mr. Smith himself may be doing some interfering on his own account and not know it. The condition is less humorous and far worse than that fabled one where the bootleggers were so thick they were selling to each other.

But after all, it is a matter of good radio citizenship.

What Major Armstrong Thinks

"The radiation from regenerative receivers . . . is just as serious for the future of radio . . . as any question of monopoly. I have no hesitation whatever in saying that if you let this thing go on for another year, nobody will hear anything. What you have got to do in some way is to prevent the increase of these sets. . . . It only takes one man in a group of a hundred to spoil the whole business for everybody. That is where the difficulty is. If ninety-nine fellows say 'Well, I will expend the extra money and not interfere with my neighbors,' one fellow can spoil it by getting the cheaper (radiating) set. I am afraid you are up against the human element. When you have whistling interference there is no enjoyment for anybody."—Edwin H. Armstrong, *Inventor of the Regenerative Circuit.*



How Valuable is Radio Publicity?

WHETHER any one whose work is adaptable to radio performance should broadcast this work free of charge is a question that will be the subject of lively controversy as long as broadcast directors refuse to pay for this service. The position having previously been taken in this department that, as every laborer is worthy of his hire, those who broadcast should be paid provided they have an established professional standing, it would seem upon first thought that exception could not be taken to the attitude of Heywood Broun of the New York *World* when, in his daily column in that paper, he recently expressed indignation that any one should so far forget his commercial value as to dispense talents free in this fashion. But the advisability of broadcast directors depending on free talent for the presentation of their programs, and the advisability of any one possessed of artistic self-respect agreeing to sing or play or lecture, as the case may be, for nothing, are two distinct questions. Mr. Broun, it would seem, was dealing with the latter one.

Dr. Sigmund Spaeth, one of the most authoritative and constructive living writers and lecturers on music, has taken issue with Mr. Broun on his position in this matter, and he speaks from experience as he has for some time been lecturing on music through station WOR, at Newark. He states:

The artist who "has the goods," who requires only a hearing to convince a huge public that further hearings are well worth while, and, what is more important, deserving of financial reward, such an artist need not hesitate to broadcast freely and confidently, with an assurance of an ever increasing demand for personal appearances.

In my own case, the radio has been helpful in bringing before the average American citizen the title of my new book, *Common Sense of Music*, and that is just the sort of person I want to reach. I am not trying to reach the musicians and established music-lovers of the country, for they are taking very good care of themselves. The radio audience represents brand new material, full of interest and curiosity, and I am convinced that thousands of these listeners will eventually have *The Common Sense of Music* in their libraries. In fact, a great many of the letters which I receive contain direct orders for the book, which is something that might appeal even to Mr. Broun. In addition, there are frequent requests for popular talks on music in various clubs, schools, and colleges, even occasionally in a private home, and such engagements, naturally, imply the payment of my regular fee. It is impossible to give one's entire message over the radio, if that message is at all worth while, and all that is necessary is the confidence that a part of the message will create the desire to hear the whole.

Dr. Spaeth seems to have made out a pretty good case for himself by frankly stating that if he chooses to use the radio as a means of publicity it is in no way beneath his dignity to do so.

Mr. Broun, in his writings, has proved himself to be fair-minded, with a healthy outlook on life. He is a critic who does not himself resent criticism, genial and constructive. He

will surely not object to being asked why, if he so resents any one dispensing his talents free, he should have allowed complimentary copies of his two books to be sent to newspapers and magazines all over the country in order that he might obtain notices of the books in these publications—in other words, free publicity. Assuredly this was "dispensing his talents freely."

What is the difference, then, between this sort of publicity and that employed by Dr. Spaeth when he uses the radio? What is the difference between giving to the public samples of one's writings through newspaper quotations made from a free copy of the book, and through a personal talk over the radio which is given free of charge?



—Morris Rosenfeld, New York

WINIFRED T. BARR

Miss Barr is frequently heard through WEAF. She is the official pianist at this station

Having spent many years behind the scenes of this country's musical life, the present writer can say with emphasis that any artist, no matter how great, who uses the radio for publicity purposes is employing a more dignified means to this end than the large proportion of the means employed constantly along less obvious lines. It is more dignified to keep yourself in the minds of the public through occasional free presentations of your work than through paying a press agent to concoct sensational stories about your personal tastes or habits of life.

Public Men Need Broadcasting

THE people of integrity who are heard over the radio do not claim that they are broadcasting for their health, or from altruistic purposes. They state frankly, as does Dr. Spaeth, that they want the publicity. And, as long as the radio offers opportunity for free publicity, then all power to those who take advantage of it! They are not only enjoying a big opportunity, but they are playing the game with the cards on the table. Those who say they do not need such publicity are simply bandying words. Every one who depends on public patronage needs publicity unceasingly.

All of this, as we have said, has nothing to do with the question as to whether or not the broadcast directors should ask people to broadcast for nothing. We have taken an unequivocal stand on this question by asserting that the people of professional standing who give performances over the radio should be paid for their services. And we are convinced that as soon as the broadcast directors have had sufficient experience in putting forth programs they will begin to change their policy in this respect. As it is, they have met and solved tremendous technical problems that, a few years ago, were undreamed of, and it can scarcely be expected that during the short period broadcasting has been in operation they could solve their program problems with equal ability. Any one who listens-in night after night soon comes to the conclusion that this problem will be solved by the listeners rather than by the directors. But as long as the present system exists, it is a wise man or woman who, needing publicity, takes the opportunity, as does Dr. Spaeth, to get it through the radio.

When Debussy Was Introduced to the Radio Audience

ONE can scarcely estimate the value of such a broadcast feature as the half-hour program on "Claude Debussy and His Music," given at station WGY by Vladimir Karapetoff, of Cornell University. It is interesting to observe that Mr. Karapetoff is Professor of Electrical Engineering at that institution. Even those who during this program may have been somewhat confused by trying with so brief an opportunity to understand something of this French composer's individual style, must have listened with interest and, it is hoped, with a desire to hear more about the man and his music.

Some of us can scarcely uphold Mr. Karapetoff's attempt to give, in his analysis of the compositions played, a specific meaning to



—Hiller, Pasadena

YVONNE FARR

Really an alias, as her name before she left her parental Philadelphia home was Edna Hudson. Her friends still call her that, but the public knows her only by her stage name. She prefers stage life to society life and is here seen as she appeared in the prologue to the motion picture version of "The White Sister." She was recently heard over the radio at station WIP, Philadelphia

the various themes or episodes or phrases. Debussy was the first of the musical impressionists, portraying tone moods instead of definite scenes. His "Cathedral in the Mist" is not supposed to portray an actual cathedral, but rather to inspire in the listener the mood that would come to a sensitive spirit by seeing a cathedral through the mist. "What the West Wind Saw," which was another of Mr. Karapetoff's selections, while having a more easily sensed contour than the majority of Debussy's works, can still be interpreted from



—H. Tarr, Inc., New York

HILDA RAMON AND CHARLES BRYDEN

Among the musical programs heard from WEAF during the last few months, the joint recitals of Miss Ramon, mezzo-soprano, and Mr. Charles Bryden, lyric tenor, have proved a popular feature with discriminating listeners

as many points of view as there are listeners to hear it.

An impression existed for a time that Debussy invented the whole-tone scale which is so prevalent in his music, whereas in fact he became interested in this musical mode while in Russia, where it seems to have originated in that country's folk songs. But it was Debussy who brought it to the recognition of the musical world. With this scale, he produced the mystic intangible effects which soon placed him as the first great master of musical impressionism. This composer has as yet had no competitive successor. The whole-tone scale, let it be explained, is simply a scale without semitones—made up simply of whole tones.

Even the brief glimpse of Debussy's genius given through Mr. Karapetoff's well-executed program at WGY must have aroused curiosity as to this composer among many who hitherto had known little if anything of him. And once you are curious about a subject you are in a fair way to learn something about it on your own initiative. Debussy was first brought to the general public's attention in this country when Oscar Hammerstein produced in New York his opera "Pelleas and Melisande" at the Manhattan Opera House, with Mary Garden in the rôle of Melisande.

The Philharmonic and the Goldman Band of New York Are Popular

AS A feature of eager interest in the locality in which the conductor of this department is at present sojourning—Toledo, Ohio—the concerts of the New York Philharmonic Orchestra at the Lewisohn Stadium, and of Goldman's Band at Central Park in New York, and broadcast frequently by WJZ and WGY, came second only to the interest excited by the proceedings of the Democratic convention. And that, so far as the success of a musical broadcasting feature is concerned, is, in the vernacular, "going some."

Whenever the telephone rang on the day one of these concerts was to be broadcast the present writer knew some one was about to ask, "Would it be convenient for me to drop in tonight and hear the Philharmonic (or Goldman's Band)?" Until the capacity of the seating space available was exhausted the answer was always, "Yes. Delighted."

And, wonder of wonders, even on the hottest nights the music was heard, sometimes with even greater clarity, so far as strings and wood wind were concerned, than if one had been seated, listening at the concert. But, alas, for that aggravating daylight saving time! Eight-thirty in New York is seven-thirty in Ohio, and seven-thirty in Ohio during July and August is too light for good radio reception from such a distance. But after it became dusk—what joy!

Real Artists from the Virgin Islands

WHEN listening to the first broadcast performance ever given by the Navy Band of the Virgin Islands, we made a note on a handy writing pad, "Very smooth playing. Not quite as much zip as the American bands, but a good deal more sentiment."

We were not cognizant at the time that the Virgin Islands are inhabited mostly by the

colored race, and we are still a bit hazy about just where they are situated. But there is no haziness in the impression made by that band, and we know now that the members, who are all colored men, were true to their race when they showed somewhat less aggressiveness and more sentiment in their playing than do American bandsmen. Their performance at station WCAP immediately followed their serenading of President Coolidge on the White House lawn. We hope the President enjoyed their performance as much as did those who later heard them over the radio.

What Do Broadcasters Know of Adverse Opinion?

AMONG the expressions of opinion received on a recent editorial in this department relative to broadcast speakers and announcers in general and women in particular, comes one from Dorothy Doane Haynes of Winfield, Kansas, from whose letter we are moved to quote some paragraphs, omitting, in charity, the names of those people or stations who are hit hard. Here are some of Mrs. Haynes's comments:

There are people who have stood out in past programs to such an extent that they are not easily forgotten. Some of them were women. And, of course, some were pleasant and others were not. Among the pet peeves Mr. Haynes and I have is — of station —. When we feel like throwing things, we listen to her. And when her horribly affected voice comes over the air, we feel like throwing the whole thing out of the window. We listen, then both say, "Yah! Yah! Yah!" and hunt something else quick.

Then there is that — man who has begun to say, "Radiocasting." Of all the silly words! It reminds me of a piece of machinery. . . . Of the speakers, it is a rule that if they are talking about W. C. T. U. their voices are unpleasant. I have never yet heard a W. C. T. U. woman who was pleasant to listen to.

Preachers are generally too sanctimonious sounding. I wonder why they do it. They sound so pained, and yet resigned to the awful wickedness of the world. . . . I always like to hear Mrs. Poehler of WLAG. Her lovely voice no doubt has its explanation in her vocal training. It is a pleasure to listen to her talks. And the Story Lady at KDKA



ONONDAGA INDIANS

As they looked when broadcasting a war dance in the studio of WGY, Schenectady. Those who listened-in had no difficulty, provided they possessed a fragment of imagination, in visualizing the scene, for the whoops of the dancers and the drum beats were highly realistic—real "Injun" stuff

(I hope she is there again next winter), and the one at WFAA, Mary Tooney, and the announcer at WFAA. Too many of the men announcers try to be funny, as the one at —. He would be good if he would cut out the slapstick. Graham McNamee is a splendid announcer. And so is the one at KHJ. Can't you just hear him? This is K-H-J — Los Angeles — California.

Oh, there are heaps of pleasant voices that come to us both speaking and singing, and I for one have never thought that the men, as a rule, were more delightful to listen to than the women. There are good and bad of both.

Copious quotations have been made from this letter not only because it is entertaining and discriminating, but also because when opinions are expressed with no idea of their reaching the persons discussed, their value is augmented. We have a rather fixed idea that letters sent to broadcast stations are mostly of a complimentary character. Those who would criticize unfavorably seldom trouble to write. They say, "Yah! Yah! Yah!" and "hunt something else quick." So we look upon Mrs. Haynes's derogatory comments as of even greater value than the praise, although that is of no small value.



—Thomas Coke Knight, New York

ALICE WILLIAMSON

the "A. M." of the "C. N. and A. M. Williamson," two names long since famous among people who have enjoyed the writings of these joint authors. Since the death of Mr. Williamson at their home near London, Mrs. Williamson has "carried on" alone. She is now in this country and a short time ago delighted many of her admirers with a radio address given through station WJZ

THE announcer who informed his listening world that the "Gavotte" by John Sebastien Bach, about to be played, had been dedicated by Mr. Bach to Mr. So-and-So of



HOWARD I. MILHOLLAND

Or, "H. M." as he is known over the radio. Mr. Milholland is studio director and chief announcer at station KGO, Oakland, California

Vermont, had his dates somewhat mixed, as John Sebastien Bach died in 1750.

IF THINGS keep on as they are going it will not be long before "The Star Spangled Banner" will be known as the National Requiem. Not a day passes without its being heard over the radio, slow-paced, wishy-washy, sickly, sentimental, drooling. That is saying—well—a typewriter full. But let it stand. And, like all truths, it can stand alone.

Is there no one—band conductor, orchestra conductor, singer—who can send this song out over the radio with at least some vestige of stirring vitality? As it is now played, one is tempted to shout back, "Yes! We have no star spangled banners to-day!"

WHAT could be more fitting than to send, via air mail, an advance announcement of a program to be heard on the air? This was the progressive course adopted by station KGO, at Oakland, California, and one recipient of the program can vouch for the strange sensation, half thrill, half wonder, with which it was received more than two thousand miles from its starting point.



—Boice, Troy, New York

THE CAMPUS SERENADERS

The personnel of this dance orchestra is drawn from students of the Rensselaer Polytechnic Institute at Troy, N. Y. Their monthly programs, given through the Institute's broadcasting station, WHAZ, have been heard in every state in the Union, every province of Canada, from Alaska to Panama, from Hawaii to Bermuda and in New Zealand. According to the director of WHAZ, these players have received more than 10,000 letters of appreciation. A tribute well deserved, as you will agree if you have heard them

A NUMBER of inquiries have also been received asking who is Igor Stravinsky, two of whose compositions were played at the New York Philharmonic Stadium concerts referred to elsewhere in this department. To describe this Russian in a sentence one might say that if any one can take from Richard Strauss the honor of being the greatest living composer, that person is Igor Stravinsky. In his methods he is the most extreme of iconoclasts; in his mastery of orchestra, supreme; in imagination, superbly gifted. People have been known to leave a concert hall during a performance of one of his works, dismayed and offended by such amazing discords, such unexampled freedom of utterance. But the history of music shows that the discords of yesterday are the harmonies of to-day. The Boston Symphony Orchestra created a profound sensation last winter in Boston and New York through the first presentation in this country of Stravinsky's "Sacre du Printemps." Mr. Stravinsky will make his first American visit next winter and is already booked to conduct many of our leading symphony orchestras.

THIS stupendous human miracle, in its quiet suggestiveness of the majesty of God's power in the creation of man, awakens feelings I cannot describe, and which are too holy for expression by any language of this world."

According to the *Atlantic Monthly*, George E. Waring, Jr., of New York, wrote thus to his wife regarding the latest stupendous achievement of man. The radio? No, for the year was 1858. He referred to the then just completed Atlantic cable. What would he write about broadcasting were he living to-day?

THE 999th inquiry, "Are you any relation to Donald Mix, radio operator of the McMillan expedition?" arrived by mail some days ago. Until we know for sure that we are not, we have decided to claim relationship to this gloriously adventurous radio expert. It gives one such a feeling of adventurous prestige.

Efficiency Plus

The Roberts Knock-Out Set With Resistance-Coupled Amplification

By ZEH BOUCK

EFFICIENCY in the criterion of the broadcast fan is quite removed from abstruse theoretical considerations, and is expressed in the most simple arithmetic as "results per dollar." Perhaps I might say, a little more technically, results per tube, which is much the same thing. From the point of view of the enthusiast, and even by the more abstract calculations of the engineer, the radio frequency-regeneration-reflex Roberts circuit is the most efficient receiving system employing more than one tube.

Radio-frequency amplification has been introduced into all modern and efficient receivers. No truly high class receiver, as determined by the advanced standards of to-day, can be designed that does not incorporate one or more stages of such amplification. Within certain limits, radio-frequency amplification is more effective than audio intensification, because the output of a detector tube varies approximately as the square of the applied input voltage. A little reflection will demonstrate the advantage which R. F. amplification takes of this squaring. For instance: If we have a signal coming down the antenna with an intensity of 2, and amplify it ten times through one stage of R. F. (10 x 2) the output of the detector immediately following will be 400. However, if such a signal is first detected (with an audio output of 4) and then amplified (10 x 4) our final achievement will represent a total amplification of only twenty times.

Tuned radio-frequency amplification, such as is employed in the circuit we are discussing, is far more effective than untuned systems for the same reason that a receiver tuned to a distant transmitter will give a greater response to signals from that station than an untuned or poorly tuned receiver. Thus in the Roberts set we have carried the picked-up radio signal through the first tube with probably the highest practical efficiency.

This efficiency is maintained throughout the detector circuit by regeneration, which in effect is a form of radio-frequency amplification. Regeneration has the additional function of reducing the apparent resistance in the detecting circuit, compensating for inefficiencies and resistances often found in inexpert design and construction. (However, the writer desires to emphasize that this phenomenon of negative resistance is only an "effect," and, contrary to a somewhat prevalent belief, it does not actually eliminate the grid resistance, nor permit the builder to omit the usual precautions and radio finesse. The output of the detector remains inversely proportional to the resistance of the circuit. In other words, reducing the resistance of the system by using large size wires, perfectly soldered joints, and eliminating metals and dielectrics from the electro-magnetic and electro-static fields, will still increase the signal strength even when regeneration is employed.) This apparent reduction of resistance results in greater signal intensity and increased selectivity. These

Do You Believe in Resistance-Coupled Amplification?

Mr. Bouck has applied an excellent resistance-coupled amplifier to the Roberts Two-Tube Knock-Out circuit with splendid results. This article continues the practical experiment and research of this author in the inviting realm of the RADIO BROADCAST Knock-Out series. The article, like most of those of Mr. Bouck's, is really two articles. The first part consists of an able discussion of the technical "why and how" of what the circuit is and does, and the second part is a clear presentation of how to do it. Walter Van B. Roberts himself described his extraordinary circuit in this magazine for April and May. In July, J. E. Roberts described the Roberts circuit with an additional stage of audio, and Mr. Bouck told how to use the arrangement for short-wave reception. In September, J. B. Brennan's article told how to build the Roberts circuit with a push-pull amplifier.—THE EDITOR.

phenomena are very interesting and merit the student's serious attention. For an admirable non-technical discussion of their operation, the reader is referred to *The Outline of Radio*, by John V. L. Hogan.

