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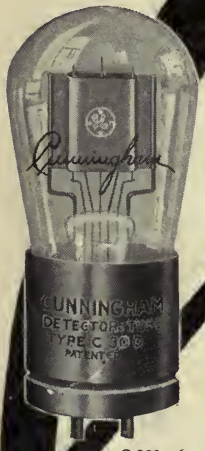
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RADIO BROADCAST

Vol. 6, No. 1 November, 1924

Will Radio Make the People the Government?

Democracy Is Government by Public Opinion and Radio Broadcasting is Bringing Politics Into the Front Parlor—Will Those Who Listen Vote?

BY MARK SULLIVAN

ONE afternoon during the Democratic Convention in July, a Texas delegate remarked, "This will cost Texas a million dollars in its cotton crop through farmers staying away from the fields to listen in on the radio. But," he added, "it's worth it. It'll let everybody know just who's who and what's what in this convention."

Whatever accuracy his judgment may have had about the money involved, his deduction about the effect of the radio on that Democratic Convention was correct. There was one day in which the news of it might have been compressed by the practitioners of that most compact of arts, the headline writers into something like: "Western Radio Fans Listening-in On Convention, Hear New York Hiss Bryan, and Telegraph Delegates to Stand by Commoner." That quickness of response on the part of public feeling is going to be one of the effects the radio will have on politics. Coupled with its widespread use, its ultimate universality, it will work several political transformations. In political conventions, and in every other sort of political discussion, the thing most ardently desired by everybody who has confidence



JOHN W. DAVIS

Democratic candidate for President, campaigning by radio. Radio is aiding the people to find out just what each candidate says he stands for. Probably the most notable feature of the 1924 campaign is the use of radio by all three candidates

that his position has popular support, is quick access to that public, and facility for the public to express itself.

This increase of facility is one of the things the radio will bring about. Popular support existed to some extent before; and to the degree that it existed, it was the most powerful of political leverages. For the fact that Woodrow Wilson had a political career, the largest single contributing factor was an incident at the Democratic Convention at Baltimore in 1912. During all the early days of that convention, Champ Clark was in the lead, with Wilson a second, at one time so destined, apparently, to be permanently a second, that some of his advisers counseled him to withdraw, after Clark had pushed his leadership to the point of an actual majority. Just about that time, however, the convention adjourned over Sunday. During that week-end adjournment, the convention and the individual delegates were flooded with telegrams demanding that Wilson be made the nominee. It was through this pressure from the country that the Democrats took the unprecedented step of refusing the necessary two thirds to a candidate who had already got more than half the delegates, rejected Clark, and nominated Wilson.

BROADCASTING CONGRESS

THAT is the kind of thing that is going to be greatly accelerated by the radio. We have already had the radio for the first time this year in the conventions and in the acceptance ceremonies of the candidates. Undoubtedly the proceedings of Congress will soon be broadcast, I think. A public that got so much interest out of the Democratic Convention will insist on the same access to Congress. And Congress as a whole won't be disposed to deny it. There is already a bill pending providing for the installation. The bill was introduced by Senator Howell of Nebraska. Senator Howell was one of the very earliest radio zealots in America. He was acutely interested in it and active about it long before most of us paid any attention to it. Senator Howell has a scientific thread in his training that he got from his education at the Annapolis Naval Academy. Also, he is a most earnest believer in the public ownership and management of utilities that concern the public generally. Before he came to the Senate he was, as the manager of the city gas system of Omaha, one of the earliest, and possibly the most successful, director of a publicly owned utility in the United States. Senator Howell heard about the use of the radio in Europe quite early, and some three years ago made a trip to Vienna to study its working in that city. He thinks strongly that the radio should be facilitated in every possible way as a medium between the people and the Government. Due to his own bent and experience, he would take an earlier and longer step toward identification of the radio with the Post Office, for example, than most of his fellow senators now think practicable or desirable. Short of that, however, there is little doubt that his bill to equip the two Houses of Congress for the broadcasting of speeches and other public business will be adopted. I don't know of any public man who opposes the idea of the maximum possible radio dissemination of all forms of public business and public discussion. If any of them have qualms, they won't state them publicly, for they know it is an innovation that cannot be stopped. Theoretically, a politician may believe in some other form of government than through public opinion or public emotion. But practically they know that it is the form of government that is now here. And if you assent to the principle of government by public opinion, you must assent also to the doctrine that the wider the dissemination of public information, and the greater the number of persons enabled to participate in the formation of common judgments and common reactions in the shape of emotion, the more logical it is.

HOW IS RADIO GOING TO BALANCE POLITICAL FORTUNES?

POSSIBLY we shall have some erratic, some curious and unanticipated results in the fortunes of individual politicians and leaders. There appears to be such a thing as a radio personality. In the present campaign it is claimed that Coolidge has it, while Davis has not. A correspondent of a Democratic paper, Mr. Charles Michelson of the New York *World*, wrote about this:

Mr. Coolidge is no orator. There is a wire edge to his voice, due in some degree to the regular nasal twang of the thirty-third degree Yankee and in part to his meticulous enunciation of each syllable; but according to the professors of the new art, he has a perfect radio voice. The twang and shrillness disappear somewhere along the aerial, and he sounds through the ether with exact clearness as well as softness. Mr. Davis, on the contrary, has a voice which to the direct auditor has that bell-like quality of resonance that doubles the

quality of his delightful rhetoric. Via radio, however, this muffles and fogs to some extent. The radio was perfected just in time for Mr. Coolidge. His adversary has all the best of it in presence and personal magnetism. Davis is tall, with a face that would fit in a group picture of the signers of the Declaration of Independence and features like an idealistic medallion. Coolidge looks shorter than he is; his features are sharp and give a probably unjust impression of peevishness. Before an audience Davis glows, while the President always looks unhappy whether he is or not. Under these circumstances, the radio must be Mr. Coolidge's salvation. He doesn't look as if he had the physique to stand the strain of an old-fashioned campaign—half a dozen speeches a day and traveling every night for months—in the first place, and in the second his hard, statistical, analytical method of expression is scarcely calculated to counterbalance the unimpressiveness of his appearance. So the advent of radio must be listed as one more item in the total of the Coolidge luck or destiny or whatever it is that seems to make things come right for him politically.

Who Is the Government?

Some pessimists like to think it is the Senate, some the House, more think the Government is the President, and some few seem to think it is the Supreme Court. But when the broadcasters began sending out the Republican and Democratic conventions, the political observers with their ears to the political ground began to wonder. It took no seer to observe that the "peepul" were again taking an interest in politics. And during this campaign, very largely being conducted by radio, politics is prowling right into the front parlor.

What is going to happen? Mark Sullivan, who contributes a political article to *World's Work* each month, and whose daily stories from Washington in the New York *Herald-Tribune* are counted some of the most authoritative and interesting in the field of political writing, considers these questions:

—Is Congress Going to Broadcast?

—What Is Radio Personality?

—Can Broadcasting Replace the Congressional Record?

—What Is Going to Become of the Old Line Political Speaker?—THE EDITOR.

ARE OUR SPEAKERS GOING TO BE DIFFERENT?

I HAVE speculated a good deal, without arriving at any very competent conclusions, about what the effect of the radio will be on Congress as a whole and on individual politicians. Just what type of public speaker will the people prefer to listen to? One of the premier Marathon talkers in the Senate is Heflin of Georgia. Without having measured the lines in the *Congressional Record*, I should say off-hand that Heflin is one of the greatest long-distance speakers, one of the most nearly ever-flowing fountains of words, in public life. When a newspaper man hurries into the press-room on his way to the gallery, fearing he may be missing something important, and finds the bulk of the newspaper men chatting in the ante-room, the explanation they most generally give him for their temporary retirement is that "Heflin is talking." Or they remark, "There is nothing important on. Heflin is delivering the twenty-third installment of his attack on the Federal Reserve Board."

As it happens, it is the depraved taste of the writer of this article that elevates him to the distinction, rather uncommon among newspaper men and among senators, of liking to listen to Heflin talk. Heflin is not a beautiful person, but he has two engaging qualities: He has that agreeable intonation of the South—and he can tell Negro stories better than any other man in public life. I would venture more and say that Heflin can tell more Negro stories and better ones than any professional entertainer. Heflin knows the difference between a stage-carpentered Negro story and the true Negro story, the kind that reflects the real soul, the habit of thought, the way of looking at things, of the genuine unsophisticated Southern colored man. And Heflin doesn't tell his stories merely for the sake of being amusing. He adapts them to the situation he is discussing with an art that is often rather more effective than heavy logic.

As to the soundness of Heflin's economics, or the high-mindedness of his political arts, there is some difference of judgment. They tell a story about Heflin. That is, they repeat something that Heflin is alleged to have said on the stump in Alabama some years ago. I never heard Heflin address an audience of Alabama farmers in the hills far back from the railroads. I should like to. For there, I should imagine, Heflin would be at his best. In any event, disavowing personal responsibility for the authenticity of the story, I repeat it in the same spirit in which Heflin repeats his

stories about Black Sam and Mollie the cook. Heflin made a campaign for the Lower House in the year at the beginning of the War, when cotton was at six cents a pound. Then he made his appeal for the Senate in 1918, when the war-time demand had got under way and raised the price of cotton to upward of thirty cents a pound. All this economic and political history Heflin is alleged to have summed up to the Alabama farmers in a passage running thus:

"You good folks, you-all sent me to the Lower House of Congress when cotton was six cents a pound, and then you saw cotton go right straight up to thirty cents a pound. Now, good folks, you send me to the Upper House of Congress, to the high-up place—you send me to the Senate, and then you watch where the price of cotton will go to."

Unhappily it was soon after Alabama elevated Heflin to the Senate that the War ended and cotton descended rapidly to under ten cents a pound—which unkind reversal of fate, some members of the Federal Reserve Board believed, had more than a little to do with Heflin's Senatorial attacks on them as the authors, according to his theory, of the deflation of the price of cotton.

Let the Non-Voter Beware

For this year, great efforts are being made to bring the sluggish voter to the polls. With radio interesting great additional groups of citizens in the affairs of government, many organizations are pushing a "Get-Out-the-Vote" campaign. The National Association of Manufacturers is coöperating with the American Radio Association to appeal to the voter by radio and by newspaper announcement. And the Boy Scouts of America are going to make a personal canvass designed to reach every voter. James E. West, Chief Scout Executive, says in a letter to Radio Broadcast, "It seems to us that this problem offers the Boy Scouts of America an excellent opportunity for applying its method of 'learning by doing' by having scouts make an earnest effort to increase the voting average of their respective cities and towns, beginning with their own homes and neighborhoods, entirely on a non-partisan basis." There are many who think that the noticeably increased interest in practical politics is due in a large measure to radio.
—The Editor.

SENATORIAL NEGRO STORIES BY RADIO?

WILL the radio audiences want to listen to Heflin's Negro stories? Or will they prefer the less ornate, the less mellow and mellifluous but rather more austerely accurate facts and figures of a speech on the tariff by Senator Smoot? If the radio audience has the same reaction as the personal presence audience, it should work out all right. Last winter the two senators whose speeches were most certain to draw an audience to the Senate galleries were Borah of Idaho and Walsh of Montana. In those two cases, the size of the gallery audiences were in direct proportion to the fundamental merit of the speeches and the speakers.

A good many questions will arise about distribution of time. We have already seen that the radio is making its own imperious demands about a preferred hour. In 1920, before the radio came, the two candidates for the Presidency, Cox and Harding, both timed their acceptance speeches for the afternoon, because from three to five o'clock were the hours most convenient for the greatest number to be there in person. This year both the candidates timed their acceptance speeches with a view, not to the audience, that could actually be there, but to the radio one. Eight o'clock in the evening, in the Eastern territory where population is densest, seems to be the hour accepted as best adapted for the largest number of radio listeners. Presumably, when the radio reaches into Congress, that will be the most prized hour. If it is, there will result a change in the hours of the sessions for the common system now, except in the congestion at the end of a session, is for Congress to sit from eleven in the morning until five in the afternoon.

CONGRESS WILL BOW TO RADIO

THAT mere change of working hours will be minor compared to complications about assigning the preferred hour to the speakers who will want it. Probably the outcome will be a wholesome increase in the potency of party leadership. It would seem probable that with the radio installed, each party will tend to gravitate about one leader or a small group of leaders, and will tend to give these leaders the preferred hours for the formulation and dissemination of official party policy. One hopes that there will not be too much disposition on the part of the radio listeners to give their ears to the entertaining

speaker rather than the sound one, or the ones chosen to give official expression of party policy. One wonders just how it will be determined what speakers the radio listeners want to hear—and what ones they want to "walk out on."

RADIO NEEDS A "GET OFF THE EARTH" SIGN

THE radio so far provides no means for the listener to shout "Get Off the Wire!" or "Get Off the Air!" or "Get Off the Earth!" or whatever else it is that an irritated radio listener should say to a politician who bores him, or excites his opposition. Of course, the radio listener, so far as he is concerned individually, has the most effective possible means of giving a boresome speaker permission to "take the air" in another than the radio meaning of that phrase. All the listener has to do is to turn his dials and put his mind on the more agreeable harmony of a concert. The difficulty is, that this method lacks a certain kind of personal satisfaction. It does not provide the listener with a mechanism for conveying to the speaker the information that the listener is through with him. It fails to give the listener that agreeable and wholesome outlet for a surging emotion that comes from rising in his seat and marching stiff-necked toward the door. At the same time, it has compensations for the less combative and the more courteous. From a radio audience you can tiptoe your way out without suffering the embarrassment of the feeling that you may be disturbing your fellow-auditors.



A TELEPHONED PHOTOGRAPH

Of the Republican convention at Cleveland. The linking of wire photography and broadcasting has brought the Nation in almost immediate touch with political events. Mrs. Florence C. Porter, of California, is seconding the nomination of Calvin Coolidge. The microphones can be seen at the top of the lectern



NIGHT SESSIONS OF CONGRESS

Will become very important if the legislative arm "speaks" through the microphone, for only a comparative few could listen during the daylight hours

YOU CAN'T FOOL THE RADIO

THE fundamental merit of the radio in Congress will be that it will enable the public to get its information direct. At present, aside from those speeches from men who, because of one distinction or another, have all their speeches printed in full—aside from these, the public is now dependent on the vicarious censorship of the newspaper re-

porter. It is the reporter who ignores some speeches, makes mere allusions to some, and transmits extracts from others. In all this exercise of judgment or taste, there are the aberrations that inevitably accompany any individual judgment. Undoubtedly one of the chief defects of the present method of reporting Congress is that it lays undue emphasis on the bizarre, the picturesque, the humorous, or the sensational. These, frequently, are the high spots picked out of speeches by the reporters, and therefore the only portions of the speeches that ever reach the great mass of the public. This is a constant and legitimate occasion for complaint on the part of public men.

I once spent some weeks at Carlsbad. It was a time when the proceedings of Congress were unusually important, and when I happened to have unusual interest in them. Again and again, in the dependence on the newspapers enforced by that exile in Europe, I was impressed with the inadequacy of the information I could get through the newspapers. I recall one day when the only news of our Congress in the European edition of an American paper consisted of a brief account of a personal controversy the late Senator Penrose of Pennsylvania had with a fellow-senator. The only direct quotation transmitted was a bit of caustic sarcasm.



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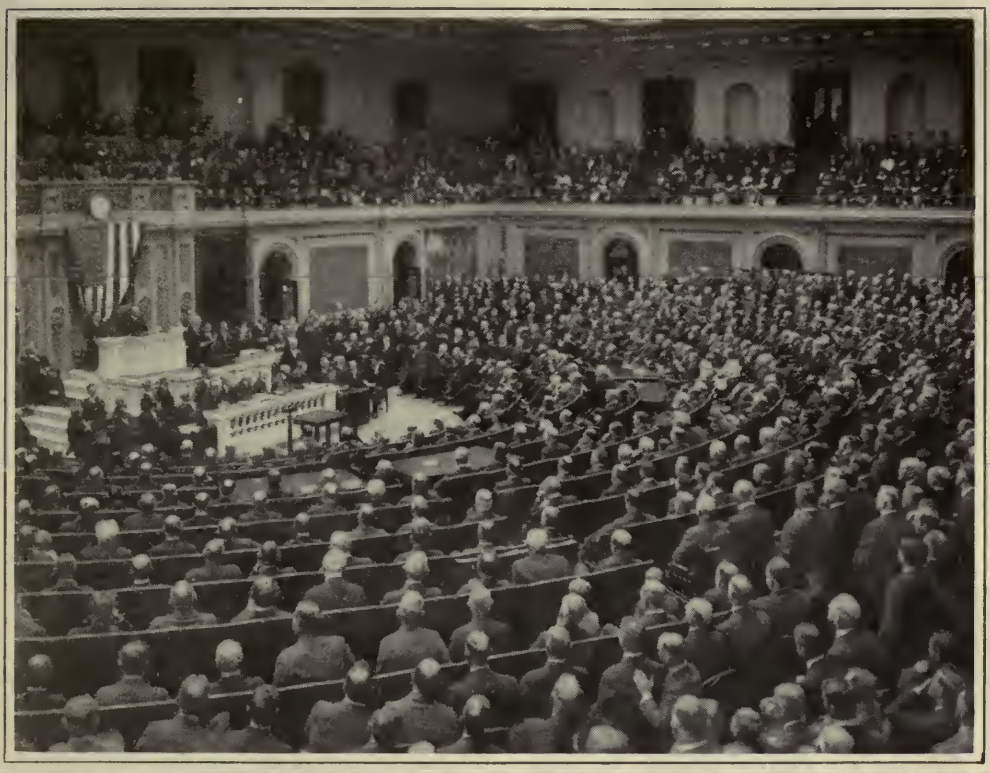
HENRY MORGENTHAU

Before a microphone in New York. Public men welcome the opportunity to address and interest the greatly increased audience the radio gives them

RADIO: DEMOCRACY'S FINAL SUPPLEMENT

WITH the radio, all this will be changed. The person who wants to listen to Congress will be able to do so, and there will be many who will want to listen. Let there be no doubt of that. There has always been in this country an immense unfilled demand in this field. I have heard it said by a competently thoughtful person that the absence of complete reports of the proceedings of Congress in a form and with a promptness available for all the public, was a real impediment to the functioning of our American democracy, an impediment so serious that it might be adequate cause for apprehension. In London, the proceedings of Parliament, with comparatively little condensation, and with only such editing as makes for clarity, are printed in full in at least three morning London newspapers. In America we have nothing like that. The nearest we have is the case of two or three New York papers which print a few speeches in full, and have a condensed summary of the rest. The reason for the difference between England and the United States is not any lack of thoughtful interest on the part of Americans in their national legislature. Americans read much more and support many more newspapers in proportion to population than the English. The difference is largely mechanical and geographical. So far as regards proceedings of Parliament in the newspapers, all England is practically one city. The British Parliament is in the largest city, whereas our Congress is in one of our relatively small cities. More than this, a London newspaper that goes to press at two o'clock in the morning can be in the hands of readers in the most distant hamlet of the Kingdom before evening. With us, California is some four days distant from the Capital, and the cost for telegraph tolls to a San Francisco newspaper that might be ambitious enough to print all the proceedings of Congress, would be prohibitive.

To offset this difficulty of ours, William Jennings Bryan and some others have repeatedly proposed some kind of official newspaper that should, through the machinery of a non-partisan Board of Editors, make and distribute an adequate official summary of the work of Congress. That idea has been proposed again and again. It has never got anywhere, for the reason, among others, that a Board of Editors sufficiently non-partisan to satisfy everybody is a dream impossible of



WHEN SHALL WE LISTEN-IN ON THE GOVERNMENT?

Mark Sullivan thinks that the time is not far distant when the proceedings of Congress will be broadcast. The average newspaper cannot give full reports of the two Houses, and the *Congressional Record* reaches but a few of the people

realization. The only thing that would meet, without criticism, what Bryan had in mind, would be a literal transcript. We already have a literal transcript in the shape of the *Congressional Record*. With that, the difficulty is its rather too great literalness. It includes such immense masses of irrelevant quotations introduced under "leave to print," and so much parliamentary minutiæ about resolutions and the like, that it is forbidding, even to a reader with the most ardent desire to follow the proceedings of his government with intelligence. I find it a strain to read the *Congressional Record*, and it is a part of my business to do so. The consequence is that of the aggregate circulation of the *Congressional Record*, which is something like thirty-two thousand, the bulk, under the system of distribution now practised, goes to little country newspapers as a complimentary gift from the local congressman; and finds its ultimate usefulness more in providing little print-shop stoves with fuel, than in the information of the public.

CAN STATIC INTERFERENCE BE ELIMINATED?

WALTER VAN B. ROBERTS has written a discussion of this much discussed subject that is as informative as it is interesting. What are the engineers doing to eliminate the present difficulties? What are the most productive lines of experiment? What results are likely to occur from the present line of investigation?

The Ways and Means of Audio-Frequency Amplification

Applying the Family Tree Method to a Non-Technical Treatment of this Highly Important Adjunct to Radio Receivers

By JULIAN KAY

THIS is the third article by Mr. Kay in the "What's In a Name?" series. The first article appearing last June, sorted out and classified the various types of radio receivers in present use. The second, in July, told the story of radio-frequency amplification. It is no secret that many new members of the radio fraternity glibly use terms of whose meaning they have not the slightest idea. The articles in this series, each a complete unit, by the use of the unique and helpful Family Tree diagram, and a praiseworthy non-technicality of treatment, aim to clear the radio air for those who find it a bit thick.—THE EDITOR.

THE criteria by which an ideal radio set is measured are two: distance and clarity. Both of these prime qualities are attained through the proper kind of amplifiers.

Preceding articles of this series have discussed the merits of various detectors, that essential radio "ear," and the means of aiding a detector to eavesdrop over a wide area—namely, radio frequency amplifiers—were explained. The super-heterodyne will be cited in a succeeding article and discussed as the most efficient combination of radio receiving apparatus known to-day.

Radio sets are now nearly complete. One can listen over great distances, and so far at least, what we hear is a fairly accurate representation of what is being transmitted at the distant station. The final problem is to supply "pep" in sufficient quantity and in such a manner that what is heard is still something like what is being transmitted.

Fig. 1 shows the position of audio-frequency amplifiers in the usual radio circuit. These amplifiers derive their specific name from the fact that they follow a detector. In other words, they appear in the low or "audio" frequency part of the circuit. The band of frequencies which they will be called upon to amplify lies between about 100 and 5,000 cycles per second.

The careful construction of an audio amplifier is really more important than most radio fans appreciate. To rush out to the corner radio shop, to grab a cheap transformer, and to jam the parts together is not the way to make a good amplifier.

There is still a morbid inclination among certain of the *nouveau* radio public which takes the indefensible form of boasting of listening to respective sets a half dozen blocks up the street, and the thrall of hearing horribly distorted music over a distance of a thousand miles seems to hold many. The fortunate tendency, however, is toward "how well" one hears rather than "how far" or "how loud."

An amplifier as the name implies, is anything that returns to you with interest whatever you give it.

Do You Know—

—How to judge a good amplifier?
—What audio frequencies are?
—How much an amplifier amplifies?
—What types of audio frequency amplification there are?
—How "quality" and "quantity" both can be secured from an amplifier?
—Why the "frequency characteristic" of a transformer is important?
—What the function of the C battery is in an amplifier?
—What a power amplifier is?

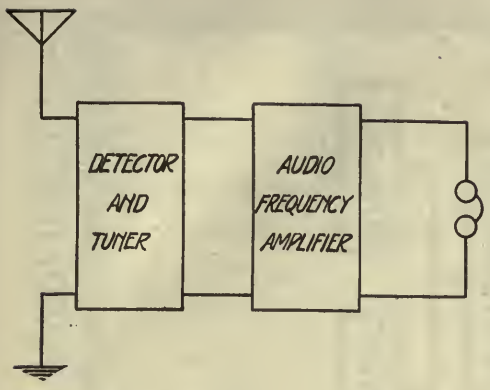


FIG. 1
Audio frequency amplification comes after the tuner and detector

A savings account, or a prize fighter incognito, are good examples. The particular type of amplifier in which we are now interested is a vacuum tube affair, like most of our present day radio equipment, and is one of the most uncomplaining contraptions that man has produced. As long as you do not treat it too roughly it returns to you with interest exactly what you give to it.

The motto of a well behaved amplifier stated in classical language might well be:

"Small favors thankfully received and large ones granted in return."

It amplifies, some "an hundred fold" and then some more.

TYPES OF AUDIO AMPLIFIERS

THERE are two general classes of amplifiers in which we are interested. These two divisions depend upon the matter of coupling two or more together. As the Family Tree shows, the first large group is made up of those which are "conductively coupled," that is, in which the output of one amplifier and the imput of the next are actually connected together either by a metallic conductor or by means of a condenser. The second group depends for the transfer of energy from one unit to the next upon magnetic coupling existing between the two windings of a transformer.

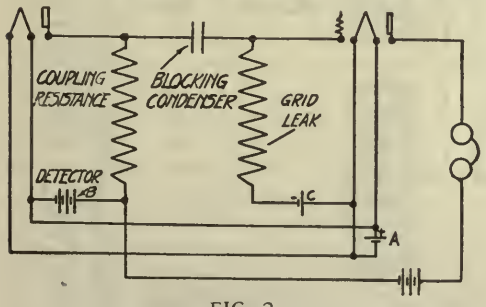


FIG. 2
A resistance-coupled amplifier unit

Resistance-coupled amplifiers, of which the general type is shown in Fig. 2, have one great advantage—(if properly constructed) in that they are distortionless. On the other hand, there is one great objection which has not as yet been overcome—they require much higher voltage B batteries for the same amplification than do the transformer or choke coil-coupled types.

If a choke coil is substituted for the resistance, the B battery objection is partially remedied, but the amplifier now has a "frequency characteristic," that is it tends to amplify some frequencies more than others with a resultant distortion. This may, however, be overcome by proper design.

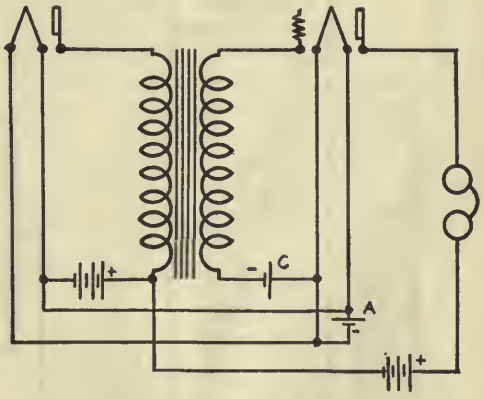
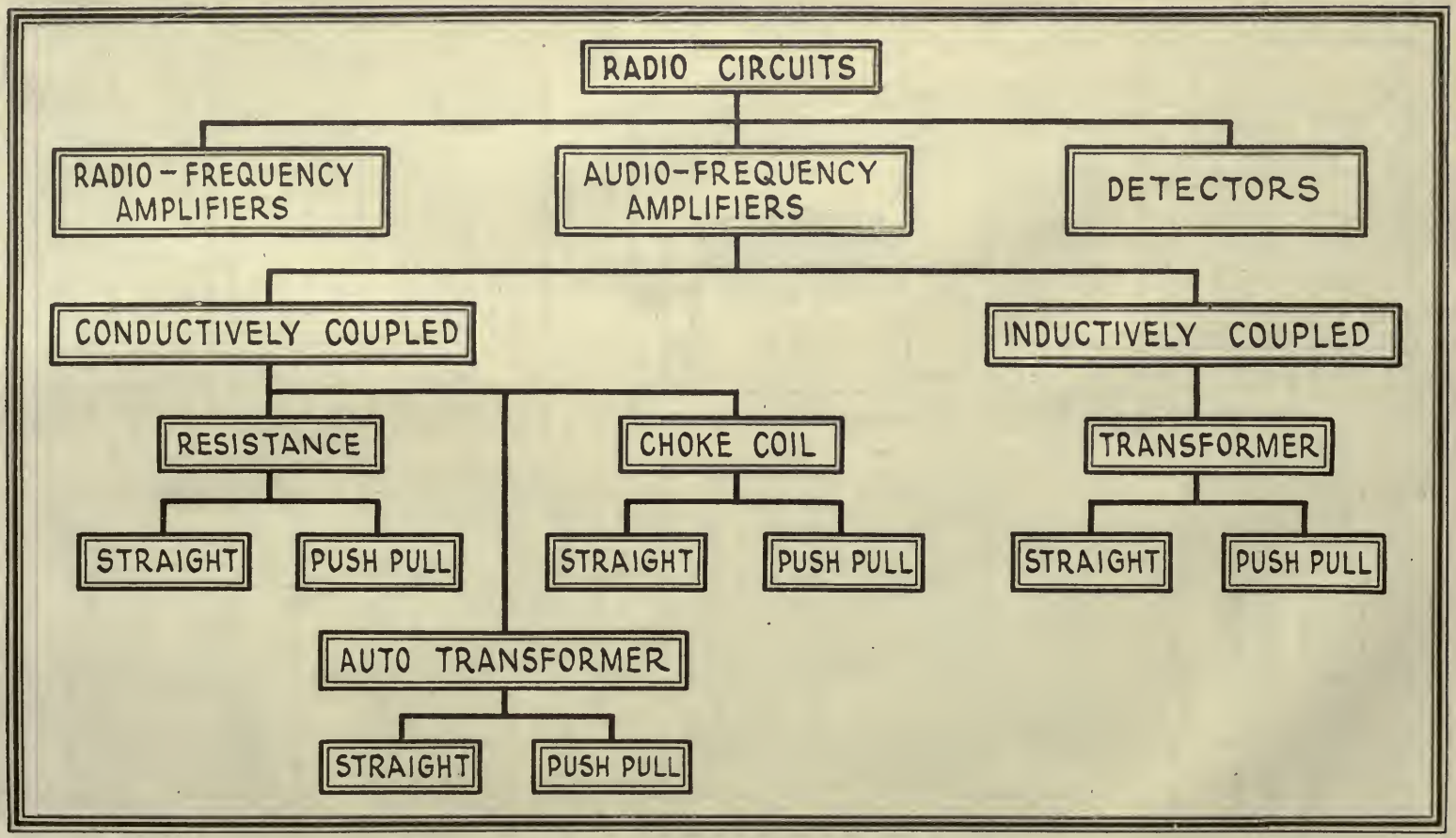


FIG. 3
A transformer-coupled amplifier. Note the use of the C battery

TRANSFORMER COUPLING

AT THE present time, the transformer is the all important link between signals that are detected and signals that are actually heard. Upon its efficiency depend the quantity and the quality of the music we hear. Unfortunately, quantity and quality seldom come in the same package, and in the case of the usual amplifier, when you have one you want the other and vice versa. And it is possible to have both.

Fig. 3 shows the customary transformer-coupled amplifier. In this diagram, the transformer looks like a simple and guileless piece of electrical apparatus—just two coils of wire on an iron core—but as the quaint saying goes:



THE FAMILY TREE FOR AUDIO FREQUENCY AMPLIFIERS

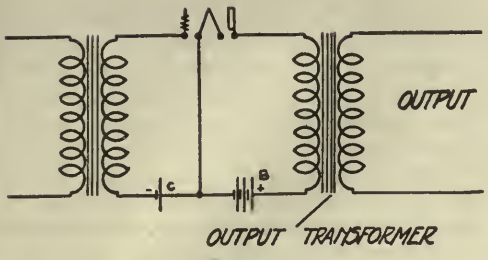


FIG. 4
How an output transformer is used

"You haven't heard the half of it."

QUANTITY VERSUS QUALITY

THE two aspects of the amplification problem—quantity and quality—are indissolubly bound up in the transformer. The first is controlled to a great extent upon what is known as the "turn-ratio." For instance, if the secondary has ten times as many turns of wire as the primary, the turn-ratio will be ten, and at the secondary terminals will appear ten times the voltage that was applied to the terminals of the primary.

If we use a vacuum tube with an amplification factor of six, the overall amplification of this combination—theoretically at least—ought to be six times ten or sixty. Actually, this is not realized since half of this voltage is consumed in the tube itself.

At this point, the question naturally arises, why not use a turn ratio of fifteen or twenty?

The answer lies in our discussion of the second amplification problem, "quality" or clarity, as it is often called.

QUALITY AMPLIFICATION

THE "frequency characteristic" of a transformer is a measure of how well the device will transmit various frequencies.

When we realize that we are amplifying musical sounds of frequencies that may lie anywhere between 100 and 5,000 cycles per second, and that each individual frequency should be reproduced for us exactly as they are transmitted, we see the value of a "flat characteristic."

Fig. 7 shows the characteristics of two audio transformers, the other apparatus being the same in the two cases. One transformer transmits all frequencies very much alike, while the other gives a tremendous amplification around a thousand cycles. Such a transformer would not give accurate reproduction and would probably present any soprano as nothing better than a terrible squawk.

Any one can make a transformer that will have a "hump" around 1,000 cycles. In fact the majority of cheap transformers enjoy such camel like humps.

The difficulty is to make an instrument with a flat frequency characteristic. If we strive for high quantity amplification, we must use many turns on the secondary, and that means a large distributed capacity which in turn means that the high frequencies will be lopped off and will not get through. If we make a cheap transformer, we economize on core and wire, and as a result the primary has a low inductance. Accordingly, the low frequencies are cheated.

And there you are.

To make a good transformer costs good money and the manufacturer must compromise. He is between the devil and that awful deep sea. If he is reliable, he makes a low ratio coil, which keeps down the distributed capacity and amplifies the high frequencies, and puts as many turns on the primary as he can afford, which brings in the bass viols and drums, and then juggles the remainder of the apparatus until he gets a good characteristic.

If people were willing to pay, say ten or more dollars for a transformer, they might get quantity and quality at once, say a high ratio transformer with a flat characteristic, but, in the immortal words of the prophet,

"What a pity we weren't all born rich."

OVERLOADING

THERE is another important aspect to the high turn-ratio coil that deserves more attention than is usually paid to it. This is the phenomenon known as "overloading," which takes place as soon as the grid of an amplifier tube becomes positive. Figs. 4 and 5 show one method of overcoming this trouble which is evidenced by "blare" and flattening of notes when an especially loud signal comes through.

Suppose, for example, that the grid of an amplifier is normally maintained at a negative potential of five volts. As soon as the voltage

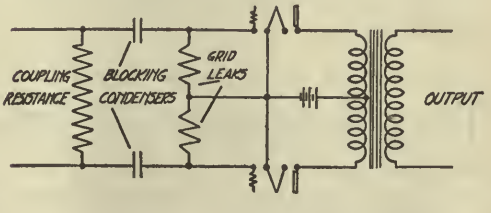


FIG. 5
The way a resistance-coupled push-pull amplifier unit is built

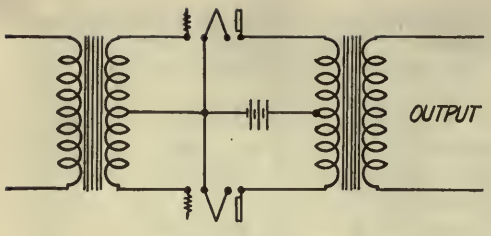


FIG. 6

A transformer-coupled push-pull amplifier. This type is quite generally used and produces much volume

applied to this grid is greater than incoming signals by five volts, the grid becomes positive during one half cycle. The result is that the positive and negative halves of the incoming signals are not amplified alike and distortion occurs.

Here is where the C battery comes in, as shown in Fig. 3. It serves two purposes, to place a negative potential on the grid and thereby to advance the overloading point, and to decrease the drain on the B batteries.

It is worth while to note at this point that a high ratio transformer with a hump near 1,000 cycles may overload at that point only —which may explain some of the wondrous squawks that occasionally greet us. Often a horn has a resonance point in the same neighborhood as the hump of the transformer, and what a wicked racket these two phenomena may produce!

Listen to any of the cheap horns that hang outside the average dinky radio shops, and then judge for yourself, if you can still think after the experience.

Another method of eliminating distortion due to overloading, is to use large tubes, say a Western Electric 216-A, and then more C and B battery voltage. Or, a push-pull amplifier of the resistance, or transformer-coupled type, as shown in Figs. 4 and 5. A resistance-coupled push-pull amplifier, which has no frequency characteristic and also quite a power capacity because of the push-pull feature, makes a good last stage in such an amplifier unit.

HOW MUCH AMPLIFICATION HAVE I?

THE overloading limit, then, is the input voltage at which the grid goes positive. This point is controlled by the kind of tube, the C battery, and the turn-ratio of the coupling transformers.

In general, the following rule may be a safe one to follow:

Any signal that can be heard with the phones plugged into the detector circuit will overload the last stage of a properly constructed two-step amplifier using "five-to-one" transformers. Fig. 7 shows exactly what this means.

Suppose each tube has an amplification factor of 6, and the turn-ratio is 5. Then the overall amplification, taking losses into account, may be around 150. An alternating current then flows in the plate circuit of such an amplifier which is 150 times that which flows in the detector circuit. If only .006 volt alternating current exists in the detector, then we must use about 9 volts negative potential on the grid of the second amplifier.

POWER AMPLIFIERS

SO FAR, we have spoken only of "voltage amplifiers." Now, then, what is a power amplifier? One hears the term very commonly used. Now it is power that runs our loud speakers, not voltage alone, and power is usually represented as the product of a current squared and a resistance. For example, if the resistance of a loud speaker element is 1,000 ohms and we have .001 ampere flowing through it, the power

$$P = 1{,}000 \times (.001)^2 = .004 \text{ watts.}$$

That means that an amplifier that is to deliver music for a large hall must have a comparatively large plate current output. This means large tubes with large plate currents, for it is the fluctuations of these plate currents that actuate the receiving device.

The last stage of a good amplifier may well be a power amplifier employing a low ratio coil, say three to one, and a large tube such

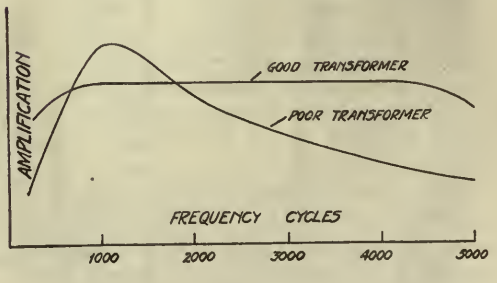


FIG. 7

A curve which shows the difference between a good audio-frequency transformer and a poor one. As the curve shows, a good audio transformer should amplify well over the entire range of audio frequencies, an end extremely difficult to attain

as the Western Electric 216-A. Better still is the push-pull already described in RADIO BROADCAST which has a very high overloading limit and a larger power output.

If one is to listen-in after the first stage of audio-frequency amplification, the high ratio coil should come first, but if a horn is to be used at all times on the second stage, it matters little the order of the transformers. If there is enough voltage to overload the last tube, it will take place regardless of whether the high ratio coil is in the second stage, or whether the coils are switched. The amplification is there in either case.

As stated previously, the ideal arrangement would be a single stage of resistance coupling followed by a push-pull amplifier with plenty of B and C battery. Finally should come a good loud speaker, usually coupled to the amplifier with an "output" transformer. Neither of these two stages of amplification would introduce noticeable distortion, and if a good horn is used, reproduction should be as faithful as is normally possible.

RADIOLATRY

By ARTHUR GUITERMAN

THE worst of all idolaters
Are zealous radiolaters
Who wreck the peace of erstwhile happy homes
With drool of variometers,
Detectors, galvanometers,
Antennae, switches, batteries, and ohms.

Their eyes devoutly glistening,
They'll sit for ages listening
With clumsy rubber muffs upon their ears,
And hail the shrieking mordancies
Of far-away discordancies
As though they were the music of the spheres.

They'll stand for prosy summaries
And monologues and mummeries
Of folks you couldn't wheedle them to see,
The rant of revolutionists,
And awful elocutionists,
Because they come from Newark, XYZ.

They'll take the driest serial
So long as it's aërial;
They'll take the saddest sentimental gush,
The ambient may squeak to them;
But if you dare speak to them
The only sound you'll get from them is,
"Shush!"

In Nome or sweet Lafcadio
There's no escape from Radio!
Then, since you cannot dodge the atmosphere,
My songs shall cheer or trouble you
From station PKW,
Because, at least, I'd rather talk than hear!

EPILOGUE

(With the kind assistance of Mr. Longfellow)

I breathed a song into the air;
That little song of beauty rare
Is flying still, for all I know,
Around the world by Radio.

(Reprinted by permission of the author from his *The Light Guitar*, copyright, 1923 by Harper and Brothers)



Courtesy *American Architect*

THE WINNING DESIGN FOR THE PARIS PRIZE

Of the Society of Beaux Arts. The problem set was the design of a transportation institute, devoted to the study of all means of transportation. The institute was to contain experimental laboratories, museums, and a hall for experiment with current inventions. The plan illustrated is the work of H. K. Beig, of the Armour Institute of Technology, Chicago. The feature of the plan is the great central mast which is designed for a radio station and a mooring mast for aircraft. Mr. Beig's application of a radio tower to a large building is an unusual piece of design

THE MARCH OF RADIO

By J. H. Morecroft

President, Institute of Radio Engineers

International Revision of Wavelengths is Necessary

WE HAVE just received a copy of a letter written by Alfred M. Caddell, Secretary of the American Radio Association, which is an illustration of the good work this organization is carrying on.