Lastly, the signal so efficiently maintained and strengthened, is reflexed through the first amplifying tube as one stage of audio-frequency amplification. An additional tube and its expenses are thus eliminated and, in consideration of our opening paragraph, a very decided jump in efficiency is achieved.

The output of this two-tube receiver, arrived at with so close an approach to engineering ideals, is capable of operating a loud speaker on signals from fairly distant stations. The volume, however, is somewhat limited for concert and dance purposes. This is partly due to the inadvisability of overloading the first tube which does the double duty of radio- and audio-frequency amplifier. The possibilities of the Roberts receiver may be multiplied, making it ideal for almost every purpose, by the addition of an external audio-frequency amplifier, operated by the output of the reflexed stage.

The author has devoted considerable research to the capabilities of the resistance-coupled amplifier, and the unequaled quality of reproduction and the genuine economy of first cost and maintenance suggest this system as the logical continuation. Likewise, in designing the receiver I am describing in this article, I have endeavored to incorporate various mechanical refinements that are equally justified by the excellence and over-all efficiency of the set.

THE FUNDAMENTAL CIRCUIT

THE fundamental circuit of the Roberts receiver plus two stages of resistance coupled amplification is shown in Fig. 1. This primary arrangement permits a number of variations according to the desires and originality of the individual experimenter. Filament control jacks for inter-stage reception, ballast resistances, and other mechanical facilities can be added to the circuit or dispensed with according to individual desire.

T1 and T2 are radio-frequency couplers. These coils can be purchased, and the experimenter is advised to avail himself of the manufactured inductances rather than attempt the winding of them. However, if desired, the coils may be wound according to the following directions:

The pasteboard or similar winding forms should have an odd number, about 17 spokes, and a first-turn-diameter of $2\frac{1}{4}$ inches. Both secondaries, S, are wound with 44 turns of No. 20 or 22 wire. The secondaries are wound "over three under three." When wiring, the outer or upper lead of S in T1, and the inner lead of the secondary of T2 connect to their respective grids.

The primary, P, of T1 has forty turns of about No. 22 wire, wound over one under one. The primary is tapped at the 2nd, 3rd, 5th,

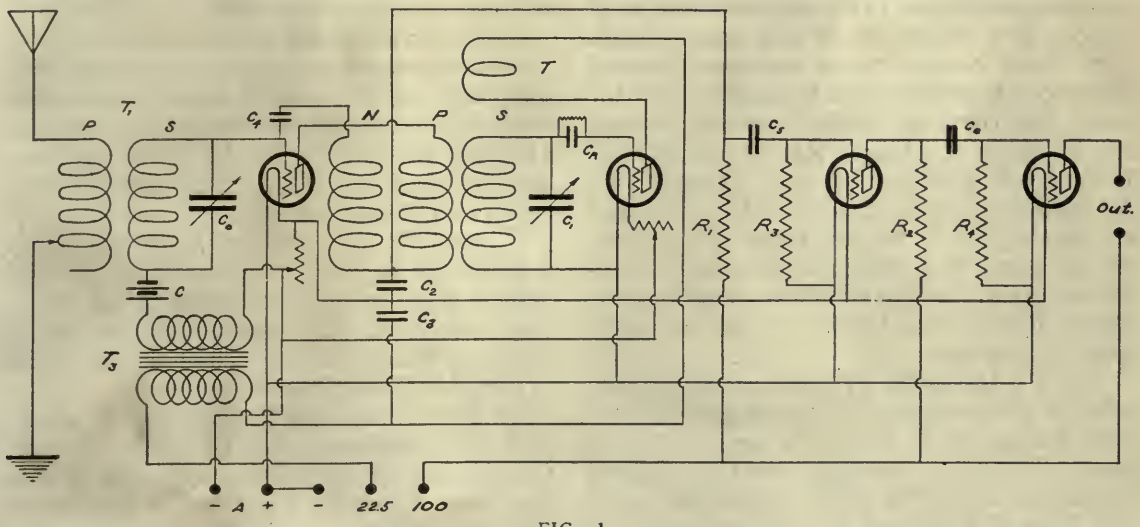


FIG. 1

The fundamental circuit. This is the starting point for readers who desire to express their own originality in the choice and arrangement of filament control jacks, etc.

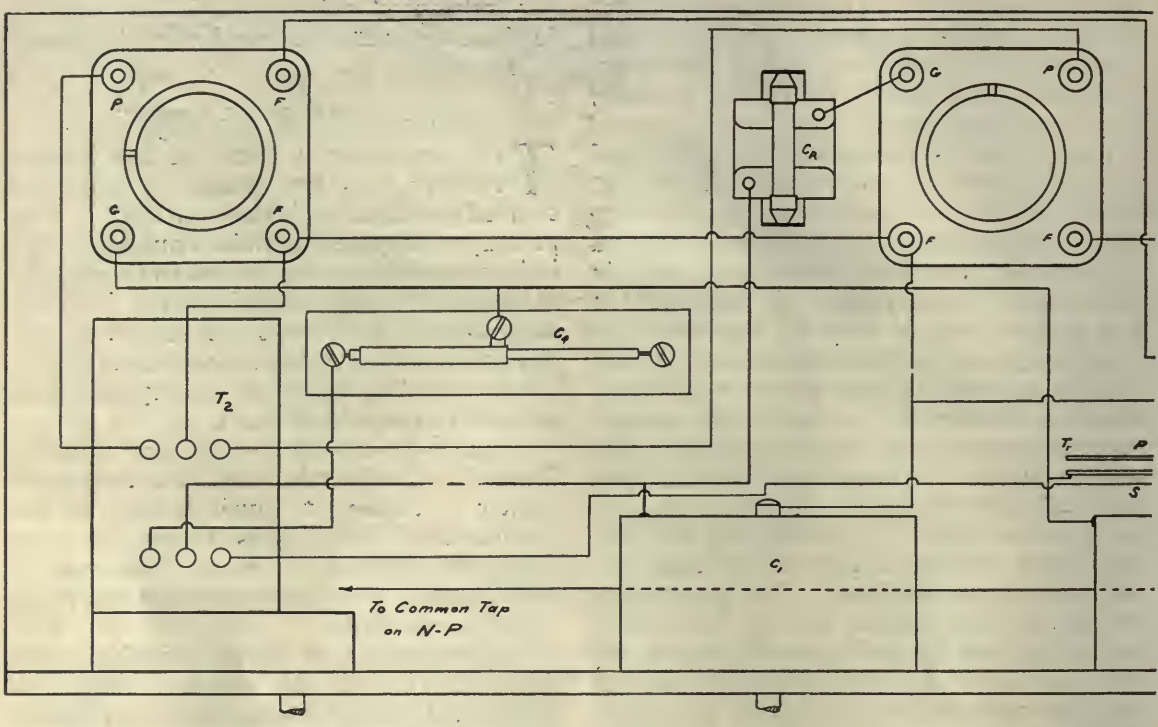


FIG.—
The specific circuit employed by Mr. Bouck. Filaments and amplifi— the tube at the extreme left, is the amplifier and the next one—

10th, 20th, 30th and 40th turns, the ground leading to the switch arm.

Coils N and P, of T2, are wound with 20 turns of No. 26 wire in the following manner: The two wires of sufficient length, or run from separate spools, are wound simultaneously over one under one, to the required number of turns. This will result in two separate coils very closely coupled to one another. The *end* of one coil is connected to the *beginning* of the other, this common terminal running through the coupling resistance, R1, to the plus B battery. The remaining two terminals are led, indiscriminately, one to condenser C4, and one to the plate of the first tube. P functions as the primary of the radio-frequency transformer, and N is the stabilizing winding that makes possible the highly efficient radio-frequency amplifier.

Coil T is the tickler by which regeneration is effected and controlled. This inductance consists of from eleven to twenty turns of No. 26 wire. The correct winding is best determined by experiment. The circuit regenerates properly when it is possible to control regeneration and oscillation over the full tuning range. The author uses a tickler of fifteen turns. It may be necessary (a fifty-fifty chance) to reverse the connections to the tickler.

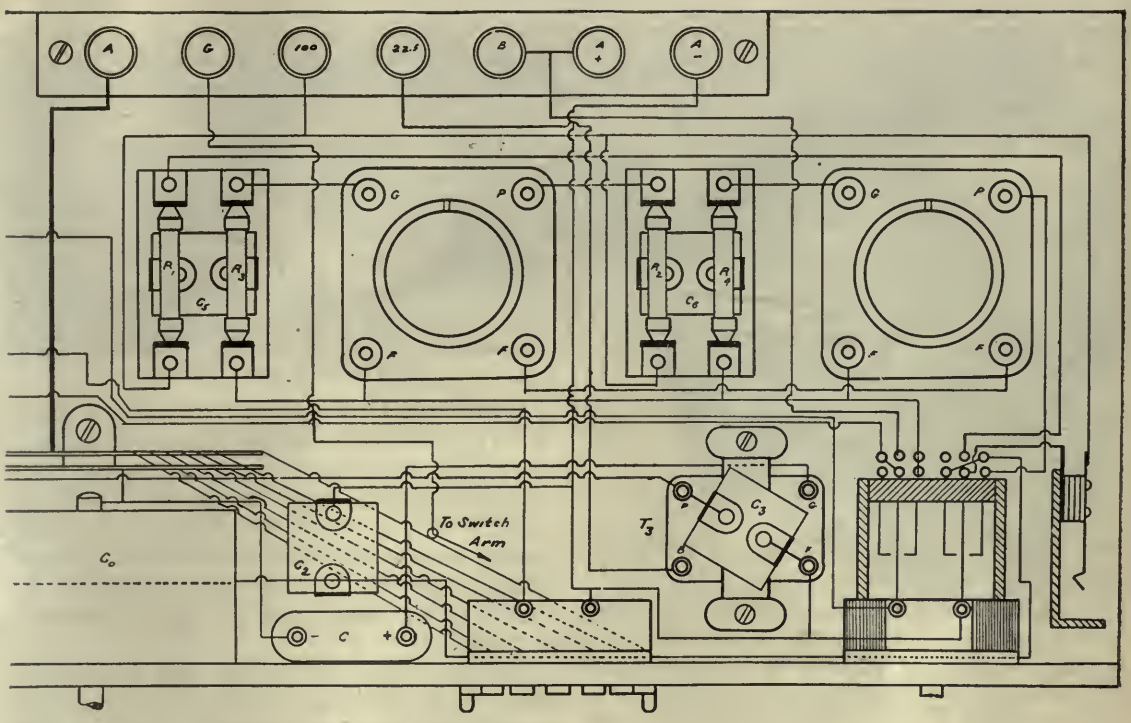
The relative position of the tickler and S of T2 represents the only variable coupling. In both T1 and T2 the primaries and secondaries are mounted concentrically and permanently separated one half inch.

T3 is an audio-frequency amplifying transformer connected according to the initialed terminals. C is a bias battery, negative through to the grid, of from $1\frac{1}{2}$ to 6 volts. This bias potential should be varied and perhaps reversed during the stabilization experiments on the first tube.

C_0 and C1 are .0005 mfd. variable condensers. It is important that they be of a reliable make, capable of attaining this maximum capacity. In wiring, the stationary plates of the condensers should be connected to the grids of the tubes.

C2 and C3 are bypass condensers of about .002 mfd. capacities. For the best control of regeneration, and for the stabilization of the first tube, it may be advisable to experiment with these fixed capacities.

C4 is the neutralizing condenser. This is easily made by winding bare wire over two



—2
—cation are controlled by the anti-capacity switch S. In this drawing,
—is the detector, which is the only change from the photographs

inches of spaghetti tubing, slipping the winding on a bit of bus bar wire left projecting from the grid terminal on the amplifying socket. By adjusting the tube farther on and off the bus bar, the capacity is varied until the tube is properly stabilized—i. e., does not oscillate regardless of condenser C_0 settings and the magnitude of incoming signals.

C5 and C6 are the isolating (or coupling, if you prefer) condensers of the resistance-coupled amplifier, having capacities of .006 mfd.

CR is the grid condenser and shunt grid leak, generally having respective values of .00025 mfd. and 2,000,000 ohms. Again experimentation with other values may improve the regeneration control.

R1 and R2 are the coupling resistors of 100,000 ohms each. R3 and R4 are grid leaks having respective resistances of 250,000 ohms and 50,000 ohms.

The usual open circuit jack is employed for plugging in the output.

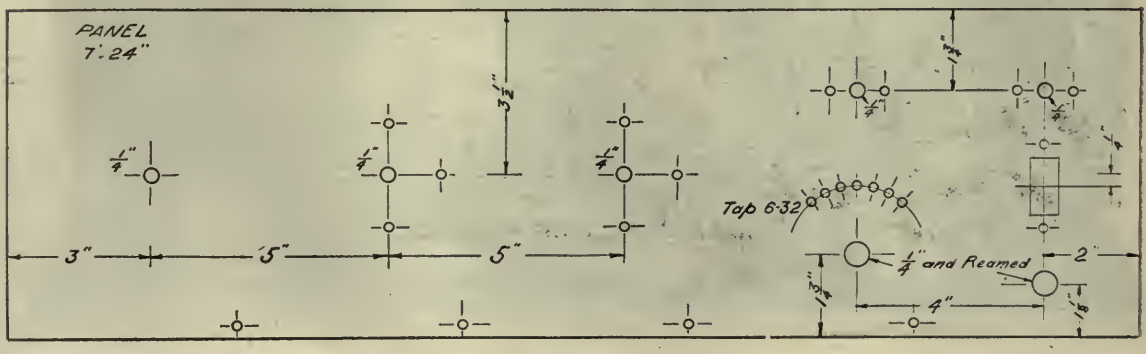


FIG. 3
The panel layout

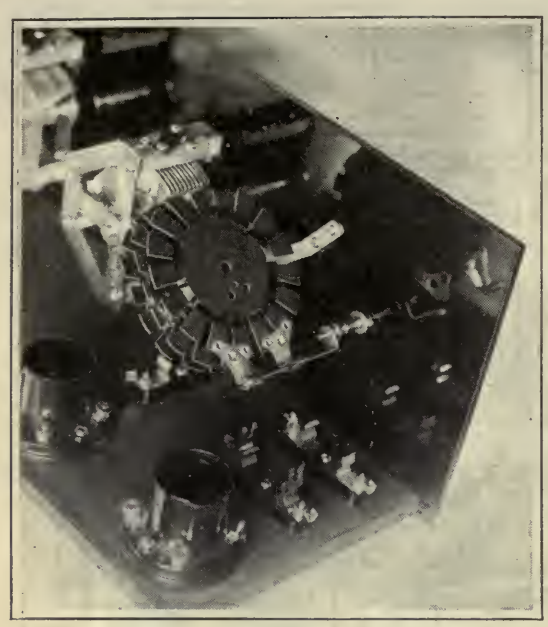


FIG. 4
Showing the manner of mounting T2 and the tickler. The commercial type of inductances have been used. The condenser mountings are also shown

THE SPECIFIC CIRCUIT

FIG. 2 shows the circuit arrangement employed by the writer. The values and constants are in every case those designated in the fundamental circuit.

The current through the amplifying filaments is adjusted by a single ten ohm rheostat and that through the detector filament by a thirty ohm rheostat.

Amplification and filaments are automatically controlled by anti-capacity switch S, which is in effect two double-pole double-throw switches. When the blades are up, the first two tubes (R. F. and detector) are lighted and the output connected in the plate circuit of the reflex tube. In the center position all filaments are "off." When the blades are down (the control handle on the panel up) all tubes are lighted, the external amplifier connected and the output transferred to the plate circuit of the last tube.

MATERIALS AND PARTS

WE HAVE determined to build a truly efficient set, and we can only achieve this end by using the very best of parts. Not an item of inferior material should go into the makeup of the receiver. While the future builder need not confine himself to the trade products selected by the writer, he should be sure that his substitutes are equally efficient and reliable.

The new type Duplex variable condensers, which represent condenser efficiency rarely attained in the commercial product, were used by the author. A vernier action is supplied by Accuratune dials.

Micadon fixed condensers have been employed throughout the circuit excepting in the case of C4. These condensers can be obtained in all the designated capacities, and clip into the Daven mountings which permit the experimental variations advised in the description of the fundamental arrangement.

Five Daven mountings are used—Two condenser mountings for C2 and C3, one combina-

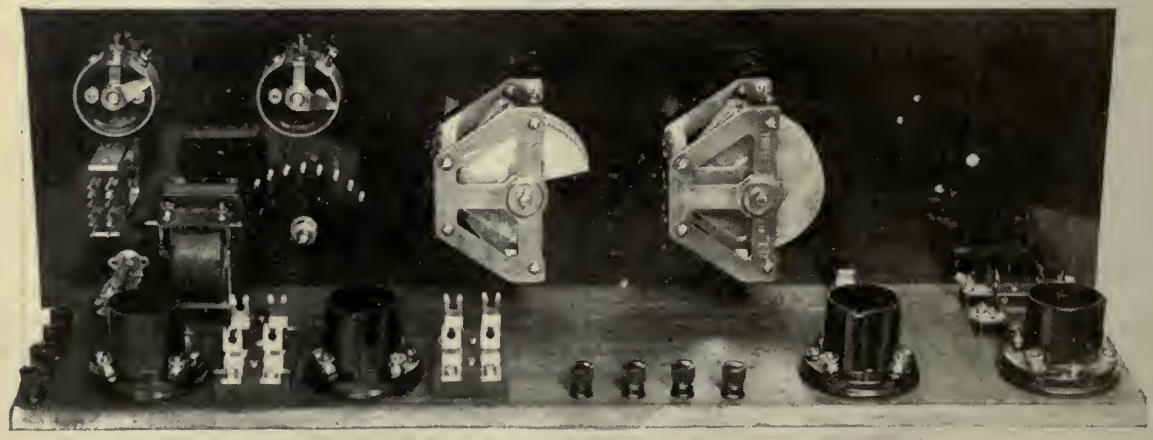


FIG. 5
The skeleton set ready for the first bit of wire and solder. The inductances have been removed, but allowance should be made, when wiring, for the space they will occupy

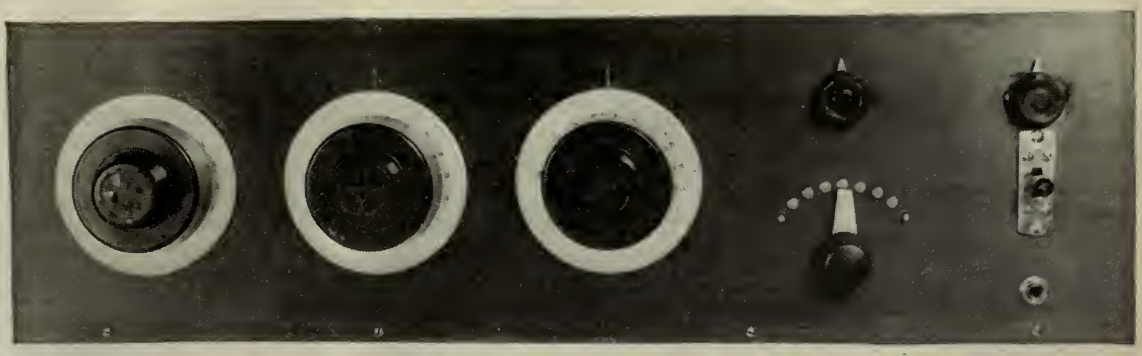


FIG. 6

Front view of the completed receiver. Truly a de luxe appearance worthy of the efficient principles which have been embodied in the design and construction

tion mounting for CR, and two resisto-couplers in the external amplifier. These mountings may be seen in photographs Figs. 4 and 5.

The Daven Improved Coupling Resistors and Daven grid leaks were also employed. These resistances, with the isolating condensers C5 and C6 clip into the resisto-coupler. (Other equally efficient coupling resistances will be found listed in THE R. B. LAB for August.)

The audio-frequency amplifying transformer is an Amertran.

Switch S is a Federal anti-capacity switch, type 1424, made by the Federal Telegraph and Telephone Company. Looking at the back of the switch, the connections should be made exactly as indicated in Fig. 2.

Na-ald sockets and General Radio rheostats maintain efficiency in their respective departments. A Carter jack and Eby binding-posts are the final touch to the deluxe equipment.

CONSTRUCTION

THE first step in building is the drilling and preparation of the panel. Consistent with our determination to use nothing but the best, bakelite is the selected material and is laid out according to Fig. 3.

All holes, excepting those otherwise designated, are drilled to pass a number eight screw. This permits a slight leeway in case of inaccuracy. The holes for the taps are drilled with a No. 35 drill and tapped for a six thirty-two thread. The taps are screwed in, no nuts being necessary behind the panel.

The rectangular hole for the anti-capacity switch is laid out according to the template furnished with the switch. The center of the switch should be $\frac{1}{4}$ inch below the center of the panel. The hole is cut out by drilling with the No. 35 drill and breaking through with a knife. The edges are filed smooth.

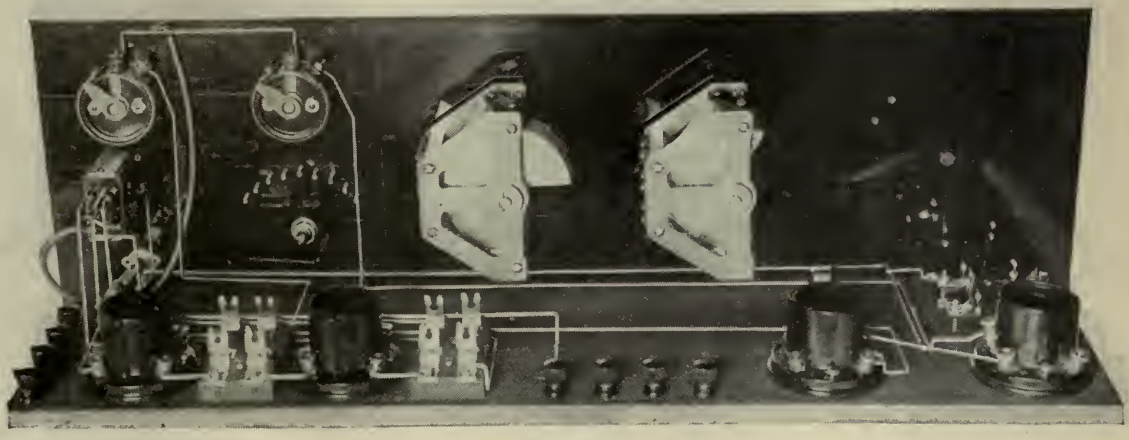


FIG. 7

The job half finished. The filaments, amplifier, and control switches are wired. After testing the filaments, the remainder of the instruments are mounted and wired

After the panel is drilled, it is grained to a beautiful linen finish and oiled. I have described this process in detail in an article on a short-wave receiver appearing in the August issue of RADIO BROADCAST. The line markers for dial settings are engraved with the ordinary square and a scriber. The lines commence one inch below the top of the panel and continue down until covered by the dial. The lines are filled in with white crayon or tailors' chalk.

The dimensions of the base are 21″ x 6″ x ½″. The binding-posts are disposed along the edges as shown in the photographs. The posts in the middle of the board are the A and B battery terminals, and those placed conveniently at the end are for C battery, antenna, and ground. No minus B battery post is provided, for in the author's laboratory the connection is made between the A and B batteries beneath the operating table. The leads from the A and C battery posts and from the antenna and ground posts are run in grooves, beneath the base board, to directly under the instruments to which they connect. This eliminates several feet of awkward exposed wiring, and the binding-posts present a more clean-cut appearance.

The mounting of the coils is a problem that the experimenter can best solve himself. The commercial inductances, though electrically efficient, are not very well designed in respect to mounting mechanics. The close-up in Fig. 4 shows the manner in which the writer has disposed of the fixed windings and variable tickler of T2. T1 presents less of a problem and is easily mounted as suggested in the photographs of the completed receiver.

The first actual work of construction is the joining of panel and base and the mounting of all instruments and parts. The inductances T1 and T2 are then removed and the apparatus, Fig. 5, is ready for the wiring of filaments, control switch and amplifier. As this wiring proceeds, it may be advisable also to remove the audio-frequency transformer, always bearing in mind, however, the positions of the missing instruments and making allowances for them when wiring in their neighborhood.

Fig. 6 shows this wiring completed, and the filaments should be tested before proceeding further. The set is now ready for the permanent mounting of T1, T2 and T3, and the final lap in wiring. Spaghetti insulation should be used sparingly and only when there exists a probable chance of wires touching.

Figs. 7, 8, and 9 are photographs of the finished receiver. Looking at the set from the rear, the tubes from right to left are: detector, R. F. reflex tube, and the two resistance-coupled amplifiers. For the most convenient wiring, the external amplifying sockets are mounted with filament posts toward the panel. The R. F. reflex socket has "P" and plus filament toward the panel, while the detector socket is mounted with minus and grid to the panel.

With a front view, running likewise from right to left, are the amplifier rheostat, the detector rheostat, the C_0 dial, C1 dial and the tickler control.

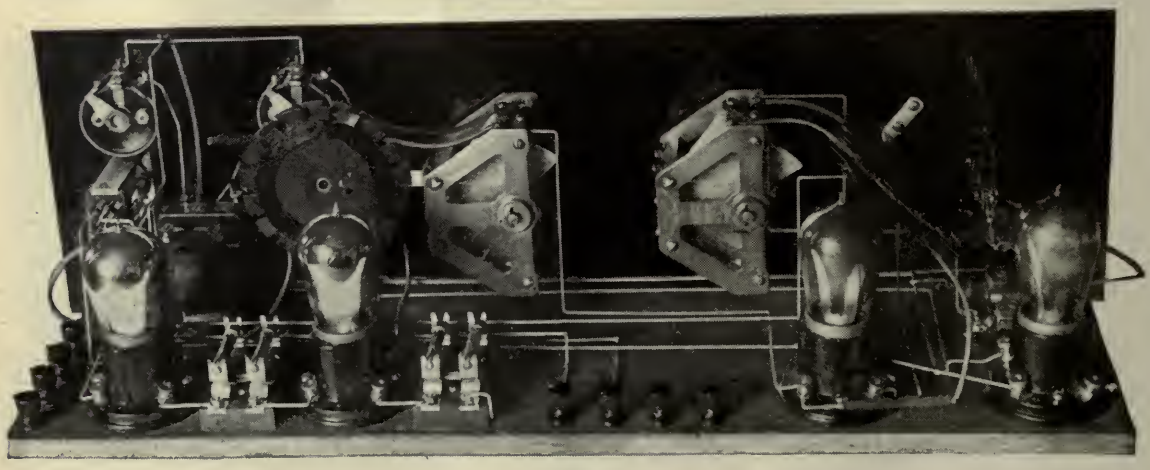


FIG. 8

From the rear. The wiring has been kept close to the base, and several long stretches wired in grooves beneath the base

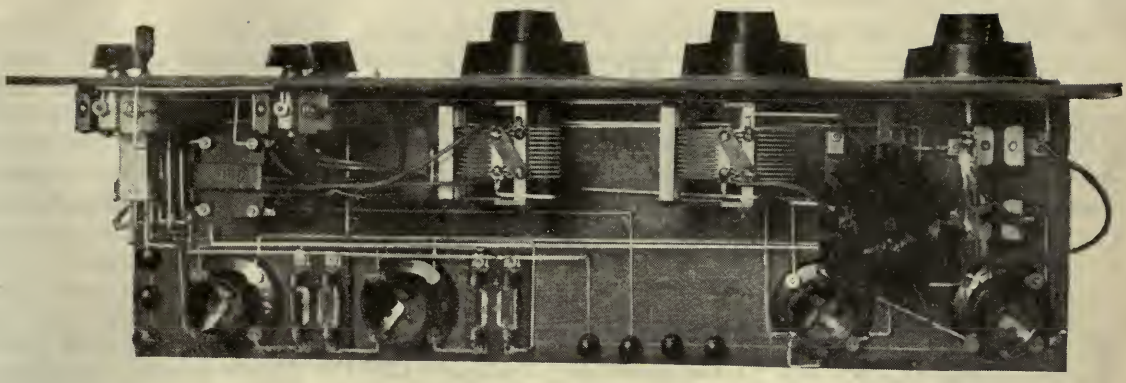


FIG. 9

Top view of the completed set. The positions of the sockets are arranged to permit the shortest possible wiring. The resisto-couplers are shown to the left of the amplifying sockets

OPERATION

THE operation of any receiver is a knack acquired through experience rather than by following any specific instructions. It is, however, possible to point out a few principles which, if followed, may make it easier to acquire this ability.

The preliminary experiments should be those affecting stabilization of the R. F. tube and regeneration. These have been touched upon in our description of the fundamental circuit, and have been treated at greater length in the author's article already mentioned on the short-wave receiver.

The individual detector tube will greatly determine the regeneration adjustments. Any six volt detector-amplifier tube will work satisfactorily. The author uses the UV-201-A in all sockets. The detector plate voltage, the grid leak and grid condenser and the capacity of the bypass condenser C_3 should be varied until the receiver regenerates, and on closer tickler coupling goes into oscillation without squealing at the spilling over point. The circuit should come out of oscillation at the same tickler dial reading as it goes into it.

The actual tuning is quite similar to that of the standard three-circuit regenerator. In receiving different stations, that tap on the antenna inductance should be used which permits the two condensers to "tune alike" or nearly so.

HOWARD S. PYLE has written an interesting story telling of the work and activities of the radio inspectors of the Department of Commerce, those tireless men who are doing their best to keep peace in the radio family. "Shake Hands With the R. I." will appear in an early number.

W H B

The Famous Wireless Station of a Famous Newspaper—A Now-It-Can-Be-Told Story by an Old Timer—Thrilling Days at the New York *Herald* Station, Days when the *Titanic* Sank, and Days when Neutrality was Violated and Thousands of Lives were Saved

By R. ERNEST DUPUY
Captain, Field Artillery, United States Army

LAST winter, sitting cozily in my quarters down at Fort Sill, in the heart of Oklahoma, I heard blizzard-swathed Chicago groping for the outside world. Gripped in the clutches of the most severe storm of years, with land lines down and not a wheel turning, the city was completely cut off until radio took a hand. Even that seemed for a time useless. KYW at Chicago was reaching vainly east and west. Atmospheric conditions, however, were blocking its efforts. Then out from Nebraska came the voice of KFKX at Hastings, acknowledging KYW and working KDKA at Pittsburgh, relaying press dispatches by voice and Morse and clearing Chicago's business both east and west. And, by the way, have you ever heard prettier Morse than that chap at KFKX pounds out?

It was just one of those queer quirks of radio, that blocked direct communication from Chicago either way across the continent but left a clear belt to the southwest and south reaching down to far-off Oklahoma; one of those freaks that give the listener-in a thrill from time to time. And as I heard the voices of the night, conquering space and storm, I began recalling the many other thrills that radio had given me, directly and indirectly, since I first rubbed up against the ether waves in 1909, and began to listen to the heart throbs of the world.

It was at the famous old New York *Herald* radio station at the Battery in New York City that I first made intimate acquaintance with the wireless. WHB—it was really OHX then, as old time radio operators will remember—reposed in a little wooden shack that squatted on the end of the Staten Island ferry slip. I was on the *Herald* then and a short time later was placed on duty at Ship News where from my friendship with the operators at OHX grew the desire for a receiving set of my own, which I soon satisfied. From that time on I have been an amateur, although I never took out a license and never operated a transmitting station.

HOW JAMES GORDON BENNETT USED WIRELESS

FOR the benefit of present day fans I must give some details of the old *Herald* station. The late James Gordon Bennett, owner of the *Herald*, saw the possibilities of radio from the very first. He had a Marconi set installed on the steamship *Grande Duchesse* of the Plant line to report the *Defender-Valkyrie III* races for the *America* Cup, working Sandy Hook. Here was probably the first time that radio was used for newspaper work. Mr. Bennett established a radio station as an adjunct to the *Herald's* renowned Ship News service not long afterward.

Some time prior to my coming on the *Herald*, Mr. Bennett had had a disagreement with Signor

When the Curtain is Drawn—

From past events in radio, which is so full of intensely interesting happenings, it is immensely worth while to stop, look, and read. Newcomers to radio, who are fast learning the lore of telephone broadcasting, should know that history, and extraordinarily interesting history at that, has been made in countless wireless telegraph stations ever since the inception of the art. One of the famous old American wireless stations was WHB, whose musical spark for years crashed out from the tall towers near the ferry terminal at the Battery, New York. WHB sent out press reports, and valuable weather forecasts, and exchanged messages with ships in the North Atlantic, making the name of the New York *Herald* known far and wide. Here is a story of inside history at that station—the crash of the *Titanic*, the wreck of the United Fruiter *Turrialba*, and stirring wartime experiences. You will like it.—THE EDITOR.

Marconi. In 1909, the *Herald* set was a National Electric Signalling Company outfit. Later he switched to the Wireless Specialty Apparatus Company for his set and its 5 kw. spark, sending news and baseball scores, was for many years a comfort to mariners from Nova Scotia to the Caribbean and well out to sea. In fact the station was copied down in South America. Three operators kept a constant watch. The station was hand in glove with the Navy and was on particularly close terms with the Coast Guard, clearing much of their business between the cutters and Coast Guard headquarters in the Barge Office. In 1912, the call letters of the *Herald* station were changed to WHB, and WHB they remained until the station was taken out of our hands by the Navy at the outbreak of war.



© Brown Brothers

THE NEW YORK "HERALD"

Building at Herald Square, New York. Several years ago, the newspaper sold this building to a New York clothing store and moved to another site. It is interesting to note the taxis of an earlier, and perhaps less speedy era. This office was connected to their wireless station at the Battery by a direct wire

From time to time I used to get thrills listening to news of the ships at sea—particularly when the Coast Guard cutters would go out into winter storms on rescue work. They cleared their business through our station and it was understood that the *Herald* was welcome to all matters of news value. When the *Republic* sank, we had our share of interesting messages and the *Titanic* disaster of course kept our station busy. The outbreak of the war in 1914, however, put all those events in the shade. But I must dwell on a few of my most important pre-war radio thrills before going on.

THE HERALD STATION—A RADIO LANDMARK

FOR instance, there was the smash of the *Turrialba* of the United Fruit Company, outside New York harbor, when old WHB handled her business and directed the Coast Guard cutter *Seneca* to the rescue. All the while the rescuers were taking off passengers, we in the radio room of WHB were listening to the bulletins that came flashing in, reporting each move. WHB had always been on good terms with the United Fruit Company, for that organization at the breaking up of the United Wireless Company had refused to take Marconi service and had kept its own independent outfit. Their ships handled traffic with our station usually when they were within range. Those were the happy days when "wildcatting" was the rule and an operator called up any station he desired to give his business to regardless of the International conventions. The only requisite for working was that both stations could hear each other.

Then there was my first radio concert, which took place one Sunday afternoon in 1913, when the Prince of Monaco's yacht *Hirondelle* startled all Manhattan's radio world—a small one then—by sending out music by radio while lying at the New York Yacht Club anchorage in the Hudson river. In his yacht, the Prince had installed a clever arrangement of keys which, when pressed, changed frequencies, and gave him a series of notes whose range was more than an octave. Using this system, he could and did broadcast a number of tunes. This was considered a remarkable performance at the time. The Lackawanna Railroad some time later brought some thrills to amateurs and professionals in radio by sending out phonograph music by means of the "flaming arc" with which the first radiophone experimenters worked.

The first real telephony through the air, however, that had anything practical about it, and that I came in contact with, was the apparatus of a Pennsylvania inventor, whose name I have unfortunately forgotten, who received permission to use our station for some of his experiments through his friendship with the late Howard C. Hillegas, then day city editor of the *Herald*. He installed a transmitting set on board the steamship *Tyler* of the Old Dominion Line and one night, when the *Tyler* was off Hatteras, called WHB. We were tremendously surprised. The skipper of the *Tyler* from his bridge talked to us so loudly that by placing the receiver against the transmitter



THE GERMAN CRUISERS "KARLSRUHE" AND "DRESDEN"

Which were lying off the United States coast in 1914 when war was declared. The *Dresden* is in the upper photograph. Many important messages from these ships were intercepted at the *Herald* station during the early months of the war. A French cruiser and several British cruisers were also off Cape Hatteras at the same time, and much radio drama was enacted between these ships, which was heard by listening commercial and amateur stations in the Eastern United States

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of the land line phone in the receiving office at the Battery, the captain's voice came clear and distinct to our city editor up in Herald Square. This, the first practical demonstration of the value of radio telephony that I have heard of, made a great furore at the time in radio circles.

NOW FOR THE WAR

NOW for the war stuff. From August 1, 1914, until war was declared two days later, the German lines made the most strenuous efforts to warn all their vessels on the high seas that a conflict was imminent. From Sayville, WSL, the big Telefunken station afterward shut down by the Government, went night after night a string of messages to ships of the Hamburg-American and North German Lloyd lines, all of the same tenor:—

WAR IMMINENT; MAKE FOR THE THREE MILE LIMIT

These messages were either in plain English or German, and mixed with them were all sorts of code to passenger steamships, and both code and clear messages to the German cruisers *Karlsruhe* and *Dresden*, which, it will be remembered, were somewhere off our coasts at the time. I copied numberless messages from Sayville to vessels, both merchantmen and warships, those first four nights of August and of them all, I only remember one not addressed to a German. That was to Sir Thomas Lipton's yacht *Erin*, then escorting the *Shamrock* over for the America Cup races, informing her captain of the outbreak of war and instructing him to leave the *Shamrock* and proceed for British waters.