As we have repeatedly stated in these columns, the amount of spark interference encountered in the broadcast range is certainly more than is necessary. Dot and dash signals, with lots of power, come in on almost any kind of a set tuned-in on the lower wavelengths of the radiophone channel. And how unnecessary much of this traffic seems. The power used is frequently enough, it seems, to reach to Chicago even though the traffic is being carried on over a span of perhaps fifty miles.

The boats of the New England Steamship Company have frequently been the culprits in the matter. They sail from New York and a short distance up the New England coast, and

they surely seem to have lots to say over the radio channel. Naturally the authorities of the steamship company think that this traffic is important. In this case, it seems that their opinion cannot be considered very seriously in view of the hundreds of code-reading listeners who hear everything said by their ships. Many of these listeners know the code and the proper procedure for carrying on radio traffic perhaps better than their own operators.

The tone of Mr. Caddell's attitude toward the steamship company is well shown by the following paragraph from his letter.

> Undoubtedly you know that there is a national regulation that specifies that all communication must be carried on with the least possible power, but qualified observers who have logged this Long Island Sound traffic, report that your operators use a considerable excess of power. And this, combined with the obsolete spark system employed results in a very coarse, poorly tuned signal that blankets the upper scale of the broadcast wavelengths and hashes up the finest programs.

In his answer to Mr. Caddell's letter, C. J. Pannill, General Manager of the Independent Wireless Telegraph Company, which controls the offending ships, disclaimed responsibility for the situation, stating that it was a question of wavelength assignment only, as the 600 meter (calling wavelength) and 706 meter (traffic wave) channels were too close to the broadcast channels so that it was impossible to carry on his traffic without the interference complained of. The letter made no comments regarding the alleged improper practices of his operators. Apparently the broadcast listener is not the only one who feels that the Radio Corporation is charging all the traffic will bear, as one sentence in Mr. Pannill's letter indicates—

> You ask that the company change the apparatus at present employed (spark) to tube transmitters, but this is not possible *owing to the prohibitive price asked for these transmitters.*

His letter, even though it did not promise any relief from the interference caused by the ship traffic, did bring up a question which will certainly bear investigation at this time, that is, the general matter of wavelength assignments. When the present allocation of wavelengths was made by international convention in 1912, radiophone did not exist to an extent worthy of attention, so naturally no consideration was given to the probable demands of the broadcast channels. Broadcasting was undreamed of then.

It is just possible that the marine radio traffic may well be carried out on a much longer wavelength than at present, as Mr. Pannill



RADIO IN THE GRAND CANYON

Of the Colorado. A recent exploring party of the United States Geological Survey brought with them a radio receiver. A 200-foot antenna, secured to one of the walls of the canyon, brought in signals from many broadcasting stations. Station KHJ, Los Angeles, broadcast them nightly news and weather reports

suggests, and it is also possible, in our opinion, that the naval service is monopolizing an altogether too wide a frequency band. In time of war, of course, the naval service should have any and all wavelengths it needs. In peace time there is no reason for shutting other services out of such a wide frequency band as is now done. A reasonable curtailing of the frequencies now set aside for the army and navy would not seriously interfere with the needs of these services. Certainly it would make available channels much needed for other purposes.

Real Romance In Radio Science

IN THE most recent list of "Standard wavelength stations" published by the Bureau of Standards, station WBZ, of Springfield, Mass., appears. This station has shown a maximum deviation from its assigned frequency of 890 kilocycles of zero per cent. since the Bureau began their measurements in May of this year. The physicists of the Bureau measure and record their readings to 0.1 per cent. and as WBZ is recorded as zero per cent., this means that the observed frequency was never as much as 0.05 per cent. away from its assigned value.

To a technically trained man, such a performance means much more than it does to the average broadcast listener, who has never had to make any accurate measurements. To illustrate what this precision means, let us suppose that we are ordered to cut off lengths of copper wire exactly one inch long. Could we do this as accurately as the radio station engineer maintains the specification for his frequency? And remember that measuring an inch with a rule, or whatever else we use, is apparently a much easier task than to measure the frequency in hundreds of thousands of cycles per second, of an electric current which cannot be either seen or held while the measurement is being made. And remember also that the current to be measured is generated in Springfield, Mass., while the measurer is stationed in Washington, hundreds of miles away.

What would it mean to be able to cut the piece of copper wire an inch long, an inch within 0.05 per cent.? Well, this would require that the wire would have to be an inch long to within one half of one thousandth of an inch. If your hair is light in color, one hair is about 0.003 inch in diameter, whereas if you are fortunate enough to have red hair it is as much



THE WORLD AT THE EDGE OF A MAINE LAKE

This radio set did yeoman service in breaking the deadly quiet of long summer evenings in a Maine Camp. The home-made birchbark loud-speaker horn gives plenty of camping "atmosphere"



OFFICERS OF THE RADIO MANUFACTURERS' ASSOCIATION

Recently organized in Chicago. The association was formed for the purpose of "improving and stabilizing the industry" and more than one hundred million dollars of capital is represented. H. H. Frost, President, is in the center, Frank Reichmann, Vice President, at the left, and A. J. Carter, Secretary, at the right

as 0.005 inch in diameter, so we can say that the piece of wire would have to be cut to the right length to within one tenth of the diameter of a red hair!

Pretty difficult to carry out, you will admit, yet this percentage of error allowed is the same as that within which the radio station keeps when the Bureau of Standards specifies that its frequency is as accurate as they find it for WBZ.

The engineers of the Western Electric Company talk nonchalantly of measuring the frequency of a radio station to within 0.01 per cent., and are actually making measurements to within 0.001 per cent. with only a small probable error! Sometime in the future a note on this remarkable achievement will be included in these columns, as this work surely is indicative of the March of Radio.

Pershing's Farewell Address

FEATS of broadcasting occur so often these days that their recording excites but passing interest. When broadcasting began, the charmed and thoroughly interested listeners were content to marvel at the mystery that allowed them to sit in the fastness of their own libraries and hear the voice of a distant singer or speaker. But now, and broadcasting is still young, the world's folk have accepted radio in the sense of broadcasting, and made it a part of their daily lives. If one were inclined to doubt that, a little more than casual glance at the daily newspaper would convince him how true this is. When cartoonists are using radio loud speakers and variously labelling them "Loud Politician," "Public Appeal," and the other tags so dear to the cartoonist, and newspaper humorists phrase their daily fun in radio terms, they are truly reflecting the thought of the times.

So when John J. Pershing, the retiring General of the United States Army, made his farewell speech on September 12th from eighteen broadcasting stations, fairly blanketing the nation with his voice, there were probably not many who listened who marvelled at the event. Stations from New York to California, and from Illinois to Texas were linked together by the wire lines of the Bell system to a microphone in the office of Secretary of War Weeks, where the ceremonies took place. There is probably not a town in the United States where the signals did not penetrate.

When Washington made his farewell to that handful of officers and men gathered at Rocky Point, New Jersey, in 1783, his voice was heard by that scattering few only. But now, the retiring General of our Army speaks to the Nation.

The linkage of these stations was a feature of the much-discussed National Defense Day and has furnished an excellent example of the service broadcasting may be to the Nation in time of national need. One wonders if the country would have been more deeply and perhaps quickly influenced in 1917, could they have heard Woodrow Wilson give his famous message to Congress, urging it to declare a state of war against Germany. It is certain, anyhow, that through radio broadcasting, the whole Nation can be linked to Washington, and brought into the very halls of government when necessity arrives.

We think it a bit unfortunate that the radio amateurs were not given an opportunity to show what they could do. The American Radio Relay League is now so well organized, and has so many expert member-stations,



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THOMAS EDISON

Inventor; East Orange, New Jersey

"There is not much in the radio being used for political campaigns this year. People like jazz music; they like to hear about contests such as the Democratic Convention, but to sit and hear a political speech—I'll tell you a story.

"A reformer went to Sing Sing to deliver a reform talk to the prisoners. He started in with that reform talk, you know, and kept up talking and talking until he had them all bored to death. He talked for an hour, and then some one—a colored man—let out a yell. A guard hit him over the head and knocked him senseless. When he came to in about an hour, the reformer was still talking. The man called the guard and said: 'Hit me again, boss, I can still hear it.'"

most of which are efficiently run and well equipped, that the organization should have been recognized in the same fashion as have the broadcasters.

Censorship in Radio Broadcasting

THE suggestion that the broadcasting stations of the Radio Corporation are censored, with all the sinister thoughts that such an idea arouses, soon drew an emphatic denial. The statement was made in one of the newspapers that "Officials of the Radio Corporation of America explained that it was their custom to require written copies of proposed radio addresses in advance of delivery, and to forbid any utterance that they considered unsuitable for transmission."

The next day, the President of the Corporation, General Harbord, wrote a letter to the paper in question stating that "it is not at all the policy of the RCA to censor the political speeches of the accredited political representatives in the coming elections." He further states that "when we have asked for an advance copy of a scheduled broadcast speech it has been when the subject was of a commercial nature, or other than political, and with one of the ends in view, either when it was desired to give advance publicity to the speech or when it was desirable to make certain that the speech was of a nature at once acceptable to the listening public."

Shall Prisoners Have Radio?

THE day has gone by when prisoners are hung up by the thumb or stretched on the rack periodically to convince them that the way of the law is best. We nowadays see to it that prisoners have light and fresh air—two of life's necessities without which any human being is soon transformed into a society-hating beast. Theoretically, any influence which will instill into the prisoner's mind the idea that law breaking doesn't pay, that the life of unharried freedom outside the prison walls is the only one worth while, should not only be allowed in the prison but should be incorporated as part of its regular régime.

What then about radio sets being allowed in prison cells? The contact with the outside world which radio makes possible for the prisoner cannot do him any harm, the social reformers say, and may do him some good.

A recent letter to us suggests that we express an opinion on the use of radio in prison. Having the normal amount of sympathy for the fellow who has been unfortunate enough to break the law and get caught (there are many law breakers who are not caught) one's natural reaction is to say, "Surely, let radio do its bit to make the prison life a little brighter." About the time we reached this conclusion, along came an announcement from the warden of the Pennsylvania State Penitentiary that a prisoner who had been allowed to have a radio set in his cell had been receiving code messages from one of his pals on the outside

as to how dope would be smuggled into the prison. The scheme, according to the story, had been working successfully.

All of which goes to show that one's sympathy may lead to an unjustified decision. So now we would say let the possession of a radio receiving set be allowed for "good conduct" to be immediately taken away for infringement of the prison rules. Such use of radio might prove quite an incentive to good behavior.

Telephoning to England

WE ARE always inclined to think of the United States as the one place on earth where things are planned and carried out on a tremendous scale. We have ranches in the West which have more space in one field than that in the largest farm in the little island across the sea; our buildings have fifty stories, our corporations have a capitalization of a billion dollars, we have more telephones in two of our cities than there are in four of the world's continents, and so on. Naturally we have thought of radio in America in larger terms than that of England and other nations. According to information of the Department of Commerce, we are surely to be outdone, in no uncertain way, in the size of radio stations. The English are putting up a station with an antenna a mile and a half long and half a mile wide, supported on twelve masts each 820 feet high! Each of these masts weighs 300 tons, and are being moved in sections so large that the transportation can be carried on only at night. With each mast an elevator is installed, large enough to take up four men.

It is understood that with this station the American Telephone and Telegraph Company expects to establish transatlantic radiophone communication. With the radio link established, the feat of telephoning from one's home to that of a friend in England will be an every day possibility.

Radio Invades the Apartment House

THE tendency to make the modern apartment house thoroughly up to date is well illustrated by the attempt on the part of the builders to incorporate radio reception as part of their service. In many apartment houses the antenna question is acute—and is becoming more so every day. One of our friends told us the other day that he had succeeded in discovering which of his fellow cliff dwellers persisted in using a blooper for a transmitter of unassigned and variable wavelength. Having been told by the oscillating set owner (after judicious questioning)



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SENATOR ROBERT M. LA FOLLETTE

Independent Progressive nominee for President, rehearsing a speech for Dr. Lee De Forest's "talking movies." All of the Presidential candidates intend to use this device in the 1924 campaign. It should be possible to use this device for radio speeches, such as Senator La Follette gave on Labor Day

where the offending antenna was located on the roof of the apartment house our friend crept up in the quiet darkness of that evening and with a vigorous tug, dislodged the pole on which the howling receiver antenna was fastened. To his surprise he learned the next day that he had also pulled down seven others. Evidently such a situation, and there are many like it, bids fair to start a real intramural war.

To avoid just such a situation, one apartment house has just been fitted with four antennas and receiving sets located in a "radio central" with an operator in charge. Each apartment has wires leading to the radio room and these can be plugged into any one of the four stations which the operator has tuned-in. It is necessary for the apartment house dweller to buy for himself an audio amplifier and loud speaker. This service will be appreciated by those who listen to complete programs. The real radio enthusiast we fear will have to buy a super-heterodyne, or a "knock-out" set of some sort, in addition to the apartment house set. Many are the listeners who still spend interesting hours in the absorbing chase of the DX signal. Maybe the stuff is no good when he gets it, but getting it—that's the thing that still fascinates.

Radio in the Modern Hospital

AT THE new Hunts Point Hospital, in the Bronx, New York each room is equipped with a radio plug. On the roof of the hospital, is the operator and the radio set. The audio output of the set can be received in each of the rooms by the use of head phones, which is the only feasible scheme of reception in a hospital where loud speakers are out of place.

The President of the hospital board, in commenting on the installation said:

> We have spent $500,000 in making this hospital the most modern institution of its kind in the Bronx. Its equipment, from the operating room down through the entire plant, is the most modern and scientifically perfect obtainable. But I do not believe that there is a single modern feature that can compare in its ultimate effects for good on the patient with the radio installation.



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HUNTS POINT HOSPITAL

New York, which is completely equipped with radio. A central receiving set whose output, greatly amplified, furnishes broadcast programs to each bed, through individual head phones. The hospital officials expect the radio to do much to break the tedium of the weary and often lonely hours of convalescence

Interesting Things Interesting People Say

SIR ROBERT DONALD (London; former editor, *The Daily Chronicle*, speaking before the London Rotary Club): "In 1913, I predicted that the chief competitor of the newspaper would be new developments in the dissemination of news. What I did not foresee was the development of broadcasting. In the future, I think that broadcasting will become the chief competitor of the newspaper. News that can be broadcast is limited in many ways, for broadcasting can give the facts and no description, which is an advantage, because many newspapers give a description and no facts. However, if people who hear speeches over the radio do not find them reported to a sufficient extent in the newspapers, they may be disposed to ask the reason why. This will stimulate the newspaper."

FRANK E. SEAVY (Somerville, Massachusetts; Department of English, Tufts College, in a letter to WGY): "When I think of the thousands of homes into which you are sending excellent music daily, homes in which, three years ago, no music above street songs was known, I feel that your work in education is vastly more important than ours."

CAPTAIN H. J. ROUND (London; Engineer, British Marconi Company, in the London *Morning Post*, regarding the use of loud speakers): "The engineer (in developing loud speakers) has to be satisfied if he can retain intelligibility in all cases with not too great a divergence from the human quality. . . . One cannot forecast the feelings of the electorate if politics becomes merely a matter of noise."

F. C. MORTIMER (New York; "Topics of the Times" in the New York *Times*): "It has been noted as a curious fact that several minutes before more than a small part of the enormous crowd gathered at Epsom Downs knew the name of the Derby winner, it had become old news to many people in such far away lands as India, South Africa, and South America. That, of course, was another of radio's many miracles, for it took only a fraction of a second for the mysterious vibrations to reach the other side of the world. . . . Anybody could survive waiting a few minutes for the winner's name, and the episode may be taken as illustrating anew that fact that, in respect to most of the material broadcast by the new device, chief interest lies in its manner of transmission."

EDWARD S. VAN ZILE (New York; in the New York *Times Book Review*): "If more books are being distributed in this country than ever before, it follows that the outstanding new features in our social and family life, namely, the motor car, the movie, and the radio are exerting not a centrifugal, but a centripetal force on the library. . . . The fact is . . . that the radio has tended toward the integration rather than the disintegration of the family. . . . The average American family is more united in its hours of leisure than ever before. . . . The cosmopolitan impetus to the mind vouchsafed by the radio inevitably intensifies the interest of the average American household in the enlightenment to be got from books. . . . Why, then, despair about the Republic?"

CAPTAIN ECKERSELY (London; Chief Engineer, British Broadcasting Company): "The present receptive range of the average crystal set is approximately twenty-five miles. My belief is that by transmitting from a sufficiently powerful station, this range can be increased to one hundred miles at least."



WILL ROGERS

Humorist and Rope-Twisting Monologist

"If you have a radio, now is a good time to get it out of fix. All you will hear from now on until the 4th of November will be: 'We must get our government out of the hands of Predatory Wealth.' 'The good people of this Great Country are burdened to death with Taxes; now what I intend to do, is. . . .' What he intends to do is try and get elected. That's all any of them intend to do. Another one that will hum over the old static every night will be: 'This country has reached a Crisis in its National Existence. Can we afford to stand aloof from our worldly obligations? . . . Of the defeated candidates, I am the only one that had the nerve to remain in New York.'"

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How to Build a Six-Tube Second-Harmonic Super-Heterodyne

Whose B-Battery Consumption is Exceptionally Low—A Set for the Constructor Interested in Efficiency and Economy

By ALLAN T. HANSCOM

FOR some time we have been looking for a super-heterodyne which required fewer tubes and was more economical to operate than those we have described heretofore. Mr. Hanscom brought one of his six-tube receivers to our laboratory and demonstrated its superiority to our entire satisfaction. It is easy to tune, selective, sensitive, and produces exceptional volume with clarity far above the ordinary.

This receiver, because it is necessary to make rather than purchase some of the coils, is somewhat more difficult to construct than those standardized receivers we have previously described. Receivers of this type are going to improve beyond our powers of imagination and this improvement is indicated very clearly in Mr. Hanscom's work, which we feel is a long step in the right direction.—THE EDITOR.

THE purpose of this article is to outline the theory of operation and to describe in detail the construction of a receiver that can be built successfully by the fans who like to make their own sets.

There are several types of super-heterodynes available, and in most cases the results are accomplished by using eight tubes or more, with corresponding large drain on A and B batteries. This is the factor that has caused the super-heterodyne to be called the "Rolls-Royce." The receiver performs excellently but at exceedingly high first cost and high maintenance.

The super-heterodyne designed by the writer is not an expensive set to build, it is not a freak, and it will bring in all stations that any good set will with a B-battery consumption of less than fifteen milliamperes using 201-A tubes and an eighteen-inch loop. When we consider that commercial types of five-tube neutrodynes draw about twenty milliamperes from the B battery, it is apparent that this super-heterodyne is not an expensive set to maintain.

The biggest advantage that a super-heterodyne has is its ability to operate on a loop. A good set of this type will positively get down to the sound level of the atmospheric electrical disturbances when using a loop, and it is therefore of no advantage to use an outdoor antenna. A poor super-heterodyne, with a low factor of amplification, will work better on an antenna, but so will any type of set, for that matter.

WHAT A SUPER WILL DO

WHAT you will hear with a super-heterodyne is exactly what you will hear with any good set, except that the directional effect of the loop will prevent some interference and the ease of tuning makes the stations easier to obtain. A super-heterodyne will not amplify a signal if the signal isn't there. By that I mean that a broadcasting station a thousand miles away cannot be heard unless the carrier wave is stronger than the static disturbances *when it reaches the receiving set.* But for the ability to go out and get a lot of stations quickly and easily when conditions are right, the super-heterodyne can't be surpassed.

Radiation, sometimes incorrectly called "re-radiation" is a fault of many super-heterodynes. In general, any circuit which has an oscillating vacuum tube coupled to a loop becomes a miniature transmitter. This condition is greatly aggravated by the use of



FIG. 1

a large antenna. The super-heterodyne described herein does not radiate because the oscillator isn't coupled to the loop. In addition, the oscillator frequency is nowhere near the frequency of the received signal, because the principle of the "second harmonic" is used.

ADVANTAGES OF THIS SUPER

AT THIS point it may be well to consider the essential parts of the super-heterodyne as shown by Fig. 1.

The only reason for this typeof set is the fact that it is better to amplify on the long waves than at the usual broadcasting frequencies. Assuming a 300-meter wavelength which has a frequency of 1,000,000 cycles per second, the super-heterodyne changes this frequency to the exact value that will pass through the long-wave amplifier (see Fig. 1). The frequency of this long-wave amplifier is not variable, and because it is in the neighborhood of 40,000 cycles per second, the amplification per stage is very high. Because the amplifier is designed to pass only a narrow band of frequencies, the selectivity is also high.