The code that the German vessels were receiving from Sayville at that time was a ten letter affair. For those of our readers who may be interested in code and cipher here is one long one that I caught, to the *Dresden:*—

ADR ADR ADR DE WSL NR I WDS 25 GOVERNMENT BERLIN TO GERMAN CRUISER DRESDEN—WSL— DESAFACADA FRIABARIUM CAROTALECO HISOPIBEAS ASTYPEACUS ALEGGISTA CUCUBEFANO EBUNDALLE ASICADRAC SLAENAJIOR (word missing) IMEPACITY LAPIZAIGNE GLUAPATREZ PUERCEGUDI HOCESANDAM ORMUZOARAN IJORTEMHOF BYPABULANM KATUPATOTE EYUNAPLUS

Some melange of words, what? And a few minutes after this was sent, I caught what I believe was the actual signal that war was declared. The message came with the usual preamble and the call letters of the *Karlsruhe*, followed by the text:—

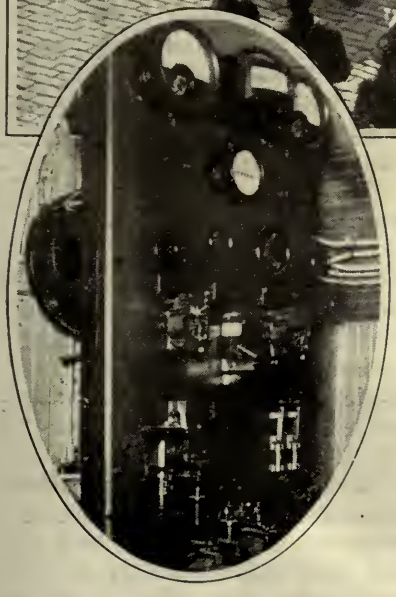
GERMAN CRUISER KARLSRUHE—WSL— SOHN GEBORNEN DEUTSCHLAND MODEL RAMIFOPINO GRYPHABARD

And out of the night in response came the *Karlsruhe's* piping high frequency spark, acknowledging. And that was the last time

that the *Karlsruhe* was heard on any American radio set.

At this time, there were one French and two British cruisers lying in the vicinity of New York. Up until the third of August, they had been carrying on animated conversation, using their regular call letters, and we had become accustomed to the individualities of their sparks. With the outbreak of war they





© Brown Brothers

STATION WHB

The base of the steel tower supporting the antenna can be seen beyond the *Herald* Ship News Office where the operating room was. The inserts show the transmitting panel and the receiving table at this station. As the photographs well show, styles in radio apparatus have changed quite as rapidly as those in men's and women's dress. WHB was of great assistance during the disaster to the *Titanic*, the *Turrialba*, and other marine wrecks. Valuable press and weather information was daily sent out from this historic radio spot

changed their calls, and kept sending streams of messages in a peculiar code that consisted mostly of punctuation marks. The change in call letters meant nothing to the operators who knew their sparks, and in a Sunday special story I wrote at that time about radio and the war, I mentioned this fact and gave the new call letters of the British ships.

About two weeks later, or after that particular number of the *Herald* had had time to get overseas and be digested

in the British War Office, a frantic cable came from our London bureau, stating that the British government was accusing the *Herald* of violating neutrality and was making all sorts of dire threats to our London office. I was called upon the carpet and solemnly told (for the benefit of British officialdom, I imagined,) what a heinous offense I had committed. I gave no more British secrets away. However, I did violate neutrality later on, this time deliberately, and thereby hangs a "now it can be told" story.

HUMANE VIOLATION OF NEUTRALITY

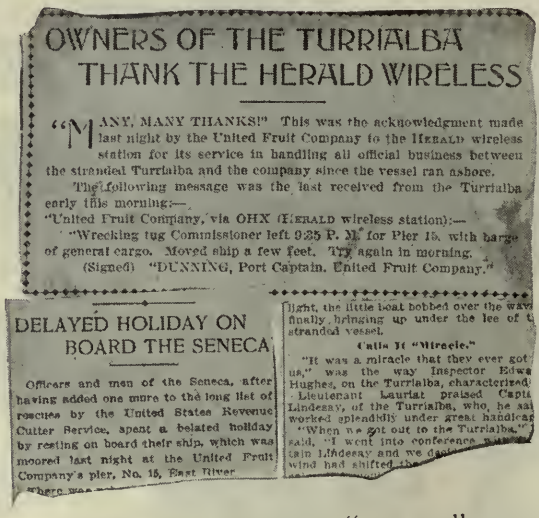
EVERYONE remembers now, shortly before our entry into the war the German *U-53* popped into Newport, Rhode Island, one afternoon, got the latest papers and as promptly popped out again, sinking the next day a number of small craft off Nantucket lightship while American destroyers stood by and rescued her victims. She came into Newport on a Saturday afternoon, a short time after four large passenger steamships—a Cunarder, a White Star, a French liner, and an Italian—had left New York. A glance at the afternoon papers, supplemented doubtless by the reports of spies, gave her captain all the information he needed and so he quietly slipped out again and lay off Nantucket Light waiting patiently for the golden opportunity that would doubtless shower him and his crew with Iron Crosses.

When the *Herald* main office got word from Newport of the arrival of the *U-53* it was telephoned down to the Ship News Bureau as a matter of course and we proceeded to get a local end to the story, which created quite a stir in shipping circles. We were working up the story about the submarine. when over the telephone came word of her departure. There was a horse of another color. I was out in the radio station discussing the U-boat with Morgan Wright, my chief operator, when the flash came. Across the sun-glinting waters of the Battery I could see in my mind's eye four great steamships sinking and their thousands of men, women, and children struggling like drowning rats in a catastrophe that would make the *Lusitania* disaster seem a mere incident. Wright and I looked at each other for an instant.

"Wright," I said; "if WHB sends out news of that U-boat's departure in to-night's press, we will be violating neutrality. Also we will be too late. Let's do it now—the responsibility is mine. Grab your key and send this——

GERMAN U-BOAT ARRIVED NEWPORT THIS AFTERNOON AND LEFT AGAIN AT ONCE. DESTINATION UNKNOWN.

Repeat it every thirty minutes until press time and then send out the full story with your other news." Within a minute WHB's spark was ripping through the ether and, within an hour, as I later learned, the four liners had turned tail and were dashing for Bermuda and safety. And that is why, after waiting fruitlessly all night, the *U-53* had to content herself next morning with one of the Red Cross line boats from Nova Scotia—the *Florizel* as I remember, and some other small fry.



OWNERS OF THE TURRIALBA THANK THE HERALD WIRELESS

"MANY, MANY THANKS!" This was the acknowledgment made last night by the United Fruit Company to the HERALD wireless station for its service in handling all official business between the stranded Turrialba and the company since the vessel ran ashore.

The following message was the last received from the Turrialba early this morning:—

"United Fruit Company, via OHX (HERALD wireless station):—

"Wrecking tug Commissioner left 9.35 P. M. for Pier 15, with barge of general cargo. Moved ship a few feet. Try again in morning.

(Signed) "DUNNING, Port Captain, United Fruit Company."

DELAYED HOLIDAY ON BOARD THE SENECA

Officers and men of the Seneca, after having added one more to the long list of rescues by the United States Revenue Cutter Service, spent a belated holiday by resting on board their ship, which was moored last night at the United Fruit Company's pier, No. 15, East River

light, the little boat bobbed over the wav finally bringing up under the lee of t stranded vessel.

Calls It "Miracle."

"It was a miracle that they ever got us," was the way Inspector Edwa Hughes, on the Turrialba, characterized Lieutenant Laurlat praised Capta Lindesay, of the Turrialba, who, he sai worked splendidly under great handicap "When we got out to the Turrialba," said, "I went into conference with tain Lindesay and we decided the wind had shifted [illegible]

FROM THE NEW YORK "HERALD"

Of Thursday, December 26, 1912. OHX was the call of the *Herald* station before the international conference which allotted call letters to the stations of every nation signatory to the conference. All the official business of the wreck of the *Turrialba* was handled by the *Herald* station

NEW YORK HERALD VS. UNITED STATES NAVY

SO MUCH for the actual happening. Now for the aftermath. I said nothing about the incident at the main office, for I enjoyed at the time the position peculiar for a *Herald* man of being responsible to no one but Mr. Bennett himself. In my department I was supreme. In a few days came word from the uptown office that I was wanted. I went up and found dear old Commander J. D. Jerrold Kelley, U.S.N., Mr. Bennett's crony and advisor on matters maritime—now dead like his old

friend—and with him was a gentleman whom Commander Kelley introduced as the director of naval radio communications. He broke the news to me that the *Herald* had violated neutrality by sending out word of the departure of the *U-53* and announced that Mr. Secretary Daniels had decided that he would close up the *Herald* radio station unless we should show cause why he shouldn't. I told the naval officer I would inform Mr. Bennett, who was in town at the time, of Mr. Daniels' decision. Pending definite action he said that it had been decided to place an officer on duty at WHB as a censor, to which of course I could only agree.

I went to Mr. Bennett at once and told him the whole story, at the same time placing my resignation in his hands. He said:——

"Nothing has been printed about this, has it?"

"No, sir."

"Good. Print the whole story, with Mr. Daniels' decision, and we will let the American people judge for themselves. That's been good work, Dupuy; you did exactly what I should have desired had I known it."

Naturally I felt much relieved, for one could never know just what views Mr. Bennett would take. After all, the fact was that one of his employees embroiled the *Herald* in an official altercation.

The *Herald* played up the story the next morning for all it was worth. And, in the meantime, I had a hunch. Our operators, I found out, had been so busy that eventful night that they had omitted to copy Arlington's nine o'clock press—a matter of usual routine with WHB. I went to the Marconi Wireless Telegraph Company of America. It was only a few months previous that I had urged Mr. Bennett to drop his feud with Signor Marconi and I had shown the Marconi Company in turn that the *Herald* could provide them with a better news service than that they had been getting, with the result that in consideration of the *Herald's* installing a Marconi set at WHB I obtained the furnishing of news service to the Marconi company. This put New York *Herald* news on Marconi vessels all over the world through our own station and the Marconi stations at Cape Cod and San Francisco. So I felt that I could enlist their help.

I asked Mr. David Sarnoff if he would obtain the radio logs of all Marconi stations, ashore and afloat that he could gather within the next few days and find out from them if NAA, the naval station at Arlington, had made any mention of the *U-53*'s departure. Within a week he had the information for me. That very Saturday night NAA had sent out the news of the U-boat—too late for it to have done any good to any allied vessels. But this news was sent out within twenty-four hours of its occurring which is expressly prohibited by the laws of neutrality. The next morning in a spread story the *Herald* announced that while Mr. Daniels was so busy regulating others, one of his own chief stations had been violating neutrality. The source of the information was not, however, made public.



—United Fruit Company

THE SS. "TURRIALBA"

Of the United Fruit Company. The New York *Herald* wireless station WHB was practically responsible for saving this ship and her passengers when she was wrecked in December, 1912

OFFICIAL FEARS AND THREATS IN WASHINGTON

BEFORE ten o'clock that morning, Washington had me on the long distance telephone. It was the director of naval radio communications. He informed me that the *Herald* had libelled the Navy Department in asserting that it had violated neutrality, adding that Mr. Daniels would immediately have an order issued closing WHB so tight that it would never open again. I asked him if a careful check had been made of Arlington's business that night and he replied that he personally had inspected the station records and that neither in the press nor in any other message was there any mention made of the *U-53*.

"Well, Commander," said I, "suppose I make a bargain with you. A bargain, mind

you, not a threat. Close us up, and the New York *Herald* will publish immediately the affidavits of approximately one hundred radio operators on duty at ship and shore stations within range of NAA all affirming that NAA in its evening press that night mentioned the arrival at and departure from Newport of the *U-53*."

"Where could you get any such information?"

"Well, Commander, if I told you that you would be as wise as I am. But nevertheless it's true, and so sure as you close us up, so surely will I run the story. On the other hand, if the Navy and Mr. Secretary Daniels forget all about closing our station, the *Herald* will accept the censorship and will forget all about the story of the Navy Department violating neutrality. How about it?"

There was a silence on the line for so long that I began to think that Washington had rung off. And then:

"All right: that's a bargain."

And the incident was closed. WHB continued in service until at last the Navy took over all radio upon the outbreak of war.

I do not want my readers to gather from this that I am insinuating that the Navy Department, either directly or indirectly, was countenancing a violation of neutrality. Far from it. What had happened, of course, was that someone at NAA had slipped that message into the press stuff that night against orders, either in ignorance or more probably from motives similar to mine, and had left no record, so that when they investigated the *Herald's* story from that end, Arlington had, seemingly, a clean bill. Had the *Herald* pushed the matter and published affidavits, however, the affair would have been so embarrassing to official circles that common sense dictated an immediate compromise, particularly as the damage was already done and the censorship of our station by a naval officer would be a sure preventive of any further trouble.

PLENTY OF ROMANCE STILL IN RADIO

LIKE most other amateurs in the vicinity of New York I watched WSL, the Telefuncken station at Sayville. So did WHB. Sayville was sending continually code messages to Nauen. Even after the closing by the Navy Department of the Goldschmidt transatlantic station at Tuckerton, New Jersey, for violating neutrality, Sayville continued its work, sending now to Cartagena, Colombia, whence the messages were doubtless flashed to Berlin. This code, as I remember was now a fifteen letter affair. At last, however, through the efforts of amateurs and government agents all listening-in Sayville was caught and closed down. It was during this period that the Providence *Journal* made its sensational news beats in revealing German activities here and radio had a great deal to do with this. From the nightly messages sent by Sayville some cipher expert discovered the Boche code and from the threads thus revealed clever detectives made short work of the rest.

I have often thought of those old days of radio, while listening in to the present routine of broadcasting, and wondered if the romance had gone out of the air. After the *Shenandoah's* night adventure, however, when that storm-tossed airship was guided to safety by radiophone, and after my own experience in hearing a storm-bound city telling its plight and linking itself to the world again through the devious channels of the ether, I have decided that the romance is still there for those who search for it.

How Radio Times Have Changed

THE article which appears below is taken from the New York *Herald* of December 26, 1912. That issue of the *Herald* was full of photographs of the survivors of the disaster to the United Fruit liner *Turrialba* and many news stories dealing with the wreck. The *Herald* station WHB, as Captain Dupuy's story brings out, had much to do with saving her passengers by radio.

This news story is especially interesting, because it shows how radio conditions have changed since "the law of 1912" (as it is always referred to now), went into effect. Especially have conditions with regard to amateur operators changed. With the formation of the American Radio Relay League, that excellently organized and managed association of amateur radio operators, the amateur has come to be

considered by those who know, as a sturdy aid to radio development. Where there have been radio difficulties, the amateur, organized as he now is, has never failed to offer his help.

While the present radio laws are generally agreed to be by no means adequate to fit the present radio situation, those that have been in force since the unsettled days of 1912 and before, have indeed been effective in curbing many of the abuses that undoubtedly obtained during the unregulated period.—THE EDITOR.

HERALD WIRELESS AIDS THE "TURRIALBA"

Irresponsible amateur wireless operators, the bane of the commercial stations on all similar occasions, interfered materially with the wireless work between the *Turrialba* and the shore stations. All Tuesday afternoon and night the amateurs kept the air filled with their messages, sometimes trying to call the *Turrialba* and at others "jamming" the stations attempting to work by sending messages to each other.

The *Herald* wireless station cleared the *Turrialba* business, handling all messages between the wrecked vessel and the company's offices. The operators were severely handicapped by the interference of the amateurs, finding it extremely hard at times to do their work. The station at the New York navy yard also suffered by the interference of amateurs.

Since the invention of the wireless, stations attempting to work with disabled vessels have always been bothered more or less by these pirates of the air, some of whom seem to jam the air out of malicious mischievousness. This was in evidence more than ever in the *Turrialba's* case, and all of that certain clique of amateurs who bother the commercial stations about New York City were heard at work both Tuesday and last night. So bad was the interference on Tuesday, that the New York Navy station was for three hours absolutely unable to read one connected message from the disabled ship.

Under the new wireless law, which went into effect December 13, all amateur wireless stations are limited to a wavelength of 200 meters. A number of amateurs in the neighborhood of the city, who have high powered stations, have made no attempt to comply with the law, and some of them have not applied for the license, which under the law is necessary to operate a station.

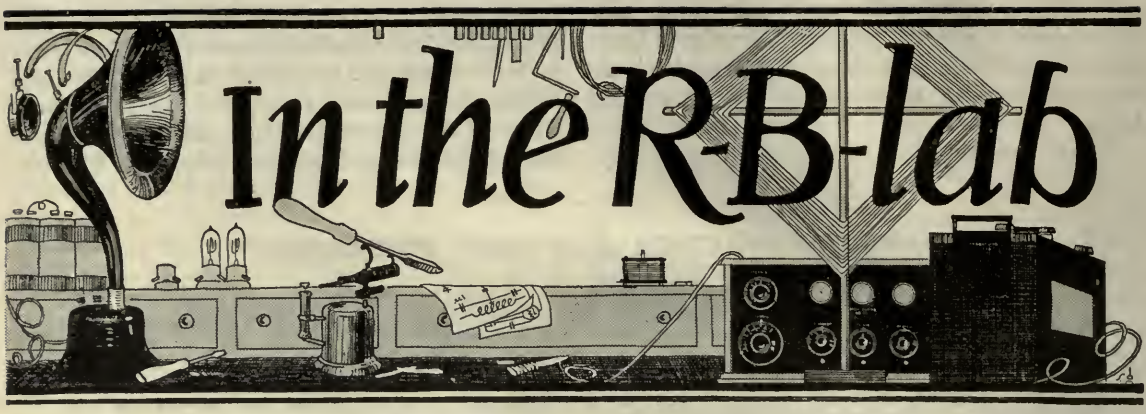
W. D. Terrell, radio inspector of the New York district, as soon as the news of the disaster to the *Turrialba* became known, sent out a wireless warning to all stations, notifying amateurs to keep out entirely and commercial stations to minimize all business as far as possible until all matters connected with the steamship were cleared up. A number of amateurs paid absolutely no attention to Mr. Terrell's warning.

Mr. Abrahams, radio operator of the *Seneca*, when the revenue cutter landed here last night, said, concerning the interference, "While we were alongside the *Turrialba*, and all Tuesday night, I could hear several amateurs who have high power stations, blocking the transmission of messages between the steamship and the shore, and by the manner in which the shore messages came out to us I could tell that they were being seriously bothered at the New York end.

Officers of the *Seneca* said that the interference reminded them of the occasion that started the lesiglation against amateurs. On Christmas night, 1909, the *Seneca* was lying in Boston harbor with a fierce northeast gale raging outside. Suddenly a call was received stating that two vessels had just been in collision and asking for help. The message said that the ships were some distance outside. The *Seneca* at once started to get under way in the teeth of the gale when the Boston navy yard station called them, saying that the operator there knew the spark, which was that of an amateur in the city. This is only one of the many occasions when the SOS call for help has been used by an amateur with deliberate maliciousness.

—New York *Herald*
December 26, 1912

MANUFACTURERS of radio supplies are working hard to standardize their equipment. In an early number of RADIO BROADCAST an article by G. Y. Allen will appear, telling of the color standardization of cords used in radio connections. It will be illustrated with complete plates showing the cords and their distinctive colors.



DESIGNING SMALL TRANSFORMERS

THERE are many instances where the work of the experimenter and fan would be greatly facilitated were it within his capability to design and build or rebuild small transformers. The transformer is an important laboratory adjunct. It operates only from a current that provides the fluctuating magnetic field that is necessary for its functioning. A step-up transformer has an output potential in excess of the line voltage from which it is operated. Such transformers are used to supply high potentials for spark transmission, high voltages for C. W. sets, receiving plate-voltages through rectification, and for charging storage B batteries in high voltage groups. The step-down transformer gives a reduced potential which has wide use for A and B battery charging, bell ringing, and filament lighting. It is not very difficult to build a transformer for any of these purposes, or to redesign and alter a transformer, adapting it to a purpose other than that for which it was originally made.

The usual transformer consists of two windings, a primary and a secondary wound on a core. Fig. 1 shows the manner of building up a "core-type" core from strips of magnetic metal. This is the most practical design of small transformers for the home construction. The voltage of the secondary varies directly with the ratio of the number of secondary turns over the number of primary turns. If the secondary has twice as many turns as the primary, its voltage will be double that applied to the latter winding. Stated in a formula, the required number of secondary turns for a desired voltage will always equal $\frac{Np \times Es}{Ep}$, where Np is the number of primary turns, Es the desired secondary voltage, and Ep the voltage of the primary.

Considering that the characteristics of the secondary will be determined by the number of turns on the transformer primary, the logical first consideration in transformer design is to determine the proper number of turns for the primary.

It can be demonstrated that a transformer operates most efficiently when the counter e.m.f. built up in the primary is equal (practically) to the applied voltage. That is, for the most efficient operation of a transformer from a 110 volt line, the primary

What the Lab Offers You This Month

—How to design and build small iron-core transformers. A simple formula for calculating the design of windings and complete instructions on building the unit which may be used in numberless ways around the amateur laboratory.

—How to build an adapter for small radio tubes, especially the Western Electric N *and the Radio Corporation* UV-199 *types.*

—A simple method for winding and counting multi-layer coils.

How to build an impromptu rectifier, which can be used on 110 volt lines, passing about $\frac{1}{10}$ ampere when charging a 45 volt B battery.

—Suggestions for building your own laboratory.

Helpful hints on radio construction and operating.

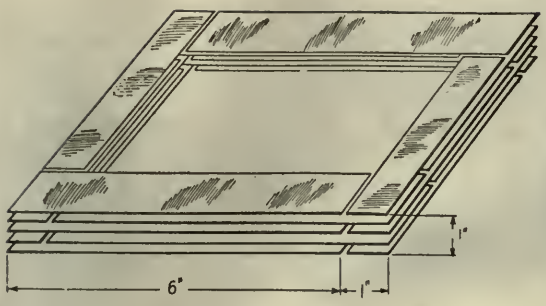


FIG. 1
The simplest way of building up a core for small transformers

winding should be such that the counter e.m.f. will also be 110 volts. Therefore, regardless of the size, and use to which the transformer will be put, the primary should always have sufficient turns to fulfill this condition.

Various considerations determine this correct amount of winding—such as the voltage, the quality of core iron or steel (the flux density) and the frequency of the current. It is all summed up in the formula—

$$N = \frac{100{,}000{,}000 \times E}{4.44 \times F \times B \times A}$$

N equals the correct number of primary turns. E is the applied voltage (usually 110). F is the frequency of the supply line (generally 60 cycles, but quite often 25 and 40 cycles). A is the cross section area of the core in square inches (the width of the winding leg times the height). B is the flux density of the core material and is measured in maxwells or lines of force per square inch. This last will vary with different grades of steel and iron. Ordinary sheet iron may be calculated as having a flux density of 33,000 lines; transformer steel, 40,000; and the flux density of some special magnetic grades between 40,000 and 50,000. If you are rebuilding a commercial transformer, you may assume a flux density of 40,000 lines.

At first glance, this may all seem rather involved. However, familiarity will show it to be quite simple. The formulas are easily applied. Let us assume that the experimenter desires to build a step up transformer for use with an S tube rectifier and filter as a B battery substitute. A maximum plate voltage of 200 is desired. Allowing for a drop of 200 volts across the rectifier and filter system, we shall need a transformer delivering 400 volts from the secondary. The transformer will be operated from a 110 volt, 60 cycle source. The experimenter now has several fundamental facts with which to work. They are:

EP = 110
F = 60
ES = 400

We shall assume that the experimenter has secured a commercially built core of adequate size. It is built up of steel strips two inches wide, to a height of two inches. This provides us with two additional facts, i.e.:

A = four square inches (2 x 2).
B = 40,000

We are now ready to substitute in the formula for N. Doing so, we have:

$N = \frac{100{,}000{,}000 \times 110}{4.44 \times F \times 40{,}000 \times 4} = 258$ turns of wire.

This is the correct number of primary turns, or NP, and we may now substitute in the formula for the number of secondary turns, as follows:

$$Ns = \frac{Np \times Es}{Ep} = \frac{258 \times 400}{110} = 938$$

The sizes of the wires are not considered in these calculations. They are determined by the current they must carry. In the case of the transformer we are designing, the primary should be capable of passing 1.2 amperes continuously without undue heating. The secondary should be similarly capable of delivering 50 milliamperes. The primary and secondary windings should be wound respectively with No. 20 and No. 32 wires. Larger sizes may, of course, be used, but they are unnecessary and add to bulk and expense.

Transformers must be adequately insulated for the potentials which they must withstand. This applies equally to the separation of the

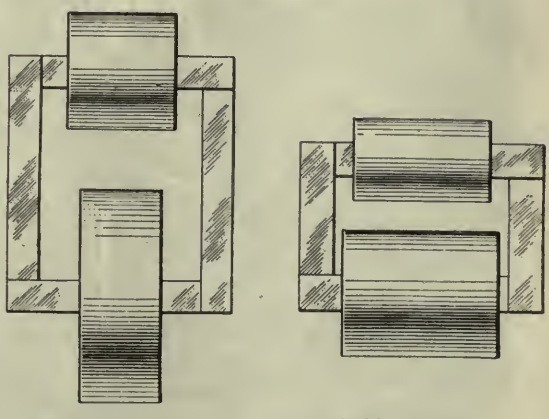


FIG. 2
Showing inefficient and good transformer designs. Utilize all the practically available winding space

individual windings and the insulation of the windings from the core.

Long narrow cores should be avoided. They result in magnetic leakage and attenuation of the magnetic field. The winding legs of the core should be separated only far enough to provide sufficient space for the windings. The coils should be low and long rather than high and short. Fig. 2 shows a good and a bad example of transformer construction. Where it is convenient, the secondary may be wound over the primary with increased efficiency. In the case of two secondaries, such as the filament lighting and charging secondaries on a battery charger, the secondary delivering the highest current should be wound over the primary. However, if it is more convenient, both secondaries may be wound on the leg opposite to the primary.

The primary and secondaries should be wound on forms that will fit closely over the core which is built up inside of the windings. When the four sides of the core have been fitted together, the iron strips should be clamped firmly, eliminating leakage and vibration, and at the same time permitting convenient mounting, such as suggested in Fig. 3.



FIG. 4
The peanut tube ready for remounting—and the finished article

AN ADAPTER FOR PEANUT TUBES

A VERY efficient and inexpensive adapter for small bulbs, such as the Western Electric N and the UV-199 tubes, fitting them into the standard six volt sockets, can be made from the bases of discarded tubes.

The burnt out or otherwise inoperative standard socket tube is broken open and the elements, glass, and cement cleaned away. The wires are removed from the base by heating the plugs with a soldering iron and pulling out the leads. The plugs, as the experimenter will observe, are small brass tubes, which should be cleaned of obstructing solder by inserting a pin while hot.

The tube is prepared for its auxiliary mounting by soldering three inch leads of approximately No. 22 wire to its own plugs. A pasteboard washer, with four holes punched in it, is slipped over the leads and pushed flat against the base of the peanut tube. The leads are then threaded down through the plugs of the large base, and the small bulb pulled up firmly into the adapter. The leads are bent over the plugs and secured with a drop of solder on the tip of each. The surplus wire is clipped.

It is, of course, necessary to run the leads from the base

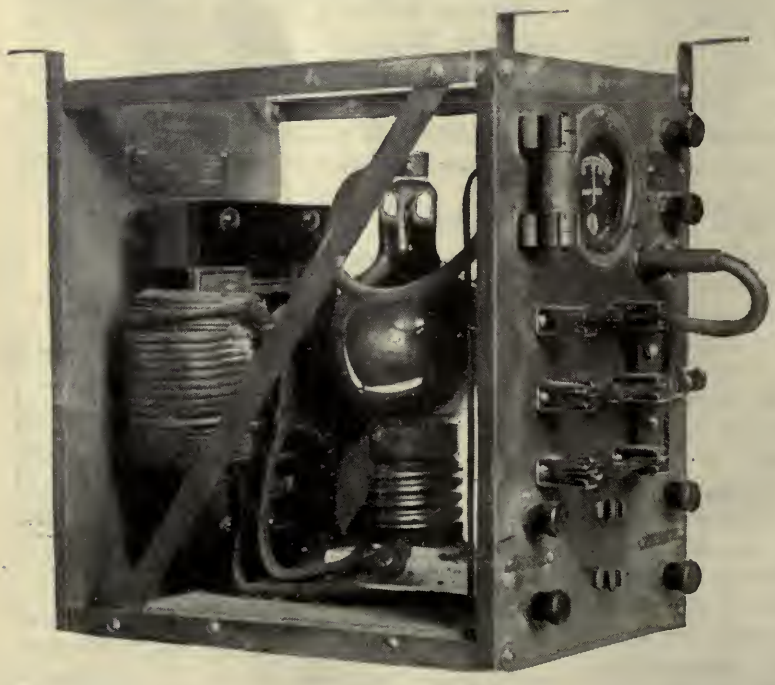


FIG. 3
A completed transformer clamped and mounted

of the tube to the corresponding connecting plugs on the exterior base. This presents no difficulty in the case of the Western Electric N tube, the base connections of which, in respect to the pin, are the same as those of Shaw base bulbs. The UV-199, however, is a different proposition, and care must be taken to effect the correct connections.

Look at the base of the UV-199, or the Cunningham C-299, with the pin up or "north." The minus filament will then be in the upper left, the plate plug in the upper right, the plus filament in the lower right, and the grid, of course, at the lower left.

A large pasteboard washer should be cut that will fit over the tube and slip snugly inside of the large base, a sixteenth of an inch or so below the top. A rim of sealing-wax is melted around the edge, finishing the job firmly and neatly.

Figure 4 shows an N tube in different stages of remounting.

WINDING AND COUNTING MULTI-LAYER COILS

THE older experimenters whose radio experiences date back to pre-broadcasting days are acquainted with the ingenious devices of the amateur operator-builder. Many of these arrangements are being rediscovered and applied by the broadcast enthusiasts, and the amateurs' method of winding multi-layer coils will appeal particularly to the fan making his own transformers for the intermediate amplifier in a super-heterodyne receiver. The mechanical and electrical data on these transformers will be found in the April number in the Laboratory Department.

Fig. 5 shows the arrangement used by Mr. Leslie Brand, a reader of RADIO BROADCAST, for winding these coils, that dates back to the days when broadcasting was little more than a dream in the minds of Fessenden and De Forest. Mr. Brand employs a Yankee hand-drill, having a ratio of one hundred chuck turns, to thirty turns of the crank. Any other make of drill may, of course, be used with equal success.

The winding form should be designed to facilitate this semi-manual winding. The bakelite, rubber or cardboard end pieces are fastened to the spool with a nut and long bolt projecting far enough through the spool to permit firm clamping by the drill chuck.

It is not necessary to use two vises. The experimenter may secure the spool of wire in any manner his ingenuity suggests, providing it revolves free and smoothly.

The turns of the crank are counted. If,

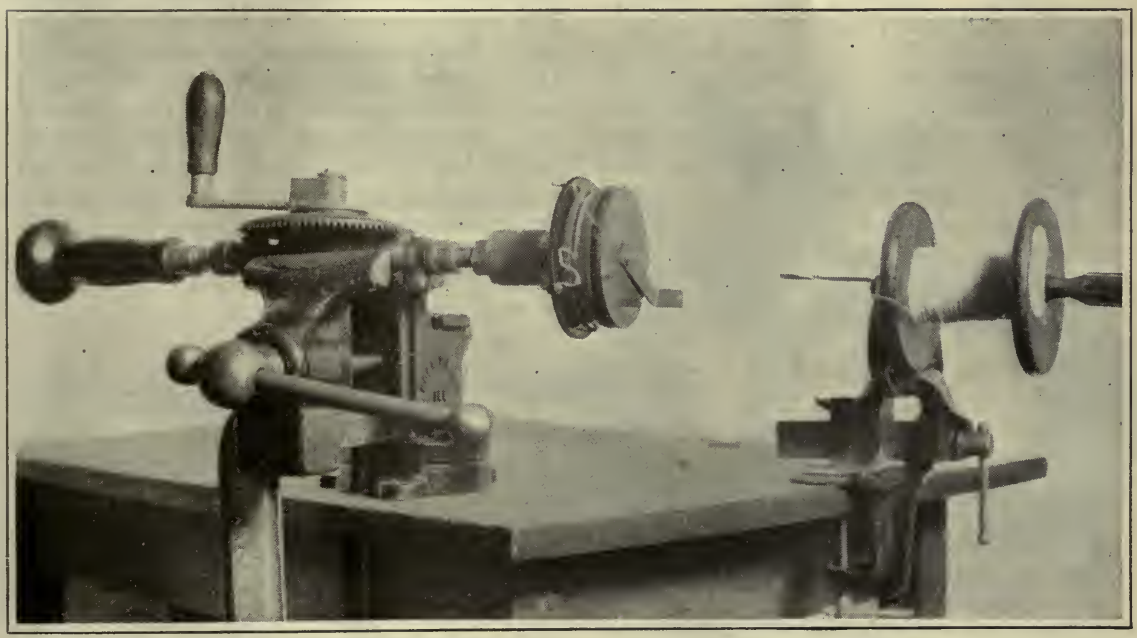


FIG. 5

A handy arrangement for winding and counting the turns in choke coils and transformers



FIG. 6

An electrolytic rectifier that can be built up in a few minutes. It costs only a quarter or two and some time may help you out

using the Yankee hand-drill, it is desired to wind one thousand turns of wire, the crank is turned three hundred times. While it is possible to wind and count at the same time, it is better to call in the services of a friend for counting. This promotes accuracy, swiftness, and permits the operator to devote his attention to a neat and painstaking job.

AN IMPROMPTU RECTIFIER

THERE are many occasions when the experimenter-fan will find use for a rectifier that can be made up quickly and inexpensively. The use of a single charger for A and B batteries and the simultaneous discharge of both sources of power, is one of the several causes giving rise to this necessity. The materials for an emergency rectifier are readily found in the average lab and home. The following will be needed:

1 marmalade or similar jar. (A drinking glass will do.)

A small strip of lead (about one inch by four inches).

1 foot of aluminum wire—or a six inch strip of sheet aluminum.

A package of "20 Mule Team Borax."

The jar is three quarters filled with hot water, and as much borax dissolved as the water will take up—more technically, a saturated solution. If the borax is not at hand, your druggist will make you up fifty cents worth of ammonium phosphate—which is a cleaner and slightly more efficient electrolyte.

The electrodes are the lead strip and aluminum wire. If the sheet aluminum is the more easily obtainable, a very narrow piece corresponding in cross section to a No. 14 wire, should be cut from it. The wire is more satisfactory than the usual sheet electrode which requires a comparatively long time for forming, whereas the wire electrode rectifies immediately. The wire should be sandpapered clean. Both elements are immersed about three inches in the solution.

The rectifier is operated from the 110 volt lines, being connected in series with an electric light bulb (preferably 100 watts) and the load—generally a B battery under charge. The aluminum electrode (positive terminal) should be connected to the plus side of the storage B battery, as per the connections in Fig. 7. This rectifier will pass in the neighborhood of one tenth ampere when charging a 45 volt battery. It cannot be used for charging A batteries.

AMMETERS FOR PULSATING CHARGING CURRENTS

ON PAGE 231 of Radio Broadcast for July, appears a photographic comparison of a hot-wire meter with a Jewell D.C. meter. The caption beneath the illustration unfortunately implied to some of our readers that the D.C. meter was an inaccurate instrument. Such is not the case, the D.C. meter in the photograph being a precision instrument manufactured by a very reliable concern which has specialized for many years in electrical measuring appliances.

As stated in the article in question, the D.C. meter is to be preferred to the A.C. instrument in charging circuits.

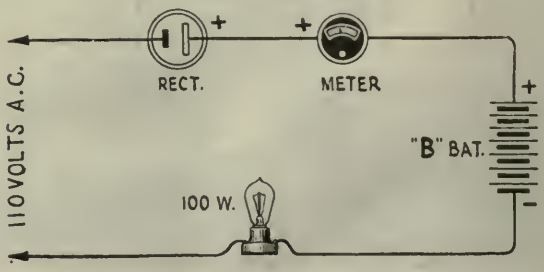


FIG. 7

The circuit for the rectifier. The aluminum electrode is the positive terminal



FIG. 8
The scriber—an indispensable instrument in markihg and engraving your panel

BUILDING YOUR OWN LAB

OUR October suggestions for the growing laboratory are inexpensive, and so we are prodigal in our recommendation of *two* purchases. They are pictured in Figs. 8 and 9. Fig. 8 is a scriber for which there is no satisfactory substitute in laying out a panel. One end of the scriber is bent at right angles to its length to facilitate marking in tight places. The scriber sells for forty-five cents.

Fig. 9 is a screw clamp—an auxiliary vise that is held in a standard vise. It is designed to hold No. 6, 8 and 10 screws with 32 threads to an inch—the sizes most used in radio construction. It is impossible to clamp machine screws for filing and cutting in an ordinary vise without injuring the thread.

The jaws of the special vise are hardened and may be used for rethreading the screws after filing or sawing. The price of the screw clamp is $1.50.

Both tools are made by the Stevens Company, New York City.

HELPFUL HINTS ON BUILDING AND OPERATING

NO C BATTERIES are required in the conventional resistance-coupled amplifier circuit such as described in various numbers of RADIO BROADCAST. The functioning of the resistance-coupled amplifier is, in effect, that of the application of a negative bias at audio frequency. The resistance-coupled amplifier "modulates down." That is, if a milliampere-meter is placed in a plate circuit of such an amplifier, it will show a decided drop in the current when signals are being amplified. The drop will be more marked on the high notes than on the lower frequencies. This is because the higher rate vibrations represent a more steady "bias"—the negative charges are applied to the grid more times per second.

DO NOT fasten antennas, poles, or antenna supports to brick chimneys. It is contrary to the advice of the National Board of Fire Underwriters. It weakens the structure, and under the stress of high winds, the chimney may crack. This constitutes a fire hazard that has been responsible for many serious conflagrations.

A STORAGE battery is often considered messy. It is so only when neglected. Clean your battery regularly every week, wiping all moisture from the top. When signs of corrosion appear on the positive pole, scrape and sandpaper it clean, and coat with vaseline.

DISCONNECT BOTH A and B batteries from the receiver when charging. It may not always be necessary, but it is safer.

BAKELITE IS more difficult to work than hard rubber, but it will not warp, and takes a more beautiful and easy grain than the softer material.

GENUINE STATIC as yet cannot be eliminated. But a lot of so-called "QRN" comes from socket prongs, rheostats, and jacks. Look them over!



FIG. 9
A screw clamp that holds your machine screws for filing and cutting without injuring the thread. The clamp is held in a regular vise

Listening-in on the World

The Story of RADIO BROADCAST'S International Broadcasting Tests Which Will Take Place this November

BY WILLIS K. WING

RADIO listeners in America will have another wholesale opportunity this year to listen-in for broadcasting from stations in England, France, possibly Spain, Holland, and Germany when the RADIO BROADCAST International Broadcasting Tests take place during the week of November 24 to 30. Arrangements on the American continent are in charge of Arthur Lynch, editor of this magazine, and organizer of the tests. European arrangements are in charge of Hugh S. Pocock, editor of *Wireless World and Radio Review* who is coöperating with Captain A. G. D. West, who is assistant Chief Engineer of the British Broadcasting Company.