The manner of creating this new low frequency is a puzzle to many people, but it is accomplished by a combination of the signal frequency with a new frequency which is generated within the set. Arithmetically, the case is as follows: Assuming the incoming carrier wave with a frequency of 1,000,000 cycles, if we generate a frequency in the set of 1,040,000 cycles, the difference between the two will be 40,000 cycles. If the generated frequency is 960,000 cycles, the difference between that and 1,000,000 cycles is still 40,000. Because the two frequencies are combined, the resultant frequency is the difference between the two. There is also a frequency equal to the sum of the two, but this is not utilized.

PRINCIPLE OF THE SECOND HARMONIC

ANY frequency has certain harmonics. By this we mean that a frequency double or triple the original will bear a certain fixed relation to it at all times. If we assume the case of a man and a small boy walking up the street together, the man may be taking strides of exactly thirty inches. Now, if the boy is taking two steps to the man's one, and the boy's steps are exactly fifteen inches, then they

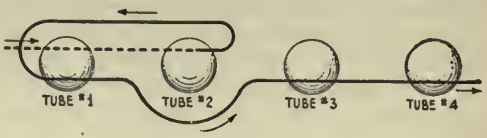


FIG. 2

will always be in line. In this case the man's step is the second harmonic of the boy's step.

In applying this principle to the super-heterdyne, the arithmetic gives us this:

Incoming signal . . .	1,000,000 cycles
Second harmonic of this .	500,000 "
Generated frequency . .	480,000 "
The difference	20,000 "

But 20,000 cycles is the second harmonic of 40,000 cycles, which is the frequency of the long-wave amplifier. By this method we generate a frequency in the set which is so different from the signal frequency that for practical purposes it is entirely independent of it.

It must be understood that the amplifier frequency does not have to be exactly 40,000 cycles. The lower this value is, the closer it approaches the audible frequencies, which extend up to about 12,000, while as it goes higher, the problem of amplification becomes more difficult.

Fig. 2 shows the path of the signal through the first four tubes. The dotted lines represent the frequency of the received signal, the solid line shows the amplifier frequency.

The incoming signal is amplified at radio



THE FRONT OF THE PANEL

Extreme simplicity of control is a notable feature of this receiver

frequency by tube No. 1, and passed into tube No. 2. This tube is oscillating and generating a frequency which combines with that of the incoming signal to produce a new low frequency which is fed back into tube No. 1 and amplified. This is known as reflexing. From No. 1 the output now goes to No. 3, where it is again amplified and then detected by tube No. 4.

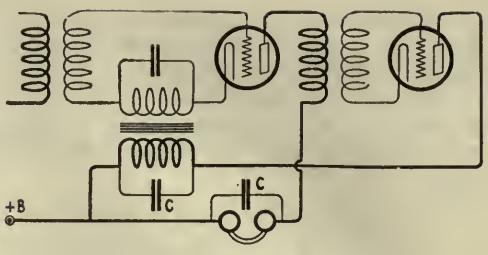


FIG. 3

ABOUT REFLEXING

WHAT are known as reflex receivers are those in which the audio frequencies are fed back through the tubes which are already amplifying radio frequencies. In this type of super-heterodyne, the audio frequencies are not reflexed, but the same conditions apply.

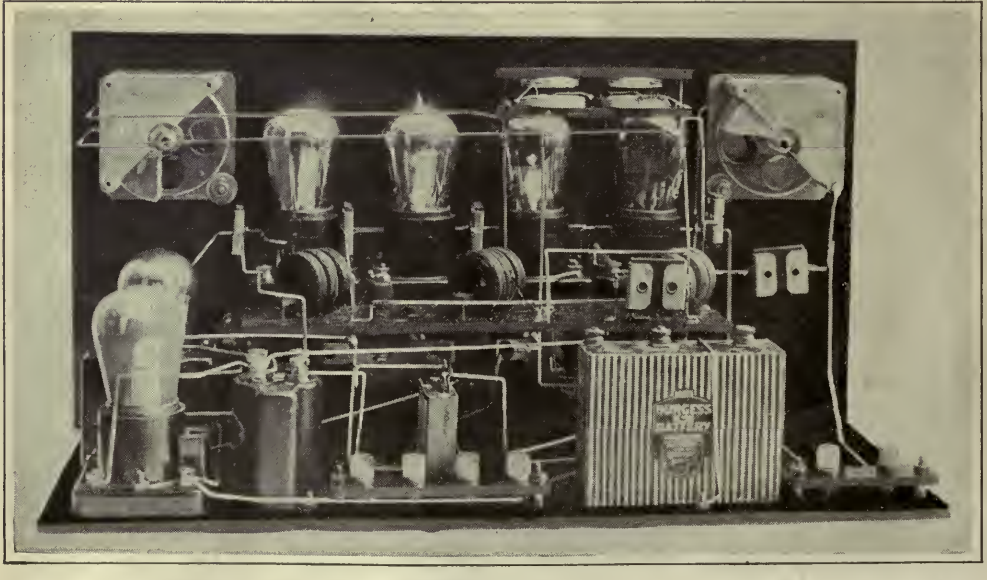
It is obvious that a tube may be reflexed for both radio and audio frequencies, but the intermediate frequency which is utilized in the super-heterodyne must necessarily be above audibility.

Fig. 3 represents a typical reflexing arrangement where the fixed condensers are used to bypass the radio frequencies. Most people do not realize that the shortest path for radio frequencies is the best path. This is shown in Fig. 4, which is exactly the same as Fig. 3 except that the radio frequencies are bypassed directly back to the filament.

As will be seen in the circuit diagram, the first tube acts as a radio-frequency amplifier while the second tube is an oscillator and detector. The output of the second tube consists of three frequencies: first, the frequency of the incoming signal; second, the frequency of the oscillator; and third, the beat frequency, which is the difference between the other two.

The higher frequencies are bypassed back to the filament of the oscillator tube but the beat frequency is fed into the primary of the first intermediate-frequency transformer. The secondary of this transformer is connected in the manner indicated by Fig. 5 which is done in order to neutralize the tube capacity which is accomplished by means of the neutralizing condenser N.

The coils A, Fig. 5, are the secondary of an intermediate-frequency transformer. If they are equal and the condensers C are equal, then the tube is neutralized, provided the condenser N is equal to the grid-plate capacity



REAR VIEW

Of the receiver, showing the method of mounting the fixed condensers between the tube sockets

of the tube. The high-frequency voltage from the loop cannot pass a current through the coil A, because of its high impedance, and the low-frequency voltage generated in A cannot pass a current through the loop because of the condenser C in series with the loop. And because the first tube is neutralized, it cannot oscillate and no potentiometer is required.

AIR-CORE TRANSFORMERS

MANY super-heterodynes use transformers with iron cores, and in most cases they use one sharply tuned transformer or filter to make the intermediate frequency sharp enough for good selectivity. The disadvantage is that the iron-core transformers are not as efficient, but the difficulty with the air-core transformers has been that the tuning is apt to be too sharp. This has been overcome in the set pictured by a special design of coils with a provision for moving the coils to tune each stage for the most efficient amplification. By this means great selectivity is obtained as well as great amplification with an absence of the hissing sound which is so prevalent in some super-heterodynes.

As might be expected, the tuning of the set is very sharp. A 500-watt station ten miles away can be completely tuned out in less than one point on the oscillator scale. The dial readings are always the same for the same station, and with the proper number of turns in the loop the settings of both condensers are approximately the same for any particular wavelength.

HOW TO BUILD THE SET

WITH the foregoing explanations, the circuit diagram, Fig. 6, may be easily understood. It is not essential that the apparatus be mounted as closely as shown in the photographs, but it is absolutely necessary to keep all grid and plate leads as short as possible and remember that the fixed condensers are bypassing objectionable radio frequencies *back to the tube where they come from. Keep these condenser wires short and direct.*

The materials needed are as follows:

1 Panel 9″ x 18″ x $\frac{3}{16}$″ (Don't use wood)
1 Panel 8″ x 18″ x $\frac{3}{16}$″ (Don't use wood)
1 Panel 4″ x 10″ x $\frac{3}{16}$″
3 Hard rubber strips—$\frac{1}{4}$″ wide, $\frac{3}{16}$″ thick, 2″ long
5 Hard rubber strips—1″ wide, $\frac{3}{16}$″ thick
  3 4″ long (2 for oscillator, 1 for terminals)
  2 3″ long (1 for oscillator, 1 for loop terminals)
6 Sockets—Composition, not metal
2 Jacks—1 double circuit, 1 single circuit
2 Rheostats—1 6 ohms, 1 30 ohms, any good make
2 Variable condensers—.0005 mfd.—Any good make with vernier dials or knobs (not separate vernier plates)
7 Fixed Condensers—2 .0005 mfd. 2 .00025 mfd. 3 .002 mfd.
1 Grid leak and condenser combined, .00025 mfd. and from 2 to 5 megohms.
2 Audio-frequency transformers—(low ratio)
6 Binding posts
  Square tinned bus bar, $\frac{6}{32}$ screws and nuts, etc.
9 Coils for intermediate-frequency transformers
4 Coils for oscillator
1 Dubilier Duratran radio-frequency transformer
1 Neutralizing condenser
1 Bypass condenser, 1 mfd.

The first step in the construction of the set is the assembly of four sockets on the 4″ x 10″ rubber panel as indicated in Fig. 7. After mounting the sockets the −F connections are joined with bus bar and the +F connections of tubes 1, 2, and 4 counting from the left are joined. This is shown in the photograph of the top view of the set.

The next consideration is the intermediate-frequency transformers. Each transformer is made of three small honeycomb coils which are clamped on the rubber panel by strips of hard rubber and small screws. The center coil is the primary and the two outside coils form the secondary. The coils are mounted at an angle of 55 degrees as indicated in Fig. 7 with a space of about $\frac{1}{16}$″ between adjacent coils. By loosening the screws which hold the small hard rubber strips, the coils may be moved endwise for accurate tuning after the set is finished.

It is very important that the wires from the coils be connected in the right direction. The inner ends of the two outside coils are connected and the coils are mounted so that the outer ends of these two coils face

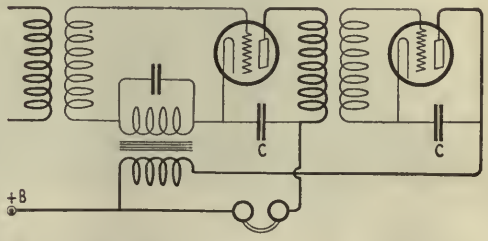


FIG. 4

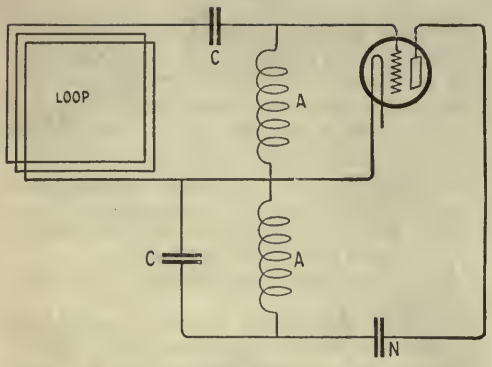


FIG. 5

in opposite directions. Looking at the end of the coils, if the wire runs clockwise starting at the outside of the first coil, it must continue to run clockwise starting at the inner end of the coil in series with it. See Fig. 8. The center coil, which is the primary, may be mounted either way.

After this, the Dubilier transformer is mounted midway between sockets 1 and 2 on the *under side* of the panel with the −F and +B connections at the rear. Then the grid leak is mounted on the under side of the panel near the grid connection of socket No. 4. At this point it is optional whether the mounted parts are wired or the wiring left until the socket assembly is fastened to the front panel.

The photographs clearly show the arrangement of parts on the front panel (9″ x 18″) and the base panel (8″ x 18″). Owing to the different parts which may be used, it is not possible to give absolute dimensions. Looking at the front view of the set, the left-hand dial tunes the loop and the right-hand dial tunes the oscillator. The left-hand lower knob is the rheostat which controls all the tubes and the right-hand lower knob is the 30-ohm rheostat which controls the filament of the third tube for the regulation of the volume. It is suggested that the audio stages be wired before the base panel is joined to the front panel, although this is not absolutely necessary.

The bus bar may be rigidly secured to the sub panel by boring a small hole and bending it as in Fig. 8A.

In soldering, use only resin-core solder.

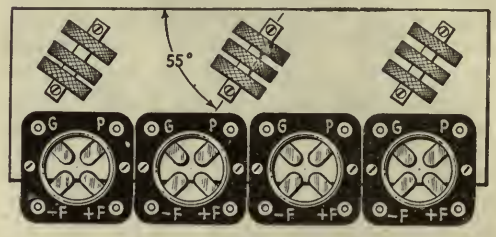


FIG. 7

If panel-mount sockets are used, it is possible to fasten the four-tube assembly to the front panel of the set by using the socket mountings, otherwise use brass angle irons. In fastening the front panel to the base panel, it is possible to drill the edge of the base panel and tap for $\frac{4}{36}$ machine screws, but this may also be avoided by using brass angle irons.

The variable condensers should be connected

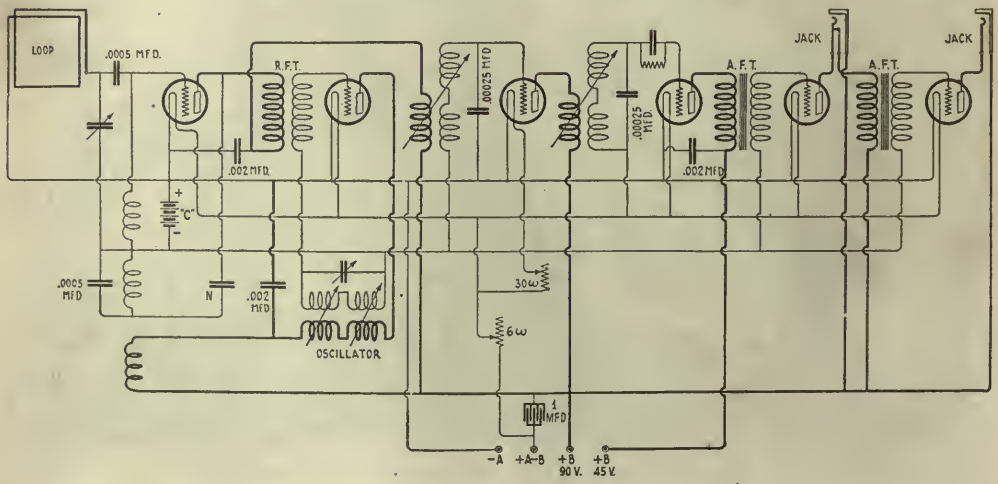


FIG. 6

Complete diagram of the six-tube super-heterodyne

so that the fixed plates go to the grids of the tubes and the movable plates are connected to the C-battery negative.

To avoid errors, it is an excellent plan to draw over the wiring diagram with a colored pencil as each wire is connected.



FIG. 8

The C battery is fastened to the base panel with a piece of bus bar as shown in the photographs.

NEUTRALIZING THE FIRST TUBE

IT WILL be seen from the photographs that the coils in the first intermediate transformer are not evenly spaced. This is because with a fixed value of neutralizing condenser the neutralizing can best be done by moving the coil A in Fig. 9. The value of the neutralizing condenser is about equal to the

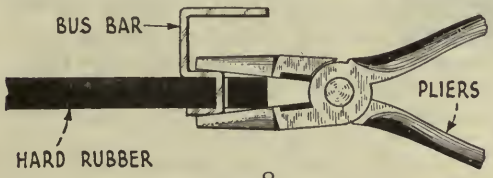
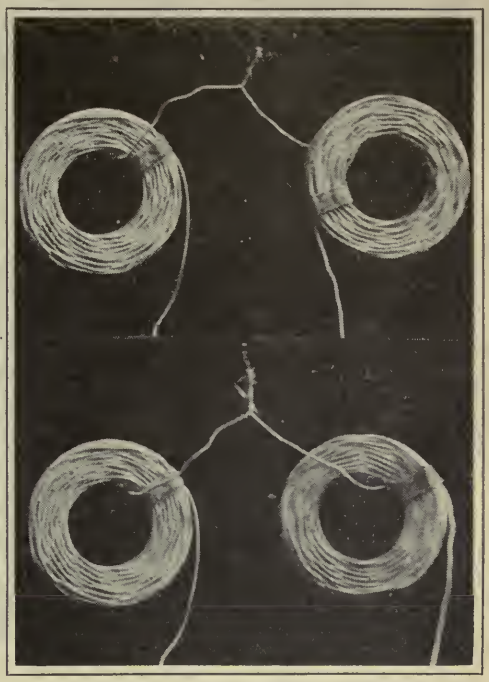


FIG. 8A

full capacity of a neutrodyne condenser when the rod is connected to one terminal and the sleeve to the other. See Fig. 10.

A flexible wire connection may be made to the metal tubing to allow further variation. Once set the position of the metal tubing may be fixed with a drop of wax.

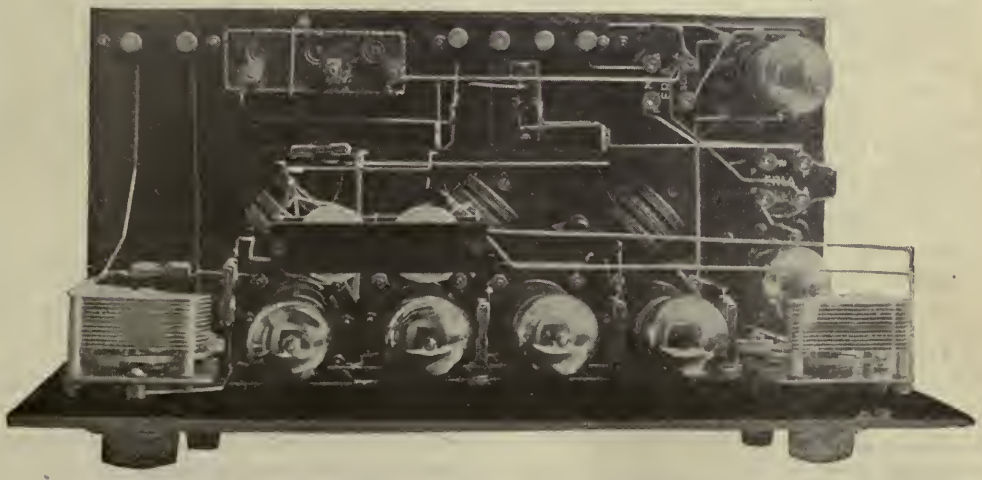


HOW TO MOUNT THE OSCILLATOR COILS

The wrong way is shown at the top of the photograph and the correct way at the lower part of the cut. Both windings should be placed so the wires run in a similar direction

THE OSCILLATOR

THE oscillator is composed of four coils, two in series in the grid circuit and two smaller coils in series in the plate circuit. The manner of connecting these coils is very



TOP VIEW OF THE RECEIVER

Which shows quite clearly the mounting and position of the intermediate transformer and oscillator coils

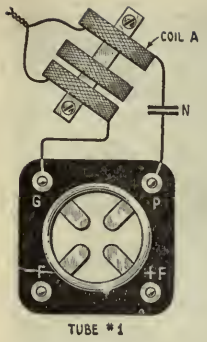


FIG. 9

important, and is indicated in the photographs. They are connected so that the direction of the current if clockwise in one coil will be counter-clockwise in the coil in series with it. This is done to provide a closed magnetic field as indicated in Fig. 11.

To make the tube oscillate it is also necessary to place the grid and plate coils together so that the *direction* of *rotation* of the grid wire is opposite to that of the plate wire in the other pair of coils. See Fig. 11.

The manner of mounting the oscillator is clearly shown in the photographs. It is supported by the bus wire leads which are fastened to each corner of the lower rubber strip. The intensity of the oscillations can be varied by changing the thickness of the spacer between the pairs of coils. For best results this should be about $\frac{3}{16}$".

OPERATING THE SET

AFTER the set is completed and the tubes are in place, connect the A battery and light the tubes. If they light, then turn them off and connect the − B battery to the + A binding post. Then touch the +B wire to the +B binding post. This may spark the first time it is touched because of the capacity of the bypass condenser, but it should not do so more than once. Then the +B 45 may be connected and the set is ready for adjusting. Turn the volume control rheostat full on and then light the tubes to normal. With phones plugged in the last jack, it ought to be possible to tune-in a powerful station after connecting the loop. Oscillation in the first tube may be noted by a series of bird-like whistles as the dials are turned. This may be stopped by moving the coil A, Fig. 9, to the proper point, or by varying the neutralizing condenser. If the set is wired properly, this adjustment is not very critical.

CAUSES OF FAILURE TO OPERATE

AMONG the various causes of trouble in operation of this receiver, some of those most apt to be encountered are:

1—Wrong wiring
2—Faulty tubes
3—Short-circuited fixed condenser
4—Wrong polarity on C battery.