For those who did not follow the trans-atlantic tests which occurred in November, 1923, we can review the results by saying that the eight stations of the British Broadcasting Company transmitted special programs for American radio listeners, and a great number of the American and Canadian broadcasters transmitted special programs for listeners on the other side. American radio fans heard the English stations, especially 2LO, London, and 5WA, Cardiff, and 5SC, Glasgow.

American listeners with some very modest receivers found that their locations were especially good for long distance receiving and were thrilled by hearing the English programs from great distances. It is no exaggeration to say that broadcast listeners in every corner of the United States heard the foreign signals.

There were some difficulties last year for American listeners. These, in order of their importance were transmission by American stations during the time when quiet was to be preserved to listen for English programs, and interference from oscillating receivers. It is probably true that there are fewer "bloopers" in action this year than last because of the growing sense of responsibility of the radio public.

PROSPECTS FOR THIS YEAR

ARRANGEMENTS made by this magazine for the tests this year are far more ambitious and far more complete than were those arranged for the first trans-atlantic test during the last week of November, 1923. Every broadcaster in the United States has been communicated with and without a single important exception, they have agreed to coöperate to the utmost this year, not only in transmitting special and interesting programs, but also in guarding absolute silence during the transmission hours of foreign stations.

Stations in Cuba, Porto Rico, Hawaii, will transmit as the United States and Canada unit; and it is entirely possible that Australia will enter the transmitting and receiving tests as part of the foreign group.

It is now planned that American stations will send for an hour between ten and eleven each evening of the tests, Eastern Standard Time, and the foreign stations will transmit from eleven to twelve, Eastern Standard time. This will allow a long enough time for adjusting receivers to hear the distant stations. A full band of darkness will be between all transmitting and receiving stations during the transmitting hours.

The tests this year should accomplish even more in the way of bringing the nations closer together than did the Anglo-American ones last year. There will be addresses by public men, well known on both sides of the water.

Complete announcement of the American and foreign stations participating in the tests and other details will be made through the newspapers and from the various broadcasting stations and in the December number of RADIO BROADCAST.

Oscillations and the Vacuum Tube

The Requirements and Governing Conditions for Oscillations in Tube Circuits—The Neutrodyne, the Meissner, and the Colpitts Oscillator Circuits

WHAT MAKES THE WHEELS GO 'ROUND: VII

By WALTER VAN B. ROBERTS

THIS article is the seventh in the series by Walter Van B. Roberts which began in the March RADIO BROADCAST. These informative discussions are written to appeal to the broadcast listener who wants to know about the workings of the important units in his receiver. Mr. Roberts has quite successfully evaded the common error of technical writers who leave much unsaid or confuse what they do say with a maze of technical phraseology and turgidity of style.

While "Oscillations and the Vacuum Tube" is part of a series, it can be read comprehendingly by the reader who has not followed the previous articles.—THE EDITOR.

A BETTER method of neutralizing vacuum tube capacity is used in the neutrodyne. We have seen that the only way energy is fed back (assuming the grid circuit and plate circuit well separated or shielded from each other) is by the effect of the variations of plate potential acting on the grid through the small capacity that exists inside the tube itself between the grid and plate and the wires leading to them. Now if we could feed back to the grid another potential of exactly the same magnitude as caused by proximity of the plate, but exactly opposite in "phase", the net effect on the grid would be zero, so no energy would get back to the grid circuit. This system *wipes out at the source all tendency* to oscillate, instead of struggling to overcome the oscillations. A typical neutrodyning arrangement is shown in Fig. 32. The secondary of the transformer is wound in the opposite direction to the primary winding so that the potential at the upper end of the secondary is exactly opposite in phase to the potential of the upper end of the primary. Through the small capacity indicated in Fig. 32, the upper end of the secondary influences the grid in a fashion exactly equal but exactly opposite to the way the upper end of the primary influences the grid through the small capacity between the grid and plate. If the voltage on the upper end of the secondary is several times greater than the voltage variations on the upper end of the primary (and it should be, for good amplification), then the "feed back" capacity shown (or neutralizing capacity) should be several times less than the grid-plate capacity in order that the two influences be of the same magnitude.

58. LOW CAPACITY TUBES

INASMUCH as the tendency to oscillation is greater the more the grid-plate capacity and the higher the frequency, two other lines of attack are immediately obvious. The first is to build tubes with smaller grids and plates and to keep the wires leading to them as well separated as possible. Some of the small dry cell-operated tubes represent progress along this line. The second way is to use lower frequencies to amplify. By taking advantage of the curvature of the characteristic curve of the vacuum tube it is possible to change signals coming in at a very high frequency into signals at some frequency low enough to be

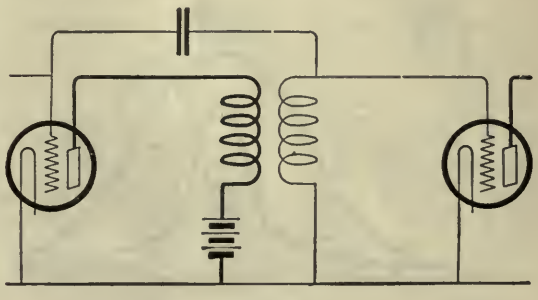


FIG. 32

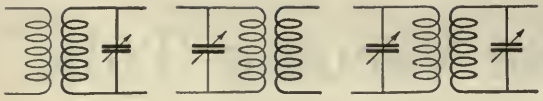


FIG. 33

more easily amplified. After amplification, these intermediate frequency currents are fed to any sort of a detector which demodulates them in the ordinary fashion, thus yielding the desired audio-frequency currents. This is the "super-heterodyne" method and will be explained more fully later on.

59. RADIO-FREQUENCY TRANSFORMERS

RADIO-frequency transformers are classified as "tuned" or "untuned." Fig. 33 shows three commonly used types of tuned transformers. A tuned transformer must be tuned (in Fig. 33 by means of the variable condensers shown) to the frequency that is to be amplified. Thus for a particular setting of the condensers, the amplification would be great for a narrow band of frequencies but negligible for frequencies even slightly outside of this band as shown by Fig. 34. The untuned type have no tuning adjustment, but even they work best at some particular frequency. The difference is that they work to a certain extent over a wide range of frequencies as shown by Fig. 35. This wider range is due to the introduction of resistance, or, if iron cores are used, by a combination of the advantage of the iron core with the effective resistance introduced into the transformer by the losses that occur in iron at high

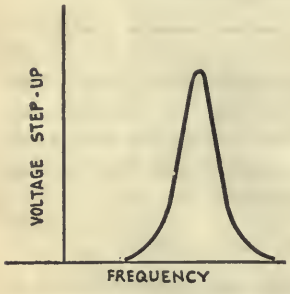


FIG. 34

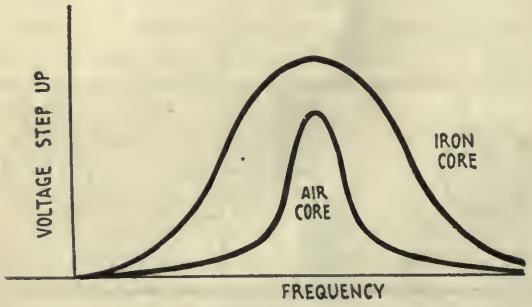


FIG. 35

frequencies. In general it may be said that when there is much resistance or anything else that causes losses, the amplification will be less than that theoretically obtainable by the use of tuned transformers. A few stages of tuned transformer-coupled amplification has the advantage of giving great selectivity, that is, amplifying only one frequency (strictly speaking, only a very narrow band of frequencies) but has the disadvantage that as each stage must be carefully tuned, it is tedious to change from one frequency to another and difficult to pick up weak signals unless the proper setting for each tuning condenser is known in advance. (In the super-heterodyne system this disadvantage disappears because the intermediate-frequency amplification is done at a fixed frequency whatever the wavelength of the station being received).



FIG. 36

60. REQUIREMENTS FOR A TUBE OSCILLATOR CIRCUIT

A MORE or less sketchy description of the setting up of oscillations was given under the paragraph on regeneration. The general conditions that have to be satisfied by any circuit in which a vacuum tube is to produce oscillations are:

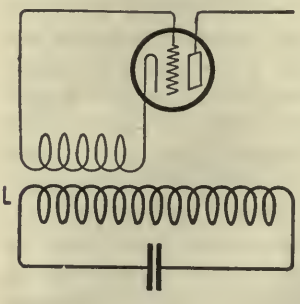


FIG. 37

(1) There must be an oscillation circuit, the natural frequency of which will largely determine the frequency of the oscillations.

(2) The grid and filament of the tube should be coupled to the oscillation circuit in such a fashion that variations of the grid potential (with respect to that of the filament) will be caused by oscillating or alternating current in the oscillation circuit.

(3) The plate must then be connected to the filament in such a fashion that the variations of plate current (which are caused by the variations of grid potential) act to increase rather than decrease the alternating current which has been assumed to exist in the oscillation circuit

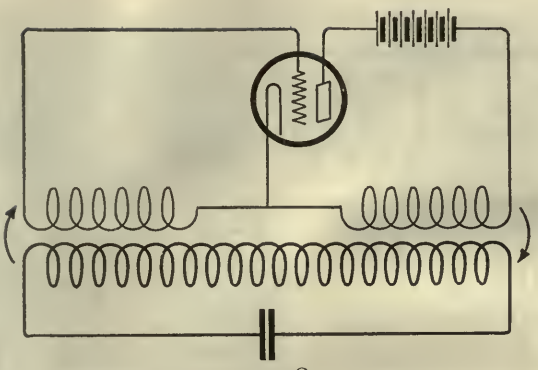


FIG. 38

and which is responsible for the variations of grid potential.

61. ANALOGY FOR AN OSCILLATOR CIRCUIT

A CLOCK is a good analogy for a vacuum tube oscillator circuit. The swinging of the pendulum corresponds to the alternating current in the oscillation circuit, and the natural frequency of the pendulum is pretty close to the frequency with which it will swing when the clock is running. Corresponding to the alternating current in the oscillation circuit operating the grid potential, we have the swinging of the pendulum operating some sort of escapement mechanism that controls the action of a spring or the falling of weights. And just as the plate current controlled by grid potential acts to keep the oscillating current going, so does the intermittent uncoiling of the spring or falling of the weights released by the escapement mechanism act to keep the pendulum swinging.

62. AN ILLUSTRATIVE OSCILLATION CIRCUIT

WE WILL build up an oscillator circuit by following our list of conditions one by one. The first condition is satisfied by the simple oscillation circuit of Fig. 36. The second condition is satisfied by Fig. 37 as the transformer type coupling between the coil L and the grid coil makes alternating current in L produce an alternating potential difference between grid and filament. The last condition is satisfied in Fig. 38 for the plate coil is assumed to be wound in such a direction that the plate current variations reinforce the current in the oscillation circuit. The flow of power is indicated by the arrows in Fig. 38. A small amount flows through the transformer coupling at the left side of the diagram to the grid and is the power input to the tube. Then *if the tube amplifies power* an increased amount flows through the transformer coupling at the right, back into the oscillation circuit. The difference between these two amounts of power just takes care of the rate at which energy is being dissipated in the oscillation circuit. This is the Meissner circuit.

63. OTHER OSCILLATION CIRCUITS

FIG. 39 shows the Hartley circuit which is the same as the Meissner except that the couplings are "direct," that is, transformer type coupling has been replaced by "auto-transformer" type coupling.

In Fig. 40 we have what is usually meant by the term "feed-back" circuit. (All oscillator or regenerative circuits are really feed-back circuits of some sort). The coupling to the grid is direct while the plate circuit is coupled to the oscillation circuit by mutual inductance or transformer coupling.

Fig. 41 is exactly the reverse of the last arrangement.

Fig. 42 is the Colpitts circuit, obtained by interchanging all capacities and inductances in the Hartley circuit. The only difference is that the capacity has to be split up into two condensers in order to connect the filament in the middle of it, and a direct current path has to be provided for electrons to get from plate back to filament. The alternating current however is kept out of this path by the high reactance of the choke coil.

Fig. 43. This is the circuit used in receiving sets employing "plate-variometer" regeneration. Sometimes the tuning condenser is omitted. In any case, the circuit between the grid and filament functions as a simple inductance, and as there is no mutual inductance between the plate variometer and the grid coil, this circuit is really a Hartley circuit with no mutual inductance, the necessary capacity

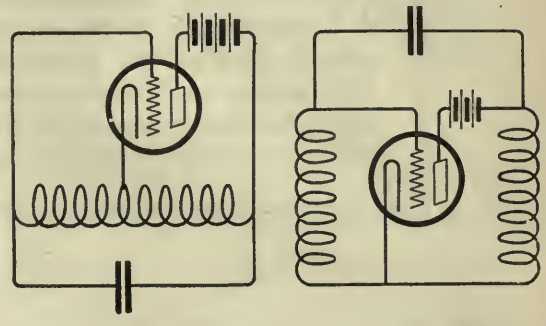


FIG. 39

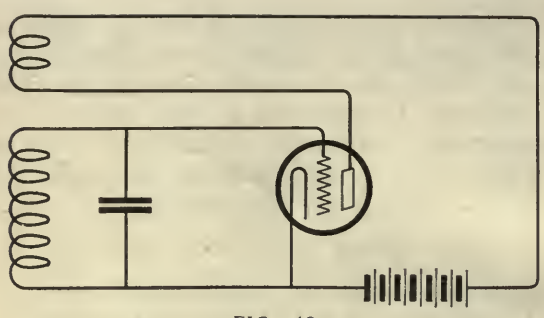


FIG. 40

being the internal grid-plate capacity shown in the conventional fashion by dotted lines.

64. RELATION OF COUPLING TO TUBE OSCILLATIONS

THE three conditions given at the outset are only qualitative. To obtain the strongest oscillations, the amount of coupling

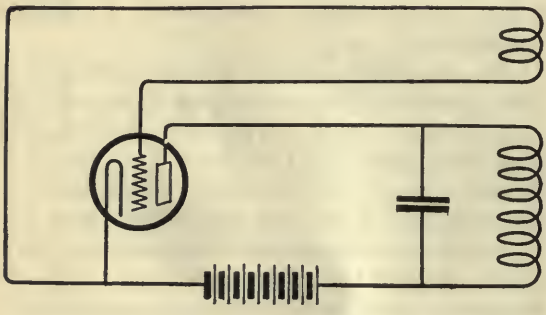


FIG. 41

between the grid circuit, plate circuit, and the oscillation circuit must be correct. If, for example, the plate circuit is coupled too tightly to the oscillation circuit, the tube is in effect connected to an impedance greater than its own plate impedance and will work with good efficiency but less than maximum output of

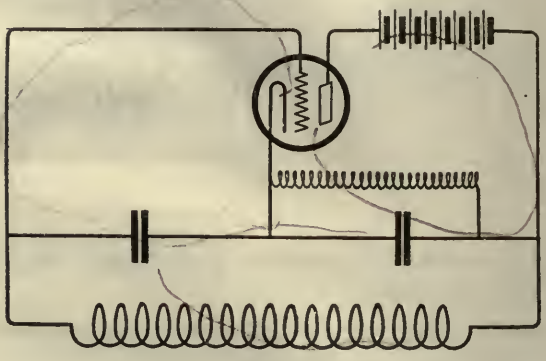


FIG. 42

power. If this same coupling is too loose, the efficiency and output will both diminish and if the coupling is less than a certain value the tube will not start oscillating at all but will merely give regeneration in case an alternating voltage of the proper frequency is applied to the grid by some outside means.

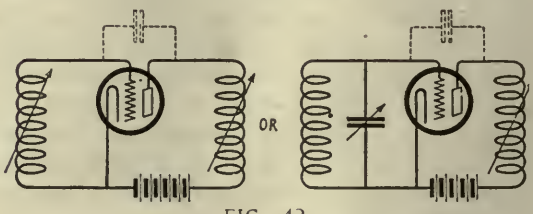
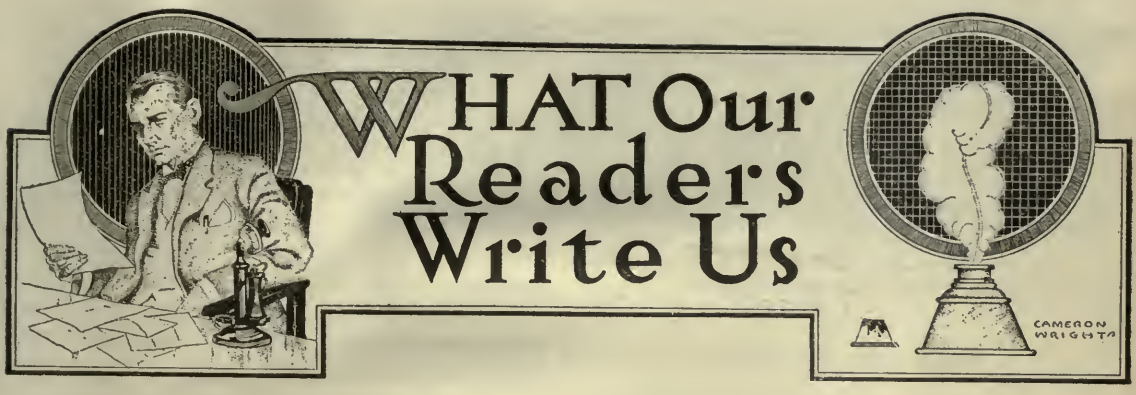


FIG. 43

NO ONE of the great numbers interested seems to know how radio — that extraordinarily effective and influential means of communication — is going to affect politics. Precedent is being set, and history being made before our very eyes in the present campaign. Mark Sullivan, one of the best known and ablest political writers in the nation, has written a highly interesting article on this subject which will appear in the November RADIO BROADCAST



The New Age of Fable

THE innocent searcher after radio information has his trials and his tribulations. Perhaps after he seeks he does find, more often he seeks and does not find. And sometimes when he seeks he finds fearful and wonderful facts. Casual listeners in some radio stores have overheard much technical information on radio which astounded their trained technical ears. Many radio dealers who have jumped hastily from their former mercantile pursuits, whatever they were, to radio, have not been able to make an equal mental jump to keep pace with radio theory. So it is small wonder that some owners of radio sets have their technical troubles, when one considers the kind of information they have to depend on. The following letter was written to us as a voluntary contribution to radio lore by a radio dealer, who must remain forever anonymous. We take, it must be said, if indeed that be necessary, no responsibility for the statements.

Editor, RADIO BROADCAST,
Doubleday, Page & Company
Garden City, L. I.

DEAR SIR:

What is the advantage of a vertical aerial? With a vertical aerial, there is a two fold advantage. First, because it is a good high-wave getter. Second, because a vertical aerial is not so inductant with the ground as is a horizontal aerial which tends to get worse and worse the longer it is.

With the vertical aerial, this inductance with the ground and consequent tendency to choked reception is practically overcome. This can be noticed in connection with the grid leak, which can almost be discarded, or used on very low resistance. This shows that with a vertical aerial, you are using your tubes to better advantage without having to drown them with so many megohms. It is understood, then, that this local buzzing is caused by the inductance between the horizontal aerial and the ground.

The vertical systems are the umbrella aerial, the vertical hoop aerial, and for peak reception, the balloon aerial. It has been found that this vertical antenna functions with the same intensity whether it be a fine or a heavy gauge wire, for the reason that this vertical antenna does not lose its charge of high frequency radio currents like the horizontal aerial does.

It is remarkable the natural amplitude of such an aerial. In comparison with the regular horizontal aerial about 100 feet long and 30 feet high, the natural or initial amplitude of the respective aerials was five times as great on the vertical aerial, which was 200 feet high.

This initial amplitude without any particular "directional hard pan" is what is wanted, the same as in photography. If you have a good, full negative, you can enlarge indefinitely, but a dull or deformed negative is very difficult to enlarge.

E. S., Rhode Island.

A Good Radio Shibboleth

AN OUTSPOKEN and deadly earnest reader sent us the following letter which asks some pretty searching questions of the thoughtless broadcast listener who uses a single-circuit regenerator. We should like to hear from readers of RADIO BROADCAST whether or not they have noticed any decrease in interference from bloopers in their localities. A tabulation of the figures would be very interesting.

Editor, RADIO BROADCAST.
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR:

Here are some questions I would like to have my fellow broadcast listeners answer for their own benefit. I have made them mild, to avoid hurting their feelings, but if I had my way, those who are convicted by their answers to these questions, would all be in jail from 8 to 12 P. M. daily.

ARE YOU A JAY TUNER?

—Are you sure your set does not radiate? If so, read no further.
—When your filament or tickler is at the highest working point, do you sometimes "give her a little more," in the hope of bringing in a weak, fading, or interrupted signal?
—Do you fuss around, trying for stations you know full well are beyond your reach?
—Do you spend every evening trying to see how many stations you can tune-in, and how often you can get them?

—Do you tune-in by the whistle?
—Do you let six-year-old brother crank the dials when you get tired?
—Do you know that the sickly whine when you tune-in carelessly becomes a piercing howl in your neighbor's loud speaker? Or don't you care if it does?
—Do you know that many a would-be fan is holding off because innumerable bloopers, and jay tuners make the air hideous?
—Do you know how cheaply you can make your blooping stone-crusher into a clear-toned, selective receiver?
—Do you know that with ten cents worth of No. 22 DCC wire you can in one hour add a primary to your single-circuit receiver that will help a lot?

C. L. E., Wilkes Barre, Pa.

Radio News from Japan

27 Tatsuoka-cho
Hongo-ku, Tokyo, Japan

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR:

I am a Japanese boy and I am going to a middle school of my city. I have heard often concerning to radio is very flourishing in your country from our foreigner teacher and have reads by the books.

In the Japan there is not only a broadcasting station, but the Training School Institute of Communications. Officials is broadcasting every day to a little radio fans. Radio music concert held in every places. I thought you would be interested to know about the radio in Japan.

Yours truly,
K. SUGITA.

A New World for Shut-Ins

LETTERS such as this make one feel that times are growing better for those who have to struggle along under heavy difficulties of physical shortcomings. Below is an interesting and outspoken letter on the subject which illustrates the point very nicely.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.

DEAR SIR:

Radio is the greatest help to me, both as an amusement and an education. Being a cripple and a shut-in, I think I appreciate radio more than those who have all their strength.

Three years ago I became interested in radio through reading a radio magazine. About a year after that, I got my first receiver. It consisted of a crystal detector, phone, condenser, and a home-made loose coupler. When the secondary was pulled out all the way, it was two feet from end to end of that loose coupler. I did not have the strength to wind the coils, which had of course to be done by hand, so my father wound them for me. After it was finished, we found that the secondary would not work, so we used the primary as a one-slide tuning coil. Not being near any broadcasting station, we could not hear anything but code, but we heard plenty of that.

Then a bit later, I added a tube in place of the crystal detector. I have added a little now and then until at present I have a four-tube inverse duplex. At the age of 14, I was compelled to leave school, but have since learned more about electricity, music, history, and other subjects by listening to the radio programs than I did from reading books.

C. M., Bradley Beach, N. J.

More Enthusiasm About the Roberts Set

THE experimenters have begun to test the claims made for the Roberts Knock-Out Two-Tube receiver, which was explained by its originator, Walter VanB. Roberts in RADIO BROADCAST for April and May. And the enthusiastic letters have begun to roll in—— in no uncertain fashion. Here is an interesting one—among many such.

Editor, RADIO BROADCAST
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

This letter is to express my appreciation of the two articles in RADIO BROADCAST for April and May on the Roberts Two-Tube Knock-Out receiver, which I have experimented with lately at some length. I am located 17 miles southeast of Boston. Using this receiver, which I made from your circuit, I heard two stations in Chicago and WOC quite well across my 14-foot den last night, on a Music Master loud speaker. With Brandes headphones, I had to remove the receiver caps ahead of my ears when listening to WGY, WNAC, and WBZ.

In making the set, I did not follow Robert's suggestions altogether. For a primary and secondary tuner, I used a pair of unwound Kresge hub and spoke forms that sell for ten cents. I used No. 20 double covered wire because I am a firm believer in coarse gauge wire on tuners. I did not make all the taps so near the beginning because I did not see the need of tapping so much. I fixed one form permanently and arranged the other so as to draw to and fro over a latitude of three inches, I find this adjustment of value because I can use it to clear up interference as well as to put volume into reception after tuning-in a station quite clearly. The other three forms used were black fibre twenty-five cent Kresge wound spider webs from which I took all the wire and rewound. I used the brass arms Kresge sells for supporting the forms. I used a separate Bradleystat for the 201-A tube and a 30-ohm resistance for the 199 tube. Instead of neutralizing by your suggested devices, I used a small 3-plate vernier condenser bought of Kresges for fifty cents. I used a three-inch dial on it, and I wish to mention particularly that I change the setting of this dial several points one way or another with each different station received, to the great advantage of reception. This adjustment, I find, adds about twenty five per cent. clarity and volume and quite a little to distance.

Since this outfit in this irregular form works so well, I am reluctant to start on a cabinet and panel for it lest boxing the thing may reduce its volume. The set now spreads out fully twenty six inches from left to right. In the construction of the set, I used a Paragon audio transformer. I removed some wire from the tickler and then replaced it, for your number of turns seemed best for general use. My antenna is sixty feet out of doors with a thirty foot lead in the house. It is about sixty feet high at the far end.

Those who drop in to look at this receiver, seeing the crude assemblage of parts as I stuck them around experimentally on the bread board, smile at the junk pile, but their expression changes when I tune-in.

H. E. D., Hingham, Mass.



QUERIES ANSWERED

What Are the Government Radio License Requirements? . . . . . *A. F. O.*, Detroit, Michigan
How Can I Reflex My Aeriola Sr. Set? . . . . . *E. O. B.*, Boise, Idaho
What Are the Specifications for the uv-1716 Transformers? . . . . *A. T. M.*, Miami, Florida
Explain the Reverse Feed Back in the Superdyne Set . . . . . *R. D. W.*, Champaign, Illinois
How May a Storage Battery Be Charged From a 32 Volt Line? . . . *Q. A. R.*, Martins Ferry, Ohio
What Are the Particulars of the Heavy Duty B Battery? . . . . . *E. W. H.*, High Point, N. C.

ABOUT GOVERNMENT LICENSES

NOT A few inquiries have reached us asking for the regulations governing the application and examination for an amateur's license.

It would be well for those so interested to write to the Superintendent of Documents, Government Printing Office, Washington, D. C., for the booklet *Radio Communication Laws of the U. S.*, which sells for 15 cents. This booklet gives in full, all the details for securing this license and others more advanced, such as the experimental station license and commercial license. The International Radio Conventions and code are also included in it.

Briefly the procedure to be followed by a license applicant is as follows:

Assuming that he knows about the technical and constructional features of the transmitter to be operated he should apply to the Radio Inspector's Office in his district.

The examination covers the regulations of the International Radio Telegraphic Convention, so that calls of distress may be recognized, and the regulations concerning interference, sending and receiving signals at the rate of ten words per minute.

It is also necessary to draw a circuit diagram of the apparatus to be used for transmitting purposes.

Then, when this examination has been successfully passed, it is necessary to obtain a station license. Radio forms No. 756 and 757 are furnished for this purpose. The information required on these forms concerns the type of transmitter and antenna used, amount of input power, wavelength, etc.

Examinations for the license are held at the office of the Supervisor of Radio Department of Commerce Custom House, in the following cities:

1st Dist.	Boston, Mass.
2nd Dist.	New York, N. Y.
3rd Dist.	Baltimore, Md.
4th Dist.	Savannah, Ga.
5th Dist.	New Orleans, La.
6th Dist.	San Francisco, Calif.
7th Dist.	Seattle, Wash.
8th Dist.	Detroit, Mich.
9th Dist.	Chicago, Ill.

Amateur transmission is limited to 200 meters and below. For operating on wavelengths other than these, a special license is required.

HOW TO REFLEX THE AERIOLA, SR. AND RADIOLA TYPE RECEIVER

COMPLETE instructions for reflexing the single-circuit receiver were contained in the June issue of RADIO BROADCAST. Some of our readers have experienced a bit of trouble in making the adaption. This has been especially true of the owners of such receivers as the Aeriola and Radiola type. On account of the peculiar split windings in the tuners of these receivers it is difficult to apply the reflexit to them without affecting their over-all

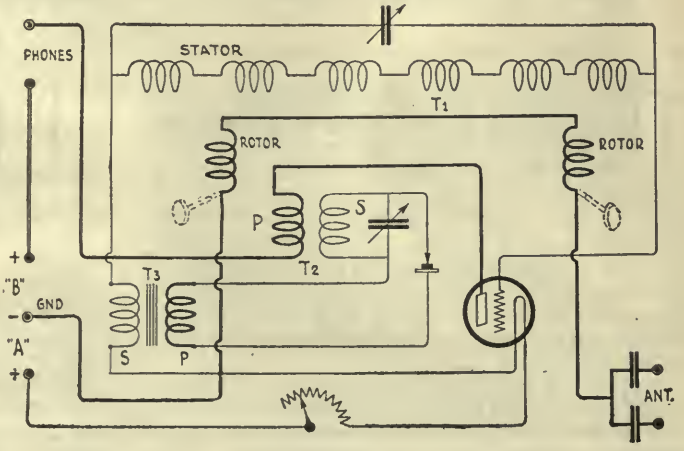


FIG. 1

efficiency. Usually the entire circuit must be torn down and the several parts re-placed so that there is no feedback or inductive relation between the tuner and radio-frequency coil units. The ordinary home-made receiver is quite easily changed over in the manner previously explained. Fig. 1 shows a circuit diagram of the Aeriola Sr. converted into a reflex receiver. A rear panel view is illustrated.

THE UV 1716 RADIO-FREQUENCY TRANSFORMER SPECIFICATIONS

MANY have asked for the construction data for winding the very scarce UV-1716 Radio-Frequency Transformers, and the following coil winding table is given.

Primary 1000 turns No. 34 silk enamel wire
Secondary 2700 " " " " " "

The coil form shown on page 493 of the April issue may be used providing the width of the slots is increased to about $\frac{3}{8}$".

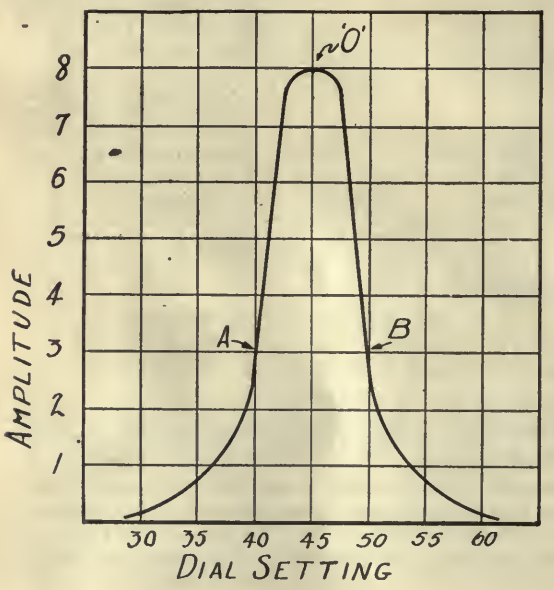


FIG. 2

EXPLAINING THE REVERSE FEED BACK IN THE SUPERDYNE

THE outstanding feature of the Superdyne is its reversed feedback control. In the ordinary regenerative set when tuning-in a station, oscillation occurs over a wide range on the tuner dial. Let us suppose it is, for example, from 40 to 50. The signal can be received clearly at about 39 but the point of greatest amplitude would be obviously at about 45. On account of the oscillator noises, it is impossible to use this point for undistorted reception. In the Superdyne, this point of greatest oscillation can be obtained, and then, by using the reverse feedback coil, this oscillation can be effectively stopped without any loss in amplitude.

Ordinarily, in the straight regenerative set we get an amplification of 3, but with the Superdyne this is increased about to 8. See Fig. 2. A and B represent the points where the oscillations begin and end respectively. O represents the point of maximum oscillation.

CHARGING STORAGE BATTERIES FROM 32-VOLT LIGHTING SYSTEM

ALL types of storage A and B batteries may be readily and successfully recharged from a 32-volt farm lighting system. Fig. 3 shows how the A and B battery may be charged merely by using the house lighting receptacles connecting with a cord and 32-volt lamp in series with the battery.

Select the socket which is most convenient for charging the battery. Screw in an attachment plug being careful that the two wires do not touch each other. Determine

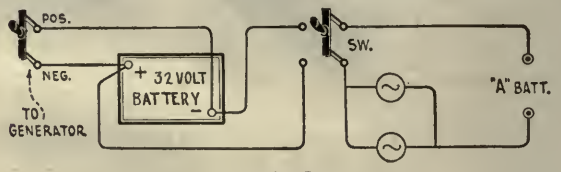


FIG. 3

the polarity of the charging wires by placing the ends of the attachment leads in a glass of water. Bubbles will form around the negative wire. If both leads show bubbles, the negative lead will give off a far greater number. After determining which is the positive and which is the negative lead, put some kind of a distinguishing mark on the negative and always use this particular socket when charging.

Properly to recharge the batteries, the positive of the charging line must go to the positive of the battery. This should be easy as you have marked your charging line, and the positive poles of the A and B batteries are also plainly marked.

When charging B batteries, use a 32-volt 25-watt lamp for the 4500 milliampere hour type and a 32-volt 15- or 20-watt lamp for the 2500 milliampere hour type. It is possible to recharge only 24 volts of B battery at one time. Therefore, a 48 volt B battery may be recharged, by charging only half or 12 cells at one time, then shifting the leads to the additional 12 cells or 24 volts. See Fig. 4.

A fully charged radio A or B battery will have a specific gravity reading of 1.275 to 1.300 and may be considered

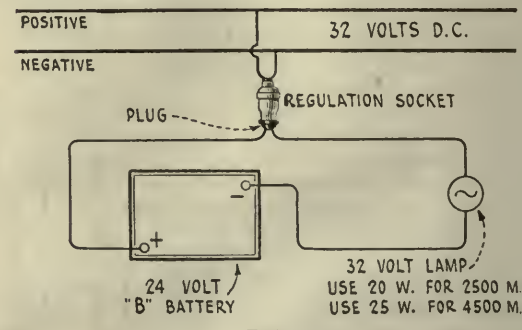


FIG. 4

discharged when it has a specific gravity reading of 1.175. For best radio results the battery should be recharged when it has a reading of 1.200.

It is possible to recharge batteries using up to 500 volts on power amplifiers and transmitters, from a 32 volt lighting system, by following the instructions with the circuit diagram in Fig. 5. Any multiple of this system may be used such as 48, 72, 96, and 120 volts.



★

TRF-50
(as illustrated)

A 5-tube tuned radio frequency receiver with built-in Magnavox Reproducer unit which consumes no battery. Cabinet measures: height, 14¾ in.; length, 20½ in.; depth, 18¾ in.

Without tubes or batteries . . $150.00

TRF-5

This is identical with the above but encased in smaller cabinet without built-in Reproducer. Cabinet measures: height, 9⅝ in.; length, 20½ in.; depth, 14¾ in.

Without tubes, batteries or reproducer $125.00

MAGNAVOX

New Broadcast Receivers combining supreme efficiency, convenience and beauty

HERE at last is the perfected instrument permitting you to enjoy *simultaneously* the most desirable elements of broadcast reception.

Three decisive advantages go with the Magnavox: unequalled simplicity of control, reproduction of exceptional clearness—handsomely carved period cabinets.

Magnavox Radio Receivers, Vacuum Tubes, Reproducers, Power Amplifiers, and Combination Sets are sold by reliable dealers everywhere

THE MAGNAVOX CO., OAKLAND, CALIF.
New York: 350 W. 31st Street *San Francisco:* 274 Brannan Street
Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

10R

★ Tested and approved by RADIO BROADCAST ★

Owing to the very low charging current needed for a B battery the efficiency of a charging plant is not lowered to any great extent by charging it from the plant storage batteries, rather than from the generator. However, a high charging current is needed for an A battery and it should only be charged while the generator is being operated to charge the plant battery. After obtaining the polarity make sure that the positive of the charging line is attached to the positive of the 6-volt storage battery as indicated on the attached diagram for charging A batteries.

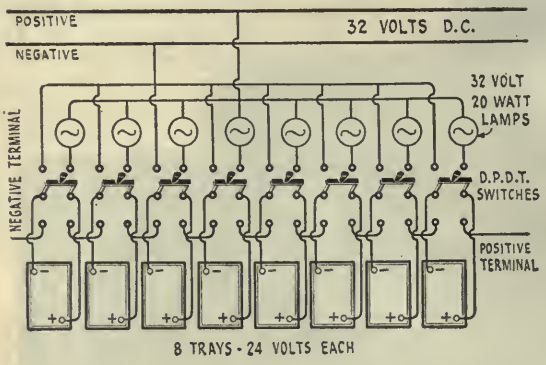


FIG. 5

B BATTERY ECONOMY

UNPLEASANT and unnecessary noises in a radio receiver may be due to static, faulty or careless wiring. And some receiver noises are directly chargeable to the B battery.

If the B battery is imperfectly connected to the receiving set, an intermittent crackling noise is sure to result in the phones or loud speaker. In any circuit which is "made and broken," a spark or arc will be set up at the point where the actual make and break occurs. Even though this loose contact in the B battery leads is slight, an abnormal amount of current will be drawn from the B battery so affected, decreasing its life and resulting in a varied voltage supply.

A B battery which has been allowed to become damp will eventually corrode and cause noises in the receiving set. Corrosion attacks the copper inter-cell connections and the zinc shells of the cells and finally eats away enough of the metal to cause imperfect and quite frequently open and short circuits.

Radio owners and purchasers will gain much by considering the type of battery best suited to their needs. Receivers employing five or more tubes draw more current in milliamperes than those having only one or two tubes. If, for instance, a battery designed for a five-tube drain is used with a receiver having two tubes, the current consumption would be lower than the manufacturer's designated rate. So the battery would not be operated at its maximum capacity and it would last much longer but its depreciation would be much greater, than a battery of smaller capacity. The National Carbon Company furnishes The Grid with the following technical suggestions:

"To secure the most service at the least expense from a B battery, it is important that a B battery be chosen which is made of cells whose size is proportional to the work to be performed. Receiving sets which require a heavy current from the B battery should be supplied with B units made of large cells.