It will be found that a station can be tuned-in at several places on the oscillator dial, but it is usually heard best at a setting about the same as the setting of the loop-tuning dial, provided the loop is of a value that will bring a 360-meter station at about 35 on the condenser scale.

THE LOOP

WITH the various loops now on the market, it is easier to buy one ready made than to make one, although a suitable loop can be made of single lamp cord (stranded) of 13 or 14 turns on a frame 18 inches square, with the turns spaced from $\frac{1}{4}$ to $\frac{3}{8}$" apart. Don't use fine wire and green wood. The larger the loop, the fewer the turns for a given wavelength and the greater the signal strength. The writer has used a variometer for a loop on stations 200 miles away with enough intensity to operate a loud speaker, but don't penalize the set with a poor loop. Get a loud signal and then control it with the rheostats.

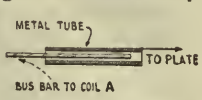


FIG. 10

A HINT TO HOME CONSTRUCTORS

DON'T solder lugs on the end of bus bar when it is going to be connected to terminals on sockets or transformers. It is far better to invest in a pair of round-nosed pliers and bend an eye on the end of the bus bar. Don't screw down the terminals with your fingers, because they will not stay tight. Use pliers or a wrench.

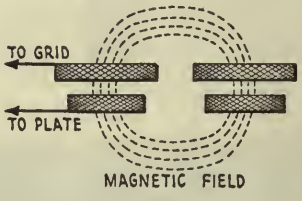


FIG. 11

A TEST PERFORMANCE

IN OUR laboratory in Garden City we were able to bring in Philadelphia and Schenectady in daylight with good loud speaker volume, using this set and a small loop and *five* tubes in *daylight*.

During two tests made at night, each of two hours duration, using five tubes and a loud speaker, the following stations were logged. The dial settings were as indicated, and may be generally helpful to those who duplicate the receiver just described. Some idea of the

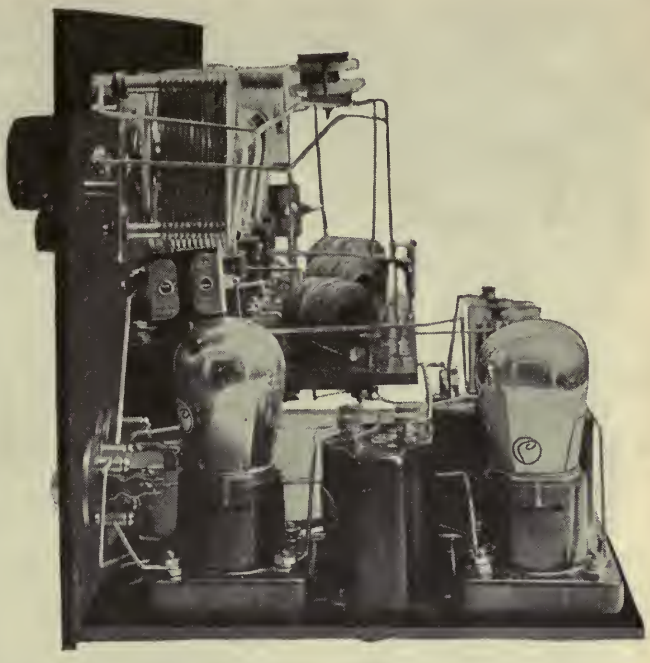
selectivity of this receiver may be had by noting the number of stations logged between WEAF and WJZ, both of which are less than twenty miles from Garden City. Both were operating most of the time during which the four distant stations were logged.

LIST OF STATIONS HEARD

CALL	DIAL SETTINGS LOOP	DIAL SETTINGS OSCILLATOR	WAVE LENGTH
WNYC	78	83	526
WIP	75	81	509
WEAF	66	73	492
WHAA	65	88	484
WOC	64	71	484
WDAF	63	69	411
WCAP	59	66	469
WJZ	55	62	455
WSB	51	52	429
WLW	48	64	309
CFCA	48	54	400
WTAM	41	65	390
WGY	39	50	380
WMAF	38	42	360
WEBH	37	42	370
WJAR	33	37	360
WLS	32	35	345
WHN	32	38	360
WCBD	32	36	345
WBZ	30	34	337
KDKA	28	32	326
WTAS	22	26	286

Many stations not included in this list were heard but were not logged because call letters were not heard. It is to be noted that most of the stations on this list are not local.

This particular receiver we used is not a freak. We have tried two, and Mr. Hanscom has made several others. They all have the same characteristics.



SIDE VIEW
Showing the output end of the set

We were so favorably impressed with this new departure in storage battery tube outfits that we contemplate using one at the temporary receiving station we are going to equip somewhere on the coast of Long Island for our International broadcasting tests. Another receiver of this type will be used by Mr. Hanscom at his home in Woonsocket, Rhode Island, for the same purpose, and he will arrange to report reception directly to our Garden City Laboratory.—THE EDITOR.

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The Listeners' Point of View

Conducted by Jennie Irene Mix

Is Radio Standardizing the American Mind?

THE discussion that has of late been carried on in this department, regarding the relative adaptability of the masculine and feminine voice to radio broadcasting, is still calling forth opinions from many of our readers. These opinions are often supplemented by others having to do with various different features of broadcasting. This goes to prove that some radio listeners are doing their own thinking, and are not, as President Faunce of Brown University recently said, becoming possessed of the "mob mind."

This "mob mind," according to President Faunce, is being created by the radio because, day after day and night after night, hundreds of thousands and at times millions of people listen to the same speeches, music, drama, stories—all of these features brought down to the level of mass intelligence. This is rapidly creating, in his opinion, a standardized taste along educational and amusement lines. A standardized mass taste means mediocrity. This is not a direct quotation of his statements, but is the gist of their meaning.



ETHEL MILLER

Mezzo soprano. Miss Miller was soloist at one of the series of concerts given by the Kudisch Ensemble from station WJZ, New York. The programs by this ensemble have proved one of the most successful among the musical features introduced at this station

If the radio were never to rise above the level of its present daily achievements, all that President Faunce has said would be true. But there are many indications that, as soon as owners of radio sets lose the desire to listen-in simply for the novelty of the thing, a portion of the public will demand something better than the sort of education or entertainment that appeals to the mob mind. And as soon as they make this demand it will be granted. The fact that such people are among the listeners-in, proves that ultimately the radio will not standardize the American mind. It may seem to be doing so now. Indeed, President Faunce can find much to support his opinion. But he very likely is not closely in touch with the inner workings of this new and great medium of enjoyment. If he were, he would realize that a goodly number, instead of swallowing all that they hear, whole and without thought, are listening with discrimination, and voicing whatever objections they feel in no uncertain terms.

Radio music, justifiably, comes in for the largest amount of such criticisms, and next



—Trinity Court Studio, Pittsburgh

ETHEL WHITTLESEY

As she appeared when featured in a costume recital of old time songs at station KDKA

to music come the speeches. It is not the quality of the speeches that brings forth this criticism, but rather the manner of their delivery. The large majority of radio speeches are, of course, read from manuscript, which is as it should be, for reasons too obvious to mention. But why should they *sound* as if they were read? As you listen, you can fairly see the speaker's eyes fixed on his manuscript. The effect is even worse than when a speaker in a public auditorium reads an address without the manuscript being in evidence instead of delivering it. If a man once read a public address in the monotonous tone employed by radio speakers he would never get an engagement twice in the same town.



HELEN KLOUGH

Motion picture correspondent and screen star, has been heard with distinct success through station WOR, Newark, N. J. One of Miss Klough's most popular talks is on "How I Interview Famous Stars, and What they Say"

Radio Speeches Are Too Much a Colorless Monotone

ANYTHING even approaching oratory is obnoxious over the radio. Familiarity is worse. But why a colorless monotone? Many speeches original in construction which contain ideas well worth the hearing, sound for all the world as if they were being read verbatim out of an encyclopedia. An announcement of tremendous import broadcast would sound like a platitude if given in a pedantic tone. The spoken message by radio can never rise above the quality of the speaker's voice and diction.

As for the diction of most radio speakers, it is well to let one who has frequently broadcast, and who has given much thought to this subject, express his opinion. This opinion was received by the present writer in a letter commenting on various matters discussed in this department. The writer of the letter is Richard K. Morton of South Boston, Mass., who has broadcast speeches from stations WBZ, WJAR, WGI, and WEAN, his subjects including historical and scientific themes, citizenship, humor, and biographical sketches. He has also conducted musical programs at a number of broadcast stations. So, taken altogether, he knows whereof he speaks when he expresses an opinion on radio talks. He writes:

I believe that the radio is showing us how few speakers have really good voices and delivery. It is showing the effect of a decline in forensic art, in practice of reading aloud, and, above all, in careful articulation and enunciation. We are lip-lazy, and we clip our syllables and sounds. We do not have a pleasant variation in tone quality. We mumble down our shirt fronts. We do not know when to breathe while speaking. We affect a sanctified monotone or an excited staccato, in our delivery. Any listener-in can add faults to this necessarily brief list. There are few listeners-in who do not fervently await better radio phonetics.

All who do their own thinking, and there are a goodly number of them in radio audiences, will hail with joy the day when the faults just quoted are eliminated from broadcast speeches. But the shortcomings in this feature of radio are not wholly due to the speakers, according to Mr. Morton. Note what he has to say about studio management.

What can the radio station do in this matter? It can test voices before putting them on the air. A sign, "Careful Enunciation," would be more valuable to a studio than the injunction, "Quiet." Fit power of the transmitter to the locality. Place the microphone better. Prevent stuffy atmosphere in the studio. Do not permit many to be close by a speaker while he is on the air. Remove from speeches difficult words and phrases, ambiguities, poor transitions, and current banalities. Prohibit too many freak broadcasts, and cheap humor. The best radio stations demand an advance copy of all proposed talks, but, from experience, I know that they should also have a guarantee as to the nature of the voice which they propose to put on the air. . . . Through good radio phonetics, public interest will be maintained in worthwhile radio speeches. The radio will then have a better chance to serve the community.

To all of which many of our readers will no doubt give their unqualified approval.

Some of the Worst and Some of the Best

AS FOR radio nuisances, we desire again to go on record with the statement that the worst of them all is the announcer with that nice, chummy, familiar manner, who takes you into his confidence. Who tells you that if

you will stand by for a moment he is going to give you, oh, something just too sweet, or lovely, or funny for anything. Who says, "Well, here we are again, feeling fine. How're you?" Who tells you, "Say, this man is going to sing the latest love song about a sweet young thing, and he's been married twenty years! Hope wifey isn't listening-in." Who signs off with, "Good night. Sleep tight. . . . Turn off the switch, George."

Time cures many evils, and time will cure this one. The instant you hear an announcer at a station you know what class of station it is, and in what sort of town it is located.

Of late, this department has been receiving numerous comments, all laudatory, anent the announcing of "Uncle John," of KHJ, the station conducted by the Los Angeles *Times*. Uncle John, whose full name is John S. Daggett, bids fair to rival the climate of California as a source of praise from people all over the state, which is equivalent to saying that this praise is all in superlatives. Yet there is always a good reason given for the praise, which is more than can be said about the eulogies of the climate!



HOUDINI

Who has talked on the art of magic from station WOR. But even he, the greatest of living magicians, cannot tell us whence comes the mystery called Radio

In a letter containing much of interest about the men and women heard over the microphone in California, Mr. J. M. McKey has this to say of Uncle John:

> Our most popular station here in southern California is KHJ. While some of this popularity is undoubtedly due to the fine quality of the programs, one of the main reasons is none other than their announcer, known to listeners as "Uncle John." I have never heard any one speak anything but the highest praise for this man. His announcements are always made in a clean-cut, even voice and are to the point. He seems to have no enemies on earth, and is never perturbed or tiresome.

This; following a good many similar comments not only from California but from other states as well, prompted us to send to Uncle John for his photograph to be published this month. But it did not arrive in time. Why not have sent it by air mail, Uncle John? From KGO, California, came a letter via airplane. Why not a picture from KHJ?

Upon second thought, perhaps the airplane route did not occur to Uncle John because he was too modest for it to enter his head that his likeness could be of that much importance to any one. If this is a true surmise, then it but goes to prove that even the best of announcers can sometimes be mistaken. And directors, too. Mr. Daggett serves in both capacities at KHJ.

Of a certain woman announcer in his vicinity, Mr. McKey writes, "She is invariably long-winded and tiresome, as she goes into details in which the public is not interested, and always uses a patronizing tone which disgusts the listener." And of a certain man announcer, "He is good and knows it. In fact he will almost tell you how much better he is than the artists appearing on various programs and what an awful dub you are."

As for the discussion about women speakers that has called forth so many opinions, Mr. McKey adds his views briefly and to the point: "With few exceptions our stations out here employ men announcers, and they are always far superior to the women. I have heard some very fine talks rendered by women, but will say I prefer men all the time."

Yes, there are radio listeners who think for themselves and will never have the "mob mind." By the same token, there are others who, either through intellectual incapacity or laziness, follow the mob in radio as in all other things. They are the ones who, as President Faunce so aptly put it, "will accept the platitudes which are acceptable to all mankind."

Good Things Are In Store for Radio Audiences

WHILE it is the custom of this department to speak of individual performances heard over the radio, such mention is omitted this month because little of outstanding merit has been heard since our last number appeared. This was no doubt due to the inevitable letting down of the programs during the late summer and early fall. But now that the regular season for music and like entertainments is advancing, material for such comment should be ample for many months to come. The advance announcements of the broadcast directors show that some good things are in store for the radio audiences.

But, as usual, the music promises to be the least improved of all the features which are an established part of broadcast programs. It looks very much as if, after listening to a speech on some big subject given by one of authority, we shall still have to hear the announcement:

"The next number on our program this evening will be: 'What Does the Kitty Mean When She Says Meouw?' played by the XYZ Orchestra."

Can you imagine such a thing happening in a lecture hall before a real audience? Then why should it continually happen to a radio audience?

The director will say that he must please all kinds of listeners. Very well, let him please all kinds of listeners. No one is objecting to that. But why try to please them all during one program? One might as well try giving a Shakespeare drama in the theater in conjunction with the latest musical comedy.

However, enough of this for the present—but only for the present. For this is one of the most discussed subjects among owners of radio receiving sets.

Franz Schubert and Robert Burns

THE explanatory remarks that often precede the broadcasting of classical musical numbers are frequently extremely well prepared and given, and then, again, are somewhat confusing. As a case in point, there was the statement made from station WGY, preceding the performance of a Schubert number, that Franz Schubert was the Robert Burns of music.

Granted that we know much more about Schubert's music than we do about the poetry of Burns, nevertheless we cannot see how the one can be likened to the other. Burns was always the Scotsman, and often colloquial, given to the interpretation of life as he saw it in his rather limited scope of vision. Schubert, although born the son of a schoolmaster and raised in bourgeois surroundings, was, as a composer, among the aristocrats of music. As a writer of songs he stands forth as the noblest of them all, and it is significant that he chose, as the texts for these songs, poems of enduring literary quality and some of them masterpieces. With all due credit to Robert Burns, when did he ever conceive, to say nothing of achieving, poems to be classed with such Schubert songs as *Der Erlkönig, Die junge Nonne, Der Tod und Das Mädchen, Der Atlas, Der Döppelgänger, Gruppe aus dem Tartarus*?

In the thirty-one years of his life—he was born in 1797 and died in 1828—Schubert raised song writing to a height that has never since been equalled. Two of his symphonies, the piano *Impromptus* and *Moments Musicals* would alone place him among the Immortals. To compare him with Robert Burns is an estimate incomprehensible to those of us who know his music well.

AN ANTI–PROHIBITIONIST claims that the man who made up a certain short program recently given at station WGY, must also be an anti, for it contained the following numbers:

The Importance of Appetite
Any Old Port in a Storm
The Old, Old Love
In Cellar Cool

These Radio Listeners Had Good Taste

AS LONG as a subject remains of interest in the public mind, it justifies comment among current events. So it is in order that mention should be made at this writing of the winners who contested for honors at one of the closing concerts given by the New York Philharmonic Orchestra at the Lewisohn Stadium of the University of the City of New York during the latter part of August.

It will be recalled by those who listened-in to this concert that five young musicians entered this competition which awarded to the two best among them a début recital in New York this fall. As such a début costs anywhere from $750 to $1,000, the competition was worth while to these aspirants for a

concert career in this country. Before each contestant's performance, and after it as well, announcement was made that from the votes of the audience present at the Stadium—close to ten thousand people—and of the radio audience, the decisions would be made.

It seemed as if any listener-in who had heard enough music to have mature judgment could not hesitate in making these decisions. Ignace Hilsberg, pianist, and Miron Poliakin, violinist, being the ones that quite eclipsed the others through their all-round proficiency. But what would the public think? That was the question. There were two singers on the program, and it is the general belief that a vocalist of average excellence is always more popular with the masses than an instrumentalist of exceptional merits.

But it was not so in this case. The pianist and the violinist just named won by a large margin.

Yet people are forever saying that you must bring yourself down to the level of the public if you would succeed. The truth is, the public practically never fails to respond to the best if given opportunity to pass judgment upon it.

There is a moral in this for makers of radio programs, a moral so obvious that it does not need expression in words.

Another Plan to Pay Radio Artists

THE announcement made recently in the *Musical Courier*, "Radio Performers Are Hereafter to Be Paid," was somewhat premature. It was based on the published opinions expressed by the committee appointed last spring by Mr. E. F. McDonald, Jr. of Chicago to devise some plan whereby this much needed reform could be brought about. One of the chief proponents of the plan is Mr. Paul B. Klugh, executive chairman of the National Association of Broadcasters. In its public statement, the committee went on record as endorsing the paying of radio performers as a means toward raising the standard of broadcast programs, and suggested a way whereby this change might be brought about.

But the desired goal has not yet been



—Thomas Coke Knight, New York

JOSEPH KNECHT'S WALDORF ASTORIA DANCE ORCHESTRA

Talk about a performance of Hamlet without the Melancholy Dane! What about an orchestra *sans* the instruments? It's up to those who see this picture to guess Who's Who so far as who plays what is concerned. The only easy guess is the man at the piano, who is Mr. Knecht himself. The men look as if playing a joke on us by trying to make us think that one instrument can make an orchestra although one swallow never made a summer. They are frequently heard through station WJZ, New York

reached. It will be, however, and soon. There is absolutely no question as to the dissatisfaction of large numbers of people with radio programs as they are now transmitted. The committee that is trying to solve this problem is working along the right track, though there is some question as to the practicability of the plan.

Ho! For a Contest of Dramatic Readers!

MRS. R. J. QUIEN, dramatic reader of Camden, N. J., who has broadcast from various stations in that vicinity, has risen up in wrath at the statements made in this department by our contributors against women radio speakers in general and dramatic readers in particular. She tilts her lance especially at Mr. Corley Kirby of station WWJ who came out just as hard against the women readers heard through his station as those heard through other stations. Knowing Mr. Kirby, we are quite sure that he would stand his ground and give good reason for it against the onslaughts of an army of critics. And enjoy the controversy too.

"I wish," writes Mrs. Quien, "that Mr. Kirby could read some of the letters I have received about my broadcast performances, and then perhaps he would not be so prejudiced against all women readers who broadcast, and remember the old saying, 'All rules have an exception.'"

But this is not all. Mrs. Quien comes forth with a challenge. We quote her regarding this discussion that has been going on and is still being merrily waged in this department by our readers:

> Since there seems to be so much discussion, why not suggest to WEAF, New York, or some central station to have a dramatic readers' contest? *I* should love to appear some evening with a male competitor and both cover the same line of dramatic work, humor, pathos, and melodrama. Let the public decide whether they like it. I would contest with *any* male competitor.

So much for the challenge. Now the question is—who will accept it? We await the answer. Or should we say "answers"?



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MYRNA SHARLOW

An American dramatic soprano who has gained many admirers among the patrons of the Chicago Civic Opera Company, of which she has for eight years been a member. She has broadcast a number of times from Chicago stations and is among those who believe that the radio will become a great musical factor in American life

The Impressive Hour When Pershing Spoke

ON THE morning after Defense Day, the majority of the papers throughout the country carried front page stories of how the two Chicago murderers, Nathan Leopold and Richard Loeb, spent their first day in the penitentiary, even what they ate for dinner being told in detail. And in some of these papers, no mention whatever was made of the fact that on the evening of Defense Day probably the greatest achievement in human communication ever known in the world was accomplished. This was the conversation carried on by General Pershing at Washington with four generals of the United States Army, located respectively at New York, Chicago, Omaha and San Francisco, heard by millions of radio listeners.

History was made during that hour when General Pershing as their commanding officer bade

farewell to these generals with whom he had long been associated. But it was considered insignificant as a news item compared with the dinner menu of two murderers. Yet it will remain in the memory of some of us as about the most impressive hour ever lived through. All those who listened-in owe a lasting debt of gratitude to the American Telegraph and Telephone Company and to the various broadcast engineers who brought about this miracle as their contribution to Defense Day.

"Thank You For Thanking Me"

IT IS not unusual to hear people complain that they have written this or that broadcast station telling of their enjoyment of this or that feature, and received no reply. If they would look at the matter in a general rather than a personal way they would realize that a broadcast station would need to employ, at much expense, a special staff to answer such correspondence. And, for that matter, when we thank a person for doing us a favor we do not expect the reply, "Thank you for thanking me." Why then expect this of a broadcast director?

Among Other Things. . . .

AT STATION WBZ, Springfield, Mass., experiments have been made to find out whether the radio listener does or does not like to hear the noise of the crowd when big public events are broadcast. So far as our personal experience and knowledge of the radio public goes, the answer is "Yes!" If the noise of the crowd is not heard now and then the real atmosphere of the event is wholly lacking. So let us hear the audience every time, WBZ!

FIRST, let it be said that the announcers at all the broadcast stations conducted by the General Electric Company are unexcelled in the quality of their work, which is always clear, concise, and characterized by that good breeding one has a right to expect but does not always find in a broadcast announcer. This being so, one error made by these announcers is conspicuous. Why do they say, "Gen-*a*-ral *A*-lec-tric" instead of "Gen-*e*-ral *E*-lectric"?

YOU never can tell how reforms may be brought about. Sometimes the unconscious indirect method does what the consciously applied direct method fails to accomplish. All of which is preliminary to saying that if broadcast stations keep on giving occasional programs of old-fashioned dance music the old-fashioned dances may come back into favor.



MAJOR A. G. RUDD

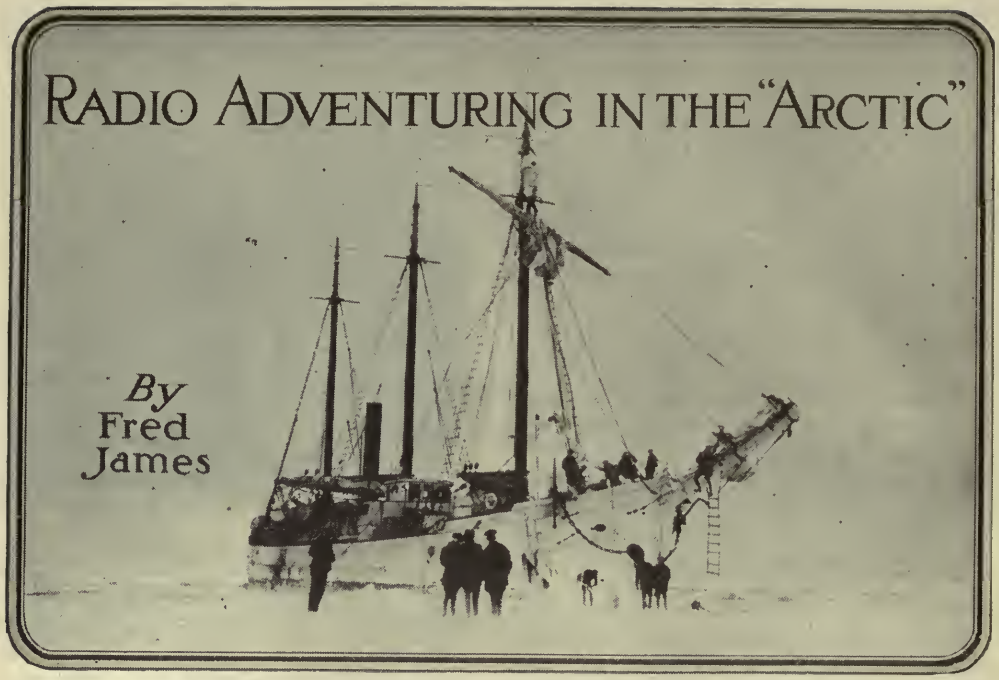
The polo expert of the U. S. Army who broadcast the International polo games direct from the Meadow Brook Club. Authority sits well upon him and we would trust him to get away with anything he undertook. We've an idea he's tackled easier jobs than broadcasting a polo match. Some speed, that takes, before the microphone

MOTION picture stars are, with rare exceptions, better seen than heard. It is a bit risky for them to reach the public through the radio because their glory is dimmed as soon as they open their mouths. A case in point is the famous film star who, speaking not long ago through a Chicago station said, "Being as there's no motion picture studio in this city"—etc.

ANY day or evening you can tune in and hear from one station or another some of the latest books discussed. It may interest the broadcast directors to know that many people enjoy this feature who are not among those inclined to write letters expressing their commendation.

THE young woman who, each evening at 7.30, from station WBZ, Springfield, talks to the kiddies is one of the star radio entertainers along this line. She gives the children such worthwhile stories that they are also enjoyed by grown-ups, which is the test that all stories for children must meet before they can be called literature.

RADIO ADVENTURING IN THE "ARCTIC"



By Fred James

NEITHER Greenland's icy mountains nor India's coral strand are now remote and isolated. Folk thereabouts are likely to be pretty familiar with the latest, from the up-to-the-minute developments in the presidential election campaign to the harvest returns in all parts of Canada. Such is the extent of the mystic bond of radio.

Since the Canadian Government ship *Arctic* left her berth in the St. Lawrence River at Quebec early last July, *en route* on a trip to the Arctic Archipelago, she has been in touch with the outside world from the time she left and will continue to be so until she returns next October, assuming, of course, that no serious accident happens. This stout little vessel, built back in 1900, has been tripping up the Arctic Seas these twenty years. This year the *Arctic* has her two regular radio equipments consisting of a standard 600 meter 2 KW spark equipment and a continuous wave transmitter working on 2,100 meters, with which they keep in touch with the long wave ship station at Louisburg, Nova Scotia, and in addition a short wave ICW outfit which will transmit on wavelengths between 100 and 150 meters. The installation of this short wave equipment is for the purpose of carrying on tests with the United States and Canadian amateurs to ascertain how short wave signals come through from the far north during the full daylight period in the land of the Midnight Sun.

The operator on the *Arctic* is Bill Choate of Toronto, owner and operator of Canadian amateur station 3 CO. An enthusiastic youth is this Bill Choate, so his superiors say. He hoped when he left to meet another Canadian, Donald Mix, the operator on Donald MacMillan's ship *Bowdoin*, somewhere tolerably near the North Pole, but up to the end of August he had not been able to do so.

The interesting facts about the watch the CGS *Arctic* is maintaining on short waves are:

Call Sign VDM
Wave Length 120 meters,
Eastern Standard Time,
Daily except Wednesday 11 p.m. to Midnight
Saturday only 11 P.M., to 3 A.M.

The radio branch of the Canadian Government, Department of Marine, has authorized all Canadian amateur stations to use a wavelength of 120 meters during the foregoing hours for the purpose of communicating with VDM.

The test transmitter comprises two admiralty T4A tubes, operating on 8,000 volts on the plate with an output rating approximately 500 watts per tube, using a standard Meissner circuit. In order to make the

transmission as penetrating as possible, no filter system is being used and the characteristic 480 cycle note will enable amateurs to place VDM immediately they hear Bill Choate's note, even if they do not get his call sign.

THE MISSION OF THE "ARCTIC"

THE CGS *Arctic* went into the Arctic Archipelago, whose islands measure more than 500 square miles, and spread over an area of more than 520,800 square miles, to relieve outposts of the Royal Canadian Mounted Police and other Canadian Government officials who have spent one or two years in the Arctic Circle. She will establish new police posts, customs houses, post offices, and complete numerous surveys and comparisons of previous observations.

There is, it seems, an abiding passion on the part of the Government of Canada for establishing and maintaining the majesty of the law even to its most remote outposts. Establish a police post at the North Pole or anywhere else with a red-coated mountie in charge and law and order will prevail. The Eskimos have learned this. Noo-Koo-Lah, one of these Eskimos, killed a Newfoundland trapper in the neighborhood of Pond's Inlet in Baffin Bay two years ago. Last year he was brought out of the Arctic and is now languishing in a Canadian penitentiary. The Canadian Government also has some commercial interests in the Arctic that need protection. There are reindeers and musk ox by the millions up there that may some day play a part in the world's food supply. Trading companies under different flags are getting busy in some favored places and they need, it seems, both protection and watching.

The expedition this year is in charge of F. D. Henderson of the Northwest Territories Branch of the Canadian Department of the Interior. He will go as far north as Ellesmere Island, 823 miles from the North Pole, the farthest point reached last year by the Craig expedition in the *Arctic*. Captain J. E. Bernier, the master of the *Arctic*, is now making his two hundred and fifty-eighth voyage. For fifty-five years he has been sailing and steaming up and down and across the seven seas and many of the waterways running into them. For twenty years he has been going into the far north on the good ship *Arctic*, a three-mast top-sail schooner of 650 tons gross and 436 tons net, 165.4 feet long and 37.2 foot beam. She has a triple expansion engine of 275 horsepower and can make seven knots under steam in clear water.

She has three masts, 80 feet high, and this year a short top-mast has been added to the main-mast to give more clearance between the antenna wires and the mass of rigging wires which sailing ships are compelled to carry.



ROYAL CANADIAN MOUNTED POLICE

Going aboard the *Arctic*, bound for the far North, to take duty at one of the solitary posts there. The admiring crew on the dock may be speculating as to whether or not these stalwart three will "get their man"

The working of the radio set in a ship fitted with sail is not as satisfactory as in a steamship on this account. The antenna wires have to be erected in a position where they will not foul the sails, booms, or running rigging, and the heavy steel guys necessary to support the spars drain away a lot of the energy which would otherwise be radiated. Since the *Arctic* is built of wood, Bill Choate has to cast an anxious eye over the side as soon as they run into Arctic floe ice. And his chief concern is the welfare of the 200 square feet of copper plate, on the ship's bottom, which constitutes his main ground connection. If he is lucky, he escapes. If the ice nicks off the copper, he has to rely on the engines and propeller for his connection, and there will be a lamentable drop in the efficiency of the transmission.

RADIO EXPERIMENTS IN ARCTIC SEAS

IN ADDITION to the regular tests with Canadian and American amateurs, special tests have been arranged with station KDKA through the courtesy of Mr. George Wendt of the Westinghouse Electric and Manufacturing Company. Experiments occur every Monday





WHAT HAPPENED TO ONE POLAR BEAR

When the crew of the *Arctic* went bear-hunting. It does not seem such a difficult task to hoist a fairly weighty bear over the side, as the photograph shows. The "three men in a boat" appear to enjoy the rather novel occupation of towing the defunct bear

night on their short wave set. KDKA is using its experimental call sign 8xs when working with Choate. The results obtained from the short wave set while the *Arctic* was proceeding down the Gulf of St. Lawrence were very satisfactory, American amateurs as far west as Oklahoma having been worked. They have heard KDKA on short wave transmission, eleven degrees from the North Pole.

Great rivalry exists between the Pacific and the Atlantic Stations. Amateur operator Jack Barnsley at Prince Rupert has rather put it over the Atlantic Division in working with Mix in the *Bowdoin*, but IAR and other notable amateurs in the vicinity of Halifax have been holding Bill Choate to the last gasp.

In addition to the regular code apparatus aboard the *Arctic*, the Westinghouse Company has provided her with special short wave receiving equipment for receiving the concerts transmitted on KDKA's short wave. Recent tests have indicated that Captain Bernier and his crew have been able to enjoy the short wave concerts long after the regular broadcast transmissions on the higher wavelengths have faded away.

The Northwest Mounted Police Posts in the far north at Craig Harbor and Pond's Inlet were equipped with radio receiving apparatus last year but until the *Arctic* returned early in this year no data was available as to what concerts, if any, they were able to receive up there last winter and the full details will not be known until the *Arctic* is back in Quebec.

CANADIAN MOUNTED POLICE USE RADIO

THE battery problem is a serious one in the case of these sets in that supplies are only taken in once a year. The receiving sets at the Police Posts are equipped with Northern Electric peanut tubes and use special batteries prepared by the Eveready Battery Company for filament lighting. In addition they are provided with 300 ampere hour Edison-Lalande primary batteries with ample refills to see them through. For B batteries they are provided with both Burgess and Eveready standard units and in addition an adequate supply of what are termed "inert cells," which are made up specially for the Canadian Department of Marine and Fisheries by Siemans Brothers in London, England. These latter are small dry cells containing no liquid. To put them in operation, the cells are filled with water when they are good for the normal life of an ordinary B battery.

It will be interesting to hear how these different batteries have made out under the severe climatic conditions prevailing in those latitudes.

The Police Station is also supplied with the portable long wave receivers specially built for

surveyors by the Radio Branch, Department of Marine and Fisheries, Ottawa. Strong long wave signals are received up north from the high power stations in the United States and Europe on this receiver, and with the numerous press schedules in effect the Police Posts frequently receive news items actually before they appear in our own newspapers. Last year the report of the death of President Harding was received by the *Arctic* within a few minutes of its occurrence. By some accident the *Bowdoin* did not receive this press message and it was not until she encountered the *Arctic* about a week later that her crew became aware of their country's great bereavement.

While the *Arctic* plans to be back at Quebec sometime in October, she has aboard supplies sufficient to last for more than a year. About the first point of call she made on her outward voyage was Godhavn, Greenland, where there is a Danish settlement, where she arranged to leave mail for Captain Donald A. MacMillan, the American explorer on the *Bowdoin*.

Among the party on the *Arctic* are six men of the Royal Canadian Mounted Police, who are going to man a new post farther north than any police post has yet been established.

NO CRUSHING CROWDS HERE

THE Arctic Archipelago is one of the greatest realms of unexploited treasures of natural resources in the world. Whether the Arctic Archipelago will ever be of economic value is still uncertain, but it is quite probable that before very long a radio station will be established in the farthest north which will be in communication with the uttermost ends of the earth. Meanwhile try your luck through the ether and listen for VDM.



THE CANADIAN COAST GUARD SS "ARCTIC"

Her Captain Bernier (upper left circle), and radio operator Bill Choate (lower right). The sturdy little vessel, which has voyaged up the Arctic seas for twenty years, is now on another trip, more notable than preceding ones because of extensive radio experiments being carried on with broadcasting stations and amateurs on short wavelengths. The top photograph shows the transmitting equipment which is a 2100 meter, one kw continuous wave set, and a 120 meter cw, two kw transmitter. The receiving equipment is shown in the lower photograph

Will This Circuit Ever Work?

Theoretically, the Receiver Described in this Article is Possible: the Addition of Super-Regeneration to the Roberts Circuit—If it is Possible, the Circuit Should Surpass any Receiver Now Known, Using Two Tubes—Here is the Technical Problem: Can You Make it Work?

BY WALTER VAN B. ROBERTS

ONE of the questions most frequently asked about the two-tube circuit described by the writer in the April, 1924, number of RADIO BROADCAST is: "Will that receiver work with a loop antenna?" Unfortunately, the circuit is not sufficiently sensitive to produce good loud-speaker results with a loop antenna except in the case of very strong signals. Not only is this true, but if the loop is placed near the set, unwelcome oscillations occur when the loop is turned so that sufficient magnetic coupling is established between it and the other coils. Hence, the circuit as it stands cannot be recommended for use with a loop.

LOUD-SPEAKER VOLUME ON A LOOP AND TWO TUBES?

THE idea, however, of obtaining good loud speaker volume with two tubes and a small loop is very intriguing and it is proposed to outline an arrangement that looks as if it might turn the trick. The writer has tried out the arrangement only in a very sketchy fashion, and although the results were very promising, it must at present be considered as founded upon theory alone. To make a thorough investigation into the best method of actual construction for this circuit would take much more time than the writer has available, and so it is hoped that some of the many enthusiastic and able experimenters who read this magazine may take up the constructional development work and in due time add another to RADIO BROADCAST's list of Knock-Out, non-radiating receivers.

Briefly stated, the idea is to make the above-mentioned two-tube set (described in this magazine for April, and May, 1924, and with other modifications, in August and September) sufficiently sensitive for loop reception by substituting super-regeneration for regeneration in the second tube, and to take measures to prevent magnetic coupling between the loop and other coils in the set. It may also prove necessary to take special pains to by-pass as nearly as possible all the interruption-frequency current around the audio-frequency transformer in order to avoid overloading the first tube with this frequency. The circuit would then be something like that shown in Fig. 1. The chief characteristics to be expected of such a circuit when properly built are:

1. It would make a truly portable set.
2. Its sensitivity could be made greater than that of a simple super-regenerative circuit on account of the stage of radio-frequency amplification.
3. Its selectivity would be greater than that of any ordinary super-regenerative circuit because the loop circuit is never damped.
4. Its volume, for any signal reasonably above the static level, should be ample for a medium-sized room, and
5. Its quality should be good because its sensitivity should be so great that the

Not a How-to-Make-It Article

Walter Van B. Roberts, whose articles on the super-heterodyne, super-regenerative, and remarkable reflex circuits have been a feature of RADIO BROADCAST for many months, is, without question, one of the most capable of our practical radio engineers.

He has vision, and his vision is tempered by a scientific background which adds practicality to his ideas. In this article, Mr. Roberts outlines some very interesting and exceptionally valuable fields of experiment for those whose knowledge and experience is sufficient for such work.

This is not intended to be a how-to-make-it article. We cannot undertake to answer questions about it. Unless the experimenter is able to figure proper inductances and capacities and similar problems of radio design, we do not advise that he attempt the solution of this problem.—THE EDITOR.

super-regenerative action would rarely need to be pushed very far.

In general, this circuit, if properly built by a constructor who is familiar with the principles involved, should be satisfactory for signals above the interference level, and where the utmost selectivity is not required. For very long distance work, however, it probably would not give as good year-round results as the present two-tube regenerative arrangement using a good outdoor antenna.

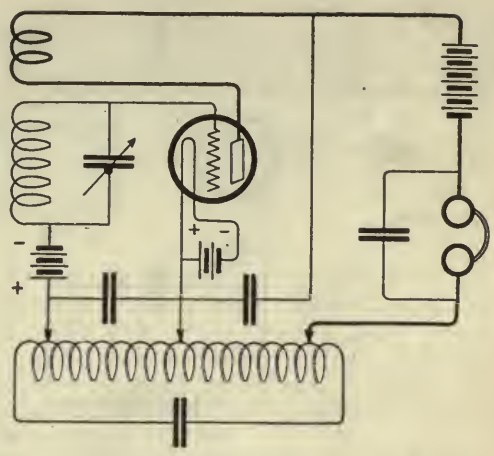


FIG. 2

One form of the Armstrong super-regenerator which every one admits does more work with a single tube than any other known circuit

PROBLEMS CREATED BY THE LOOP

THERE are several methods by which magnetic coupling between the loop and other coils may be prevented. If this coupling is not completely eliminated, or if the capacity coupling is not completely balanced out by the neutralizing condenser, the strong oscillations in the circuit of the second tube will force oscillations in the loop circuit, and these latter oscillations, persisting in the low-resistance loop circuit will re-excite the super-regenerative circuit after its periodical interruption, even in the absence of any incoming signal, and thus render the set inoperative. Hence the necessity for the care in eliminating all the coupling between the two circuits.

Moving the loop some distance from the set is not an elegant solution of the problem, and it would be difficult mechanically to place the loop on the set so that it could be rotated without introducing any coupling in any position. It might be possible, but not easy, to wind all coils on toroidal forms or their equivalent, so as to eliminate all external field. Shielding, of course, may be added to any scheme used, provided the shielding itself does not introduce coupling. Probably the simplest and best method of all would be to make the loop an integral part of the set, fixing its position once for all, then rotating the whole set whenever during operation it is desired to rotate the loop.

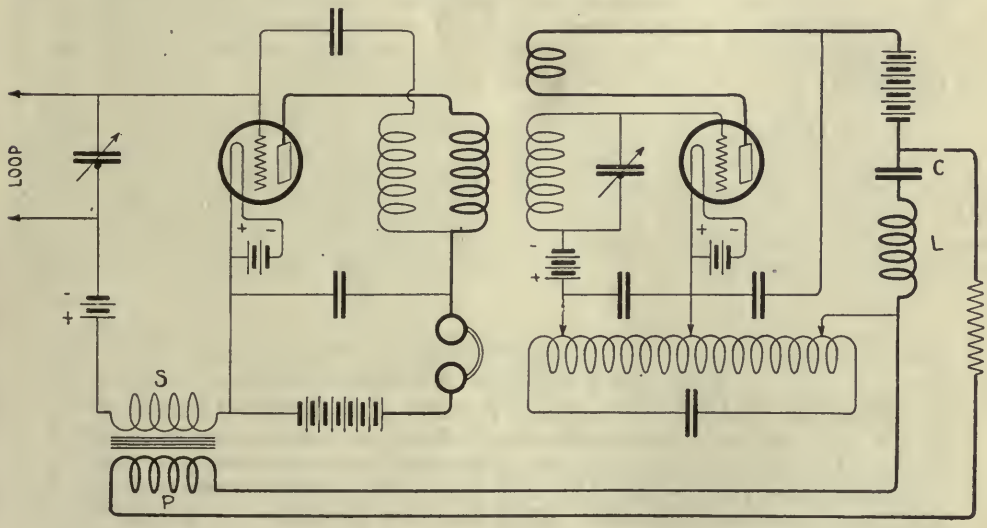


FIG. 1

Here it is, all in a nutshell. Tuned radio frequency of the neutralized type — super-regeneration of the single tube type — audio amplification by the reflex method. This circuit has infinite experimental possibilities that should result in the development of a remarkable receiver. Can you make it behave?

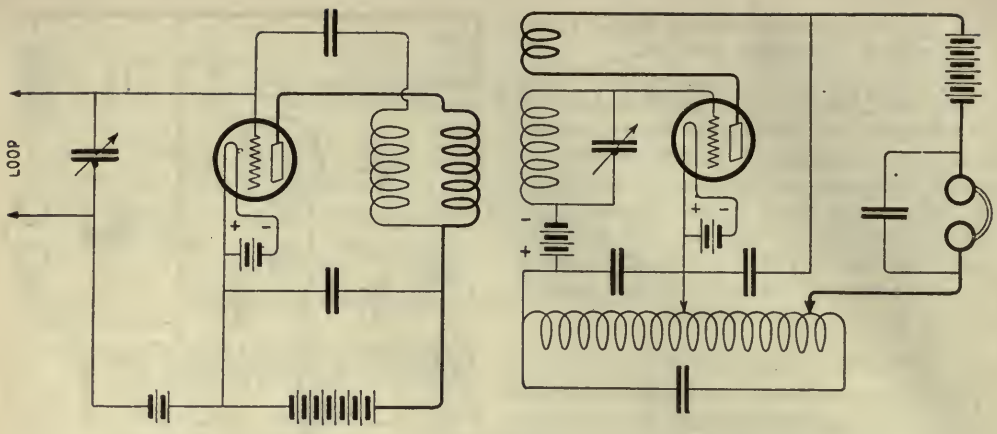


FIG. 3

Here is a circuit which Mr. Roberts offers as a possibility. No constants are given because they are unknown and must be determined by experiment. The left hand half of this circuit is almost a direct copy of the R. F. section of Mr. Roberts's now famous two-tube set—the right half is a super-regenerative circuit of practical design. After these two have been joined satisfactorily you may start on Fig. 1, which is the last word

HOW TO SOLVE THE PROBLEM

IN WORKING up a circuit such as this, the difficulties should be overcome, one by one, whenever possible. A good procedure would be to start with the super-regenerative circuit alone, as shown in Fig. 2, which differs from that published by the writer in the May, 1923, number of Radio Broadcast, in that provision is made for varying the grid and plate circuit couplings to the interruption frequency oscillation circuit independently of each other by means of a large number of taps on the inductance. Local stations can readily be received without a loop, the grid coil being sufficient to pick them up. After this one tube "super" is working perfectly, it is time to put the radio-frequency amplifier ahead of it, as Fig. 3 suggests. This, when properly adjusted for zero coupling, should make a tremendous difference and the set should now give loud-speaker volume with greatly improved selectivity.

When the builder is satisfied with the operating characteristics of this set, the final step may then be taken. This is the reflexing to obtain a stage of audio-frequency amplification. At this point, it may prove necessary to try some such filter arrangement as shown in Fig. 1. It may even be necessary to shift the position of the primary of the audio transformer in the circuit so as to bring it to ground potential. In this figure, C is as large a capacity as can be used without spoiling the quality, and L is the inductance required to annihilate the reactance of the shunt circuit LC at the interruption frequency. The series resistance may help to make the by-passing more complete.

The above hints on construction and experimental procedure are rather indefinite and unaccompanied by values for the various quantities, but they will be more than sufficient for experimenters capable of doing such work successfully. It is not desired to lure others into so difficult and tedious an undertaking.

HOW A PACK RADIO SET FINDS TROUBLE

ROBERT H. MARRIOTT, a former President of the Institute of Radio Engineers, now an engineer on the Pacific Coast, has written a very interesting story about how he uses a pack radio set to "shoot" such radio troubles as arise from radiating receivers and bad power lines. The article is written in Mr. Marriott's interesting style and is full of ideas and suggestions. It will appear in an early number.

The Story of Powel Crosley

Often Called the Henry Ford of Radio—How the Search for a Child's Radio Set Started an Immense Business

By MYRA MAY

SOMETIMES it really pays to gratify your children's desires. There have been several instances in which the wish of a child has resulted in the discovery of a good toy, or the invention of some delight to the heart of some youngster. Who knows but that through the doll Jane wants or the bicycle Jimmy dreams of, fame and fortune may seek you? Consider the case of Powel Crosley.

Crosley's little boy wanted a radio set and, like all fathers, Crosley agreed to buy one for his son. The boy was only nine years old but already he was on familiar terms with antennas, inductances, grids, B batteries, and the rest of the jargon of the true radio fan. He planned a set that would bring in distance and anticipated hearing all the baseball games right at home; he even invited his young friends to enjoy the broadcasting as his guests.

So on Washington's birthday, 1921, Crosley and his son set out to buy the long promised outfit. The Precision Equipment Company offered them a small receiving set for $130, far too expensive a one for a father in moderate circumstances to buy his son. There was nothing cheaper to be had and the father broke the news to the youngster that they would have to postpone buying the "toy." The boy, remembering his nine years, winked back the tears and mastered his disappointment. For a compromise, however, Crosley bought the child a practice key buzzer and a text book on radio.

Thereafter father and son spent their evenings mastering the intricacies of wireless. The boy studied his lessons in the afternoons so that the evenings might be free for the alluring radio. Crosley himself fell under the spell of these after dinner sessions. Within a short time they had a working knowledge of the principles of wireless. Crosley soon bought a simple crystal set. His antenna was made of hay wire.

"Every rock crusher around town came in like a ton of brick," Crosley says of that outfit. "We couldn't get any music so we added an audion detector and heard a concert seven miles away! That evening is one of the red letter days in my life. I don't know whether my son or I was prouder of the performance. I unconsciously joined the class of radio bores. I told everyone I met about the distance our home-made set had covered.

"Finally the boy and I, by this time hopeless radio fans, bought a three-barreled multicontrol set. When the wind was blowing in the right direction, we frequently heard Pittsburgh—a remarkable achievement from our home in Cincinnati, we thought. Our total outlay on our set that the boy and I had made, had been only $35. The new outfit was an extravagance we permitted ourselves now that we were going deeper into the mysteries of wireless. Moreover, we had gained a good knowledge of radio, could rig up a set and were able to diagnose our trouble when the apparatus wasn't working properly.

It All Started With an Idea

Powel Crosley, as Miss May tells in this story, found that radio equipment a few years ago was entirely too expensive. And so, after some business troubles, he started out to make radio sets which could be purchased by the "average man." Some of Mr. Crosley's admirers have called him the Henry Ford of radio. What is certainly true is that the idea of large scale production of not-too-expensive radio equipment satisfies a decided public demand. Mr. Crosley is an interesting person, both because of himself and of what he has done; and Myra May has quite caught the spirit of his personality.—THE EDITOR.

THE HENRY FORD IDEA IN RADIO

ON THAT Washington's birthday, I wondered how other men on salaries as small as mine could afford to buy radio sets at the prices I was asked. I knew that ex-

pensive equipment such as I had been shown was out of the question. I knew that many men lacked the mechanical ability or the desire to make their own outfits. Yet I was confident that radio was not a rich man's toy and I believed that it should be within the reach of everyone.

"As my boy and I tinkered with our home made set, the idea was born in my brain that a big market awaited inexpensive radio equipment. The possibilities of cheaply manufactured apparatus on a production basis appealed to me more and more. I was sure that here was an untrodden field in a brand new industry. There the opportunity was, waiting for someone to realize its value. I decided to go into the radio business on a very limited scale."

Crosley, at this time, had a small wood working factory where he manufactured phonograph cabinets. The slump of 1920 had hit his business so hard that trade was practically at a standstill. It was a godsend, therefore, to be able to use the idle machinery to turn out radio cabinets. For a time he made the cabinets for other companies, but his son's enthusiasm for radio finally convinced the father that this new art was no fad, that it was an invention here to stay and that it had unlimited possibilities. Instead of making cabinets for other concerns, he began to sell them direct.

Through contact with the manufacturers of radio parts, he discovered that there was no popular priced equipment on the market. From the time that he and his son had bought a book of directions, and started to make their own set, Crosley had seen the need of inexpensive parts. The lack of a moderate priced vacuum tube socket particularly impressed him. Although a novice at radio, he was a trained automobile mechanic, so using his knowledge in a new capacity, he designed a socket made of porcelain. Its success led him further in this new field. He produced a book-type variable condenser made with two flat pieces of wood and working on a hinge. Then he manufactured a special switch. Now that he turned out cabinets, sockets, condensers, taps, and switches, the next logical step was to make a complete set.

"Our first outfit," Crosley relates, "was a simple crystal set." It was a very simple set, but it laid the foundations of a million dollar concern and carried out a precept that said experience had taught him. He had learned the wisdom of beginning a new business on a small scale, although it had taken several failures to do it.

At the time he graduated from college, he wanted to go into the automobile business. His father was a wealthy attorney of Cincinnati, and wished his son to join his firm. Young Crosley, accordingly obediently went to law



A CORNER IN THE TESTING LABORATORY

Of the Crosley Manufacturing Company. Mr. Crosley is testing the operation of a radio receiver picked from the stock

school. Once out of college, however, he announced that he was going to make mechanics his life's work. His father answered this by telling him he must make his own way in his chosen profession.

So this likely young lawyer with automotive leanings got a job as a chauffeur for a private family. Crosley did just that. He had some valuable experience for a few months and learned what it is that endears a motor to a mechanic and a chauffeur. And he acquired the consumer's point of view.

CROSLEY AS AN AUTOMOBILE PROMOTER

THEN on his twenty-third birthday he decided to test an idea that he had had for some time. He believed that there was a big market for inexpensive six cylinder automobiles that would retail for about $1,700. So he organized a company and manufactured his first car. Interest was aroused everywhere. The young man seemed to have hit on an idea that the world had long awaited. It seemed as though success must crown his efforts. But that first car was the one and only that the company ever manufactured. Not long afterward, the defunct corporation was buried with appropriate ceremonies.



ON A TOUR OF INSPECTION

Mr. Crosley's plant is one of the largest of the independent radio manufacturers. Three years ago, he came to this same plant to purchase a radio receiver for his son. He now owns it. The story of how that came about is most interesting

"Not enough capital," Crosley explains succinctly. "I had already borrowed money to organize the company and I could not secure additional funds. I think that failure was the greatest diappointment in my life. I have never counted on anything so surely and taken a reverse to heart the way I mourned that automobile disaster. From the time I was in college, I had planned to be firmly established and on my way to becoming a millionaire at the age of thirty. I had fondly imagined that I had found a short cut to fame and fortune and that at twenty-three I could go to my father and say 'I have succeeded!' But then I was utterly discouraged. Never had the future looked so dark.

"Still despondent, I drifted to Indianapolis. That city was just showing signs of becoming a great automobile center. Here I got a job as a driver for the Carl Fisher Company. You may have heard of it; they are prominently identified with the Prestolite business. My knowledge of motors and sheer nerve put me on the payroll of the concern and when the great Indianapolis Speedway was opened, the company selected me for one of their entries.

"A few days before the race I broke my arm cranking an automobile and thus was unable to drive a car. Lady Luck seemed to have turned her back on me forever. As for Opportunity, I decided that she had forgotten my address and so couldn't knock at the door. In quick succession, I worked as assistant sales manager, copy writer, and manager for several automobile companies."

Crosley was trying to find himself, searching desperately for the right place. But as he neared the thirty mark, he was not a whit closer to the millionaire class than when his own company had gone broke, nearly seven years before. He was still not established; he was still not ready to go to his father with the news of his success. If any one had wanted to bet that Powel Crosley was to be a millionaire in five years' time, he could have had 100 to 1 odds and the sympathy of the onlookers for wasting his money that way.

It did not seem that he was ever to realize his ambitions. Returning from his wanderings in Indiana to Cincinnati, his home town, he again organized an automobile company. This time the chances for success looked good. He arranged to handle the designing, the production, and the sales end of the pro-

posed business while the other partners advanced the money. It was an ideal combination with only one drawback. They lacked sufficient capital. For the second time, a company he had organized died for lack of money. Crosley, who had lost his youthful illusions about any short cut to success did not take his second defeat as hard as the first.

SUCCESS AT THIRTY?

HIS ambition to be firmly established by thirty looked as far off as ever. Undismayed he once more tried to capture the elusive fortune. In 1913, the popularity of cycle cars seemed to offer a splendid field for a new inexpensive make. Crosley organized another company, but the concern languished and died just as its predecessors had done. The autopsy revealed the same fatal lack of capital as the cause.

"It was then that I woke up" Crosley says. "I thought that I could finance million dollar corporations on small amounts of capital that did not even belong to me. I promised myself then and there not to attempt more than I could safely manage, not to run my business on other people's money, and above all, to be strictly independent in my financial dealings. I made up my mind that I would finance myself even though I had to run a popcorn stand and that I would quit trying to fly too high on wings that were too big for me."

But Crosley was a born organizer. Although he stuck loyally to his resolution to manage his own affairs without outside help, the popcorn stand was not in his scheme of life. He started a mail order business and when it prospered he bought out one of his clients who sold automobile specialties. Next he purchased a printing plant where he ran off the advertising matter required in his other lines. And as if he were not already sufficiently engaged, he took over a wood working factory where he made phonograph cabinets.

Every time a new business loomed up on Crosley's horizon, he saw the pot of gold. The idea of supplying an inexpensive article was inherently sound, though he applied the principle in many different trades. He seemed to be drifting when he went from one line of work to the other; in reality, he was learning the limitless possibilities of medium priced goods, in high priced lines.

After each successive failure, he would rebound from the disappointment with the conviction of still another business which would make the family fortune. When this new company began paying surtaxes, he would buy his wife the long promised Rolls Royce and chinchilla coat, and as the day of his ultimate success seemed farther and farther removed, his wife never lost faith. She was sure that some day Powel Crosley would join the millionaire class and then she would have the Rolls Royce and the chinchilla coat. Her belief in him set him on the road to gratify his ambitions.



POWEL CROSLEY AND GEORGE LEWIS
Mr. Lewis is the general manager of the Crosley Company

With all of the ventures he was running, Crosley was still not satisfied. He entered still another field. This time he found the one that led to the pot of gold.

THE CROSLEY IDEA

HE TRANSFORMED his wood working factory into a plant to make inexpensive radio parts. Then he introduced the making of medium priced parts and gradually built up his gigantic concern. But he was perfectly content to start in a small way and gradually increase the business as finances warranted. He has learned the value of the humble beginning and has clung to his resolution to manage his own affairs without outside help.

Just two years after he had taken his little boy to buy the promised radio set, at the



AT WORK AND AT PLAY—
Mr. Crosley tracing the intricacies of a blu e print in the shop office of his plant at Cincinnati. The circle shows the radio manufacturer and a very good friend, in a moment of repose

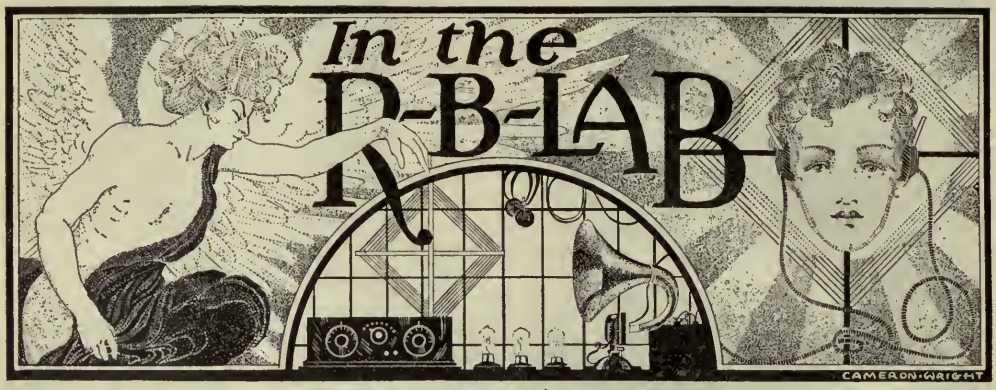
Precision Equipment Company, Powel Crosley bought out the concern.

"I worked out the details of the transaction at my sister's wedding and bought the company the next morning," he chuckles reminiscently. "When I'm figuring on some sort of deal, I can't put it out of my mind no matter how great the occasion. I believe in intensive work, however, and find you can accomplish much more by that means. Work hard while there's work to be done and then when the leisure comes, make the most of it.

"Any one can accomplish whatever he sets out to do. If he doesn't succeed at first, he will succeed eventually, provided he has ambitions and ideals and thrusts aside everything that interferes with his own progress."

SHOULD A CITY BROADCAST?

IS THERE a legitimate field for the city in broadcasting, or should that form of entertainment and instruction be left to commercial enterprise? James C. Young has prepared a highly readable article on the subject. He tells particularly what they are doing at WNYC, the new New York City station. It will appear in an early number



A MIDGET ONE-TUBE REFLEX

AS THIS issue of RADIO BROADCAST reaches the hands of the reader, it is just one year ago that we published the original article on the building of the single-tube reflex receiver—the "Knock-Out." The passing year has seen the interest in this phenomenal receiver increase rather than wane, and while it is now essentially what it has always been—the finest one-tube set possible—suggestions from our readers and research in this laboratory have greatly increased the possibilities of the set. Almost every issue of IN THE R. B. LAB, since the article last November, has contained additional data on the construction and improved design of this receiver. The latest possibilities of the one-tube "Knock-Out" to be brought to our attention are embodied in the midget edition built by E. L. Faler, of Phoenix, Arizona, and are illustrated in the accompanying photographs.

The tuner unit is pictured in Figs. 1 and 2. This is primarily a vacation set. Compactness with the accompanying ease of transportation was the first consideration of Mr. Faler. With the not incorrect idea that portability of this receiver varies indirectly with the size, he has greatly compressed.

The over-all dimensions of the set are approximately those of the average cigar-box. In fact, the designer started out with the definite idea of confining the set to this size, and the cabinet might well be one of these boxes improved with a little sandpapering and stain. A second cabinet, of the same size, was provided to hold the batteries—flashlight A cells for the UV-199 tube, and four small block B batteries.

Fig. 2 shows the back-of-panel construction and gives a general idea of how compactness is achieved. The radio transformers, T1 and T2, are the Midget Harkness coils manufactured by the Phoenix Radio Laboratories. A Hedgehog audio frequency amplifying transformer takes the place of the usually rather bulky T3, and the flat Variodon condensers are substituted for the conventional interleaving plate variables. This last, however, is a rather doubtful innovation, as the air condensers are necessarily more efficient and desirable. The interested constructor is advised to employ the usual 15-plate variable condenser, which, with the judicious placing of the remaining parts, should not increase the over-all dimensions of the receiver. An Erla fixed crystal is used in the detecting circuit.

What the Lab Offers You This Month

—How to build a midget one-tube reflex receiver according to the famous Knock-Out design.

—How to wind tiny inductances for a cigar box receiver.

—How to install pilot lamps to record the filament lighting of tubes in de luxe equipment.

—Facts about resistance-coupled amplification with dry cell tubes.

—How to choose the right rheostat for your tube.

—How to build an ultra efficient inductance: a combination honeycomb and spider web coil.

—Suggestions for the amateur laboratory.

—Hints on radio construction and operating.

The hookup of the receiver will be found on page 497 of RADIO BROADCAST for April.

MAKING YOUR OWN MIDGET COILS

THE reader interested in building a midget one-tube reflex may very easily wind his own small-size inductances. Fig. 3 shows the coils manufactured by the Phoenix Radio Laboratories, while Fig. 4 illustrates an antenna coupler (T1) wound in this laboratory on a thread spool, which works very well in the single-tube circuit. Referring to the diagram shown on page 497 of RADIO BROADCAST for April, 1924, the following winding specifications hold for T1 and T2.

The average spool has a diameter of about three quarters of an inch and a winding surface of a little over one inch. Spools of these dimensions were used in the RADIO BROADCAST Laboratory. The secondaries of both transformers are wound with 112 turns of No. 32 enameled wire. The primary of T1 has 28 turns while that of T2 is wound with 65 turns. The primaries may be wound with slightly larger wire than are the secondaries, if desired. In our experiments, the primaries were wound first, followed by a layer of paper, and then the secondaries. As the secondaries take up practically all the winding space, the result is a little more neat than if the smaller windings are superimposed upon the larger. The leads from the primary are brought out through small holes in the winding surface of the spool, while the ends of the secondary are passed through holes in the sides.

If slightly larger spools are used, subtract two to five turns from the primary and secondary, and add them in case of a smaller spool. While these midget coils compare well in operation with the standard size, the latter are to be preferred when they are equally convenient.

RESISTANCE COUPLING AND DRY-CELL TUBES

THE growing and what we believe to be permanent popularity of the resistance-coupled amplifier has given rise to questions concerning the resistor and condenser values for different tubes, particularly in reference to the possibilities of the dry-cell bulbs.

Experiments in the R. B. LAB. indicate that the resistance-coupled audio amplifier can be used successfully with any amplifying tube on the market to-day. The dry-cell tubes function very nicely, and the resistor and condenser values are exactly the same as those recommended by RADIO BROADCAST for use with the UV–201–A. For the UV–201–A, the UV–199, the WD–12 (and the corresponding Cunningham and De Forest

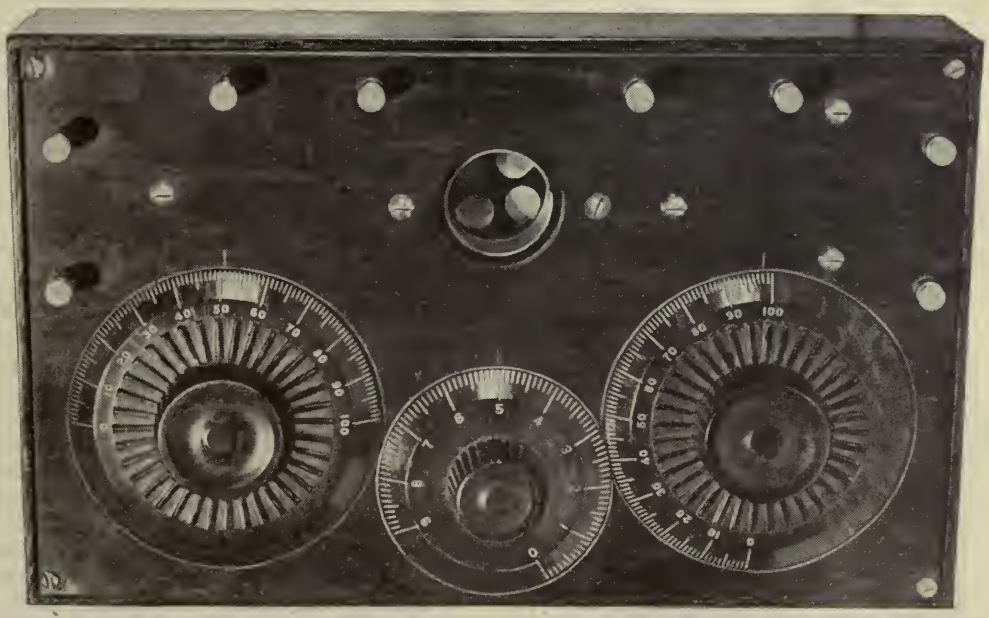


FIG. 1

The front of the midget receiver. The cabinet is the size of a cigar box

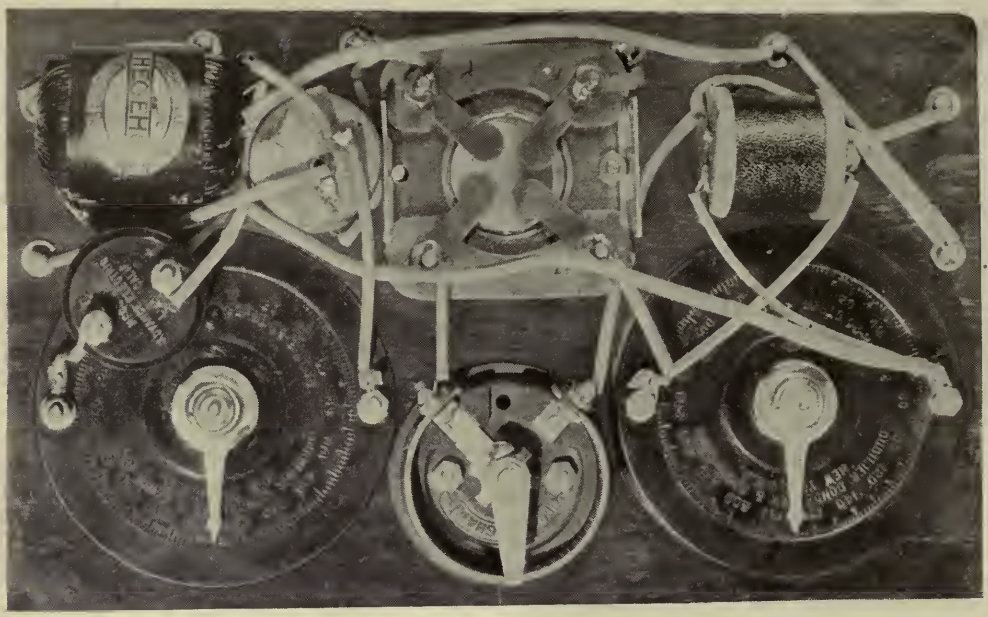


FIG. 2

Behind the panel. The compactness is achieved through use of midget transformers

bulbs), the Meyers tube (an exceptionally good amplifier for this circuit) and the Western Electric N tube, 100,000-ohm coupling resistors should be used in each stage. The isolating condensers are most conveniently .006 mfd. Micadons. The proper grid leaks, respectively in the first, second, and third stages are: 1,000,000 ohms, 250,000 ohms, and 50,000 ohms. The circuit for a three-stage resistance-coupled amplifier will be found on page 103 of RADIO BROADCAST for June.



FIG. 3

A manufactured midget coil, for the Knock-Out reflex



None of the above mentioned tubes are recommended for a fourth stage, as the power handled will often exceed the capacity of the tube, with resulting distortion. A power tube, such as the Western Electric 216–A is suggested, using a coupling resistor of 100,000 ohms, a grid leak of the same value and a .006 mfd. isolating condenser. On distant and low-power stations, the UV–201–A will function satisfactorily in a fourth step. Excepting that a 50,000-ohm grid leak is recommended, the values are the same as those given for the UV-216-A.

Using the 216-A throughout the amplifier (a very fine arrangement) the values are the same as suggested for the lower-power tubes, excepting that the grid leaks for the first three steps should be 2,000,000 ohms, 500,000 ohms, and 100,000 ohms.

The plate voltages should be at least the maximum potential recommended by the manufacturer of the tube, which may be safely doubled with considerable increase in amplification. The plate resistors effect a drop in the battery potential.

SIGNAL LIGHTS ON DE–LUXE EQUIPMENT

THE day of exposed sockets or peepholes is fast disappearing, and fashionable radio sets (for engineers are actually bowing to *mode*) postulate completely enclosed bulbs. In many cases, lack of room for tube mounting in evenly spaced lines of visibility provides a more legitimate excuse for the hiding of the tubes. Such reasons, however, by no means obviate the desirability of knowing what tubes are burning, and in case of trouble of immediately either eliminating the A battery circuit as the source of

difficulty, or affirming that the trouble lies there.

Instant knowledge of filament circuit conditions is made artistically possible through the inclusion of signal lights in the set—small pilot lamps placed in the filament circuits and behind colored jewels on the front of the panel.



FIG. 4
A home-made small edition coil wound on a thread spool

There are two possible methods of connection—in parallel with the individual filaments, and in series with them. In the parallel arrangement the signal lamps are wired from the sockets—on the bulb side of the rheostats. The burning of the shunt bulb indicates the perfect condition of the A battery circuit *as far as the tube*, but does not necessarily mean that the bulb is lighted. Unless special lamps can be secured, this method is the better of the two.

Low amperage lights (that is, those which draw between $\frac{1}{4}$ and $\frac{1}{2}$ amperes) should be employed, having approximately the same voltage as the tube. Lower voltage lamps may be used in conjunction with small fixed resistances. Connected in this manner, the pilot lamps draw an additional current from the A battery—about one ampere for three indicators. This may or may not be a negligible disadvantage.

In the second or series connection, the pilot lamps are placed in series with each filament, being used as ballasts in place of rheostats which are completely eliminated. Connected in this manner, the extra lamps place no additional drain on the A battery, but operate on the energy which ordinarily would be dissipated as heat in a rheostat. The correct lights for this highly efficient arrangement should operate on the normal current of the tube and on a voltage equal to the voltage of the A battery, minus the operating voltage of the tube (the potential drop across the usual rheostat). Special ballast-indicating lamps for all popular tubes are being manufactured and are available to the fan in small quantities. If ordinary indicating bulbs are employed, the comparatively small potential drop through the filament of the cold tube, when the current is turned on, will place a disastrously high voltage on the pilot lamp.

This system indicates very definitely just what tubes are lighted. This function and the economical character of the arrangement recommend the series connection.

The lamps are screwed into special sockets that are easily made by breaking up the usual miniature porcelain base. The metal parts are salvaged, and the long terminal strip is bent over into a convenient bracket. Fig. 5 illustrates the manner of mounting the skeleton socket on the panel. The jewels, which can be obtained in a variety of colors from any manufacturer of switchboard supplies, are the smallest size, fitting tightly a $\frac{5}{16}$ inch hole in the panel.

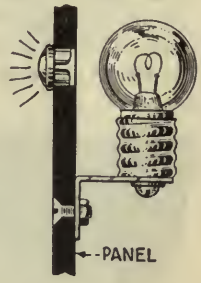


FIG. 5
How to mount the pilot lamps. All the necessary parts may be had by breaking up a miniature base

Figs. 6 and 7 show a resistance-coupled amplifier with automatic filament and amplification control in which pilot lamps have been incorporated. With the control switch in the middle, all lights are off. To the left, the output is switched to one stage of amplification, and the left-hand jewel flashes. With the switch to the right, all bulbs are lighted, the output is transferred to the last tube and the three jewels glow accordingly.



FIG. 6
Front view of an amplifier designed in the R. B. Lab. in which signal lights are incorporated

THE RIGHT RHEOSTAT

THE association of high-ohmage rheostats with the UV-199 and similar three-volt .06 ampere tubes, has given rise to a mistaken idea in regard to the proper resistances for dry-cell, quarter-ampere tubes. High-resistance rheostats, in the neighborhood of thirty ohms, are not required for the correct operation of such bulbs unless the battery voltage is considerably in excess of the operating potential of the tube.

A rheostat is included in the filament circuit to drop the battery potential to the operating voltage of the tube. It accomplishes this through a very fundamental electrical function—the voltage drop which necessarily takes place when a current passes through a resistance, and which is numerically equal to the resistance in ohms times the current in amperes.

The correct value of the rheostat for any tube is very easily determined. The best operating voltage of the bulb is always specified by the manufacturer. Subtract this from the voltage of the A battery from which

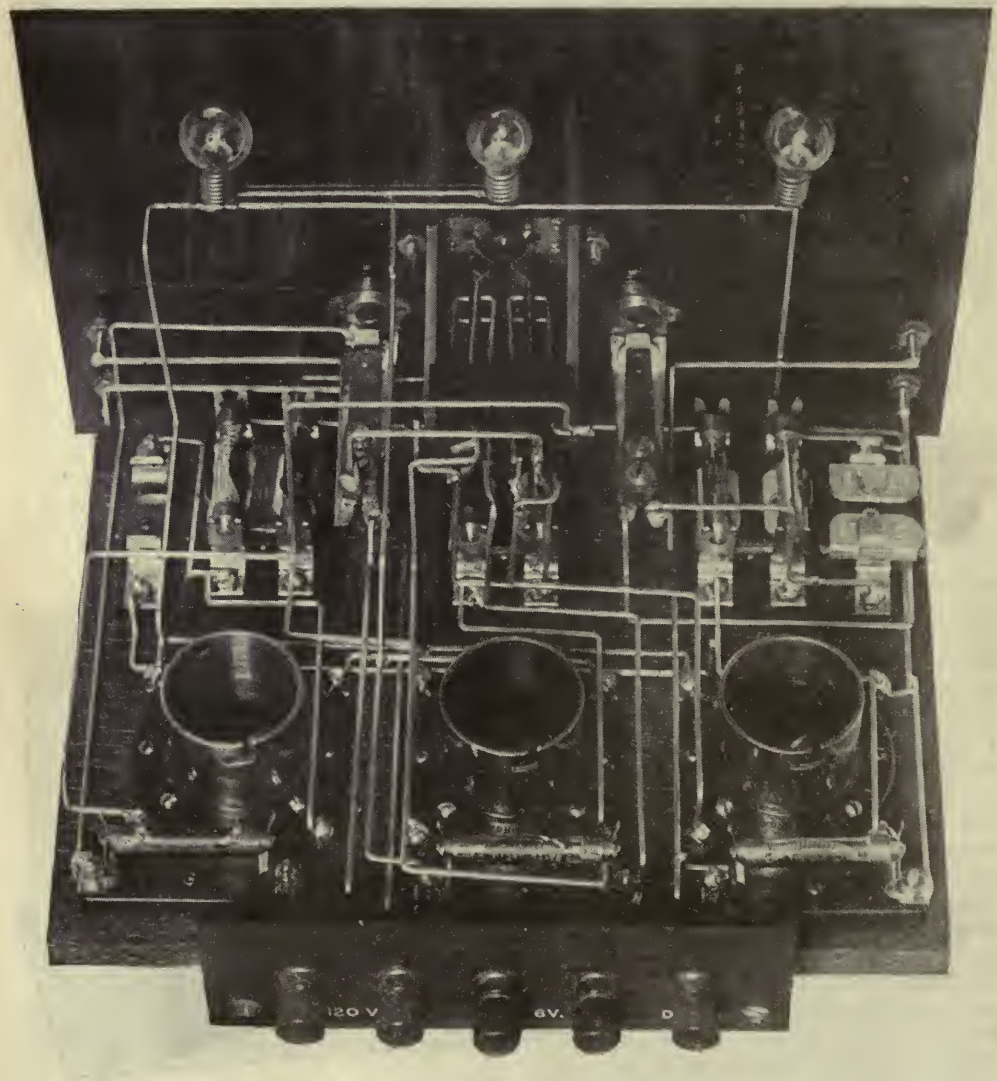


FIG. 7

Back view of the de luxe amplifier, showing method of mounting lamps. Parallel connection is used in this set

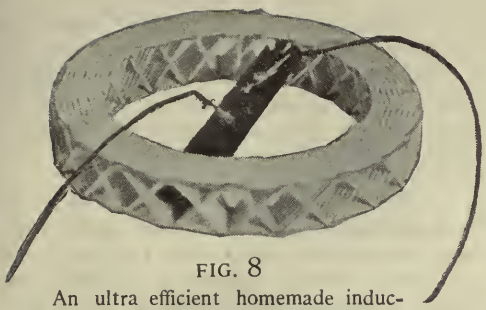


FIG. 8

An ultra efficient homemade inductance. It is easily made and will improve the operation of many sets

you will operate it. This gives you the required voltage drop. The current consumption of the tube in amperes, at the correct A-battery voltage, will also be found in the operating directions. Divide the required voltage drop by the current. The result is the minimum resistance that will permit the most efficient operation of your tube. For instance:

Operating a Cunningham C-301-A from a six-volt storage battery. The correct operating potential for this tube is five volts. 6—5 = 1—the required voltage drop is one. The C–301–A is a quarter-ampere tube, therefore, $1 \div \frac{1}{4} = 4$—i.e., at least four ohms should be used. Thus a six- or ten-ohm rheostat will be sufficient.

In cases where the adjustment of the filament temperature is at all critical (using the UV–201–A as a detector in regenerative circuits, for instance) the lower resistances will permit a finer variation of current.

The inter-relation of volts, amperes, and ohms, in regard to filament resistances and A batteries, will be found treated with especial regard to the principle of this very fundamental law in the October 1923 issue of RADIO BROADCAST.

A NEW–TYPE HOME–MADE INDUCTANCE

IN A recent issue of the Lab Department, we stated that the ideal inductance would be a self-supporting coil wound with uninsulated wire on air. Like many ideals, this arrangement is hardly practicable. Nevertheless, it can be approached, and in Fig. 8 we have what is probably the closest practical approach to this ideal condition, a coil wound by one of our readers, Mr. Horace A. Woodward, of New York City. The Sickles coil is a commercial form of this type of winding. It is essentially an exaggerated honeycomb.

The winding form is a disk of wood about three inches in diameter and three quarters of an inch wide. Into the periphery of the disk, one eighth inch from each edge, two rows of twenty-five evenly spaced pins are driven. Two-inch, No. 14 finishing nails are convenient for this purpose. Notches, which facilitate the last part of the work, should be cut between the pegs (Fig. 9) with a three-cornered file.

The coil is wound by passing the wire over two right-hand pins, diagonally across and over two left-hand pins as illustrated in Fig. 9. When the last turn is wound, the coil is sewn with a waxed thread and a flexible needle made of a short length of twisted wire. The needle is passed beneath the coil through the filed notches, taking the direction shown by the black thread in the photograph. If the

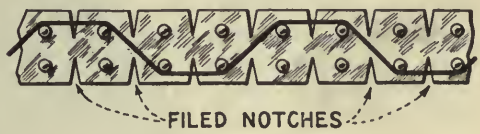


FIG. 9

The winding form for the low-capacity coil

experimenter prefers, collodion may be used as a binder and the sewing dispensed with, though this is theoretically inferior to the method employed by Mr. Woodward.

The nails are finally removed and the coil slipped off. The inductance is self-supporting and will withstand an extraordinary amount of mechanical abuse. The ingenuity of the individual experimenter will suggest the most convenient manner of mounting.

These coils may be substituted for single-layer inductances in any circuit with probably an increase in efficiency. Mr. Woodward finds them decidedly superior to the spiderweb coils in the Roberts set. Assuming a three-inch diameter for the usual flat wound coils, the same number of turns on the improved inductance will give approximately the same wave range.

BUILDING YOUR OWN LAB

ONCE again we are rather prodigal, and for November we recommend two purchases to the owner of the growing lab—an automatic center punch and an adjustable square, shown in photographs Figs.

10 and 11. (These tools cost $1.44 and $1.05 respectively.

The center punch is an efficient substitute for the comparatively noisy and laborious older type on all materials but metal, and is from twice to three times as fast. The point is placed on the marking and the punch pressed down with the hand as far as the spring ar-



FIG. 10
The automatic center punch. A speed tool

rangement permits. This will result in a definite and satisfactory indentation.

The square is an improvement over the ordinary fixed carpenter's tool. It consists of an accurate rule which is adjustable as to length, with readings in both directions on each side. An angular surface on the grip also permits the drawing of lines at an angle of 45 degrees to the straight edge.

Both tools are made by Starrett and add quickness and accuracy to the work of the radio builder.

HELPFUL HINTS ON BUILDING AND OPERATING

DON'T BLAME everything on static. There are many similar noises that are produced in your set. Disconnect your antenna. If the sounds stop, it is genuine static, and nothing, as yet, can be done about it. The nature of static and bona fide signals are so similar, and a static eliminator must necessarily also eliminate signals.

SHIELDING A RECEIVER is bad practice. It is only a pound of cure. It in no way affects the fundamental cause of capacity troubles, and it adds resistance to the circuit with resulting inefficiencies.

Mount tuning coils and inductances as far behind the panel as possible, and always connect the stationary plates of a variable condenser to the grid.

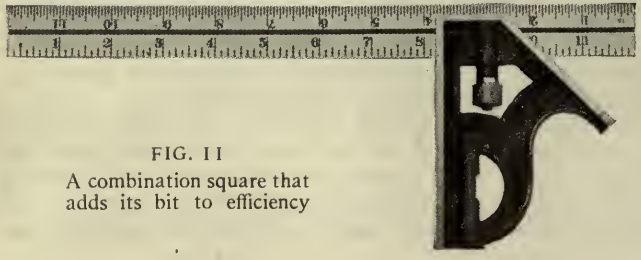


FIG. 11
A combination square that adds its bit to efficiency

A properly designed receiver needs no shielding. (This does not apply to the individual shields about the intermediate stages in the super-heterodyne, though even here the successful elimination of the metal would probably be an improvement.)

IN CONSTRUCTING or designing radio apparatus endeavor to keep inductances and tuning coils away from the panel and necessary metal supports. Eliminate all metal