"The number of hours a B battery will last on a receiving set is equal to the milliampere hour capacity which the battery can deliver, divided by the current in milliamperes which the set draws from the B battery. The milliampere hour capacity of a B battery depends largely on two things, the size of the individual cells in the battery-unit and the rate at which the cells are discharged, that is to say, the current drain.

"If the current drain is too small in proportion to the size of the cells, the time required to discharge the battery will be so great that the natural depreciation, which is so characteristic of dry cells, will consume a measureable proportion of the battery's capacity, leaving less than the full amount for useful service.

"On the other hand, if the current drain is too great for this size of cells, the battery will be overloaded and this, too, results in decreasing the capacity of the battery. Between these two extremes, is a current drain at which the battery will deliver its maximum capacity. This is the normal rate of discharge for the battery. This normal rate of discharge for B batteries depends primarily on the size of cells of which the B battery is made. The larger the cells, the larger the normal rate of discharge.

"The normal rate of discharge for the customary large 45 volt B battery is from 5 to 12 milliamperes. Most multi-tube receivers and power amplifiers draw much heavier currents than this from the B battery—usually from 15 to 25 milliamperes. Consequently, the B batteries of the usual size are seriously overloaded when supplying current to these heavy-current receivers, and their life is therefore comparatively short. This makes the operating cost of such receiving sets rather burdensome.

"To provide cheaper and more satisfactory power for multi-tube receivers, battery manufacturers have developed and recently announced a special heavy duty B battery, built specifically for use on multi-tube receiving sets and power amplifiers which require 15 milliamperes or more from the B battery.

"Because of the large cells in this type unit, it is primarily a heavy current battery and therefore will not serve light current sets as economically as the usual 45 volt B battery. Sets drawing less than 15 milliamperes from the B battery can be operated more economically from the standard size 45 volt B battery."

NEUTRODYNE NOISES

WE ASSUME that the noises in question are the ones of a crackling, frying nature, differing from spasmodic static in that they are continuous in duration, varying only in intensity. Usually these noises are strongest when the neutrodyne receiver is sharply attuned to any wavelength within its range.

The causes of such noises can be summed up as follows:

1. Incorrect values of grid leak.
2. Poor or dirty contacts on socket prongs, jack blades, etc.
3. Use of too much soldering paste or acid, creating leakage paths between adjacent wires.
4. Dusty variable condenser plates.
5. Improper neutralization.

Improper neutralization is the chief cause of unpleasant and unnecessary noises in neutrodyne receivers.

It is very necessary that each of the radio-frequency stages be completely neutralized. Furthermore, it is important that they be neutralized on several wavelength settings. For this it is best to try the system on distant stations where there is small chance of receiving a broad signal.



26.00

Build it with the

ULTRADYNE KIT

R E L

To protect the public, all genuine Ultra formers bear Mr. Lacault's personal monogram seal (R.E.L.) and are guaranteed so long as this seal remains unbroken.



Send for 32-page illustrated book, giving latest authentic instructions on drilling, wiring, assembling, and tuning 6 and 8 tube Ultradyne receivers.

50c

Now, the famous Ultradyne Receiver has been so simplified that anyone can successfully build it with the Ultradyne Kit. This Kit includes all the special parts required to build the Ultradyne, designed by R. E. Lacault, the inventor,—1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 1 tuning coil, 1 oscillator coil, 4 matched fixed condensers.

The Ultradyne incorporates the new "Modulation System"—a decided departure from the detector arrangement of radio reception used in all other Super-Heterodynes. This "Modulation System" is the latest development of R. E. Lacault, A.M.I.R.E. Consulting Engineer of this company and formerly Radio Research Engineer with the French Radio Research Laboratories.

Even Super-Heterodyne Engineers marvel at Ultradyne performance—its unusual selectivity and great range on the loud speaker.

There is no greater receiver! Now you can build it yourself!

Write for descriptive folder.

★ ULTRADYNE
The Improved
SUPER-HETERODYNE

PHENIX RADIO CORPORATION

5-7 Beekman St. **New York City**

★ Tested and approved by RADIO BROADCAST ★

The Progress of the "Covered Wagon"

AS THIS magazine goes to press, the RADIO BROADCAST COVERED WAGON has finished about one fifth of its transcontinental tour. Captain Jack Irwin and his radio truck traveled from New York, down through various New Jersey cities to Philadelphia and Atlantic City, and from there to Harrisburg and Altoona to Pittsburgh. The WAGON then traced its course to Cleveland and at the last writing was in Detroit.

Many radio enthusiasts in the various localities that Captain Irwin visited were greatly bothered by local interference. Local interference is indeed not a myth, as he soon discovered. While a great deal of local receiving difficulties have their origin in improper conditions in local power circuits, a great proportion of troubles certainly originate in oscillating receivers.

Letters are beginning to come in to the editorial offices from interested broadcast listeners who have talked with Captain Irwin along the route and they are unanimous in their approval of the work he is trying to do. The receivers developed in the RADIO BROADCAST LABORATORY are on display on the WAGON, and they are creating a tremendous amount of interest, particularly the eight-tube superheterodyne. But when a fan reported to the crew of the WAGON that he had receiving difficulty of one sort or another, Captain Irwin and the WAGON would proceed to the spot and help "shoot" the trouble.

Radio dealers in various cities are conferring with Captain Irwin and George A. Eckweiler, technical assistant, and much radio gossip about the best ways and means to arrange window displays; they are exchanging technical information and in brief, spreading the gospel of radio.

Radio listeners, if we are to judge from the personal reactions the crew of the WAGON have reported, and also the tenor of the letters reaching this office, are much in sympathy with the purpose of Captain Irwin's trip. Power companies in various cities have shown their willingness to coöperate, and radio clubs, radio amateurs, and the radio editors of various newspapers are doing what they can to help along these efforts to improve radio enjoyment for all.

Captain Irwin will have an interesting story of his experiences next month.

Supplemental List of Broadcasting Stations in the United States

LICENSED FROM JULY 19 TO JULY 31 INCLUSIVE

CALL LETTERS	LOCATION	KILOCYCLES	WAVELENGTH	POWER (Watts)
KFAU	Boise, Idaho	1110	270	150
KFLR	Albuquerque, N. Mex.	1180	254	100
KFLW	Missoula, Mont.	1280	234	5
WABN	La Crosse, Wis.	1230	244	500
WEBI	Salisbury, Md	1240	242	15
WFBB	Eureka, Ill.	1250	240	50
WFBG	Altoona, Pa.	1150	261	100
WOAR	Kenosha, Wis.	1310	229	50

LIST OF BROADCASTING STATIONS DELETED JULY 1 TO JULY 31

CALL	LOCATION	CALL	LOCATION
KDZI	Wenatchee, Wash.	WGAW	Altoona, Pa.
KFEZ	St. Louis, Mo.	WIAY	Washington, D. C.
KFNX	Peabody, Kans.	WJAQ	Topeka, Kans.
KFPQ	Denison, Texas	WLAV	Pensacola, Fla.
WABG	Jacksonville, Fla.	WQAL	Mattoon, Ill.
WBBJ	West Palm Beach, Fla.		

TOTALS

Number of U. S. Broadcasting Stations	543
Number of Canadian Broadcasting Stations	44
Number of Cuban Broadcasting Stations	34
Number of Mexican Broadcasting Stations	4



THIS BATTERY WILL MATERIALLY REDUCE YOUR OPERATING COSTS ON HEAVY CURRENT SETS

NEW!

Eveready Heavy Duty "B" Battery. 45 volts. Three Fahnestock Clips. Length, 8 5/16 inches; width, 4 7/16 inches; height, 7 5/16 inches; weight, 13 3/4 pounds.

New low price, $4.75

New Heavy Duty 45-volt "B" Battery No. 770

Extra large cells—extra long service

FOR maximum "B" Battery economy, use this *New Eveready Heavy Duty* 45-volt "B" Battery, in the following general cases:

1—On all receiving sets operating at 90 volts or more, having four tubes without a "C" Battery, and all sets having five or more tubes, with or without a "C" Battery.

2—On all power amplifiers.

3—On all sets that pull heavy currents from the "B" Battery.

Under the above conditions, the *New Eveready Heavy Duty* 45-volt "B" Battery will give much longer service than the 45-volt "B" Battery of usual size.

If your receiving equipment falls under any of the above classifications, you can make a big saving in "B" Battery costs by using this *New Eveready Heavy Duty* 45-volt "B" Battery No. 770. Buy it and you get the biggest battery value on the market to-day!

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York—San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

No. 7111
Eveready Radio "A" Dry Cell
Specially manufactured for use with dry cell tubes





Eveready 6-volt Storage "A" Battery

No. 766
Eveready "B"
22 1/2 volts. Six Fahnestock Spring Clip Connectors





No. 772
Vertical 45-volt, large size "B" Battery

No. 771
Eveready "C" Battery
Clarifies tone and prolongs "B" Battery life





No. 764
Vertical 22 1/2-volt "B" Battery

EVEREADY
Radio Batteries
—they last longer

★ Tested and approved by RADIO BROADCAST ★

New Equipment



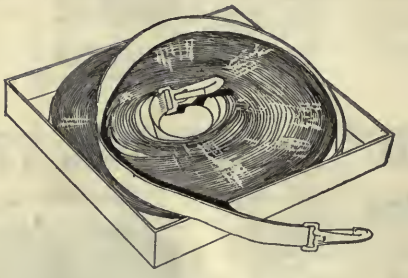
THOROLA
LOUD SPEAKER

A non-power loud speaker designed by Mr. Frank Reichmann, inventor of the Thorite horn and the Thorophone loud speaker. The Thorola is very sensitive and will deliver great volume with fidelity. It uses for the first time the push-pull principle with a permanent adjustment of the diaphragm. Made by The Reichmann Company, Chicago, Illinois. Price $25



WORKRITE NEUTRODYNE

A neutrodyne receiver employing two radio-frequency, one detector, and two audio-frequency tubes. The set contains many refinements both in technical and mechanical details. One of the outstanding features of the above model, the "WorkRite Radio-King," is the built-in loud speaker. Made by The WorkRite Mfg. Co., 1810 East 30th St., Cleveland, Ohio. Price $220



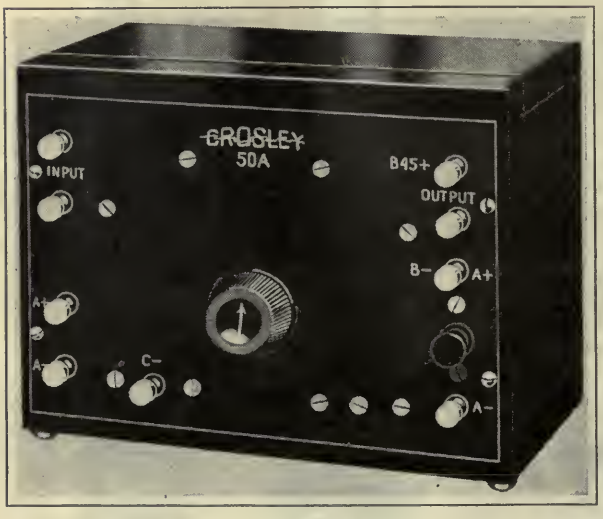
TRANSCONTINENTAL RIBBON AERIAL

A copper ribbon antenna put out in four popular lengths for broadcast reception. Made by the Acorn Radio Mfg. Co., 1806 S. Racine Ave., Chicago, Illinois



BAKER RADIO CABINET

A quality cabinet which is shipped knocked down. There are four pieces to put together requiring the insertion of but eight screws into holes already drilled. The assembled cabinet is strong and built throughout of finely finished mahogany. Made by the Baker Yacht Basin, Inc., Quincy Point, Mass. Prices range from $4.75 to $13.50 for cabinet sizes from 7 x 7 to 7 x 30



THE CROSLEY AMPLIFIER

Shown here is a two stage, single rheostat controlled audio-frequency unit. This unit gives very good results when used with receivers requiring audio amplification. Made by the Crosley Radio Corp., Cincinnati, Ohio. Price $18



RED SEAL VARIABLE CONDENSER

A high efficiency instrument using brass plates, which are soldered to make a perfect electric joint at the plates, and "pig-tail" connections thus eliminating contact troubles. Made by the Manhattan Electrical Supply Co., Inc., 17 Park Place, New York City

FADA Radio



FADA Neutrola Grand
No. 185/90-A

This is the five-tube Neutrola 185-A mounted on FADA Cabinet Table 190-A. Price (less tubes, batteries, etc.) $295.

The high, sweet notes of the violin—the low, rolling bass of the organ

TONE quality—true reproduction of voice and music without distortion—is one of the outstanding features of the new FADA Neutrodyne. You hear the music just as it is played or sung.

FADA Neutrodynes can be depended upon at any time, anywhere, to give you the utmost in radio. They operate on a simple indoor or outdoor aerial and use the types of powerful tubes which give maximum results. Each bears the stamp of FADA engineering skill plus the artistry of master cabinet designers.

You who have deferred buying a radio set—waiting for someone to produce just your combination of price, performance, cabinet design and finish—need wait no longer. In the new complete line of FADA Neutrodyne receivers you can find exactly what you want.

See your dealer. He will show you a FADA Neutrodyne that will delight you—in appearance, performance and price.

You have a range from $75 to $295 from which to select—six models, each a remarkable value.

F. A. D. ANDREA, INC., 1581 JEROME AVENUE, NEW YORK



FADA Neutroceiver
No. 175-A

Mahogany cabinet. Inclined panel and roomy battery shelf. Five tubes. Price (less tubes, batteries, etc.) $160.



FADA Neutro Junior
No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) $75.

F. A. D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC. NEUTRODYNE

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

MYRA MAY is now in France where she is writing and traveling about. "France has French-ized all the American radio terms," she writes. "They say radio with the same "a" as in brad, and an "e" for the "i." The French broadcasters don't run a twelve-hour-a-day show, but broadcast only during special hours. You must take your choice of what they give you, which may be anything from a lecture on roses to instruction on how to kill tigers."



MYRA MAY

CHARLES ORCHARD is associate editor of the Chesapeake and Ohio Railroad employees magazine. On reading Miss Mix's "The Listeners' Point of View" several months ago, he says that he grew interested in an angle of musical appreciation brought out by something she wrote. "Is Radio Making America Musical?" was the result.

THE PHOTOGRAPH shows McMurdo Silver wiring up one of his portable super-heterodyne receivers which he describes so ably in this number. It was taken in the RADIO BROADCAST LABORATORY at Garden City. "My life history" he says, "has been exactly like that of any other radio enthusiast. My first set used an electrolytic detector and a thread spoon tuning coil and brought in trolley car noises with very good volume—in 1912."



MCMURDO SILVER

J. H. MORECROFT confesses that one of his favorite diversions is caring for his tribe of bees at his place in Jersey. However, we would rather mow a 3,000 foot lawn than be friendly with the bees. Professor Morecroft has just returned from a vacation and will soon resume instructing his Columbia University classes in electrical engineering.

WILLIS K. WING whose "The Case Against the Radiating Receiver" appears in this number, is a member of the editorial staff of RADIO BROADCAST. He has "sold" wireless messages in the blue-and-gold of a ship wireless operator ever since 1915. "My only claim to fame," he says, "is that I have never said 'Radio is only in its infancy.'" How odd!

THE RADIO PROGRAM directors are still making life interesting for Jennie Irene Mix, whose radio receiving studio in Toledo, Ohio is the headquarters for some of the soundest and most delightful criticism we know. "I am looking forward to some excellent and greatly improved radio programs this fall and winter," writes Miss Mix.

ZEH BOUCK, after putting his radio friends in a perfect stew of excitement and envy over his elaborately planned and advertised European vacation, disappeared from New York one day. When next heard from, he was in Atlantic City, making feeble inquiries after the inventor of the bathing suit, for what reason we won't even hazard a guess. When the cool weather of the fall comes on, radio amateurs will begin again to hear his staccato "fist" and his familiar call—2 PI.

R. ERNEST DUPUY is a captain in the Field Artillery, United States Army, now stationed at Fort Ethan Allen, Vermont. Like many of us, he started out to investigate the fascinations of radio when it was simply wireless and when one kilowatt transformers were as scarce as gold antenna wire. And again, like many of us, his interest in radio hasn't ceased. Few men could write as interesting a chapter from their experiences as Captain Dupuy has done in this issue.



CAPTAIN DUPUY

WALTER VAN. B. ROBERTS has transferred his base of operations to New York. For the time being, he has left the classic confines of his alma mater—Princeton. The next installments of this readable and helpful technical story of his are even more interesting and more helpful than those which have already been printed.

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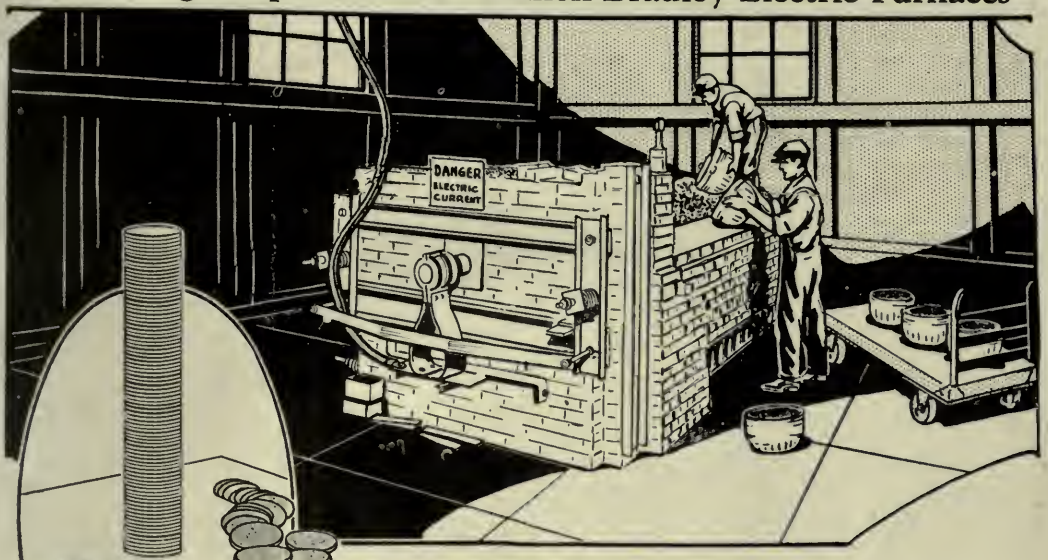
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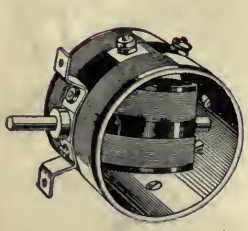
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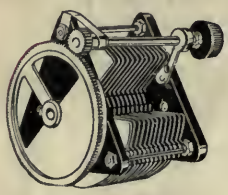
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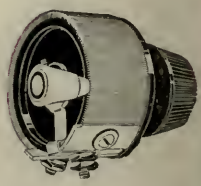
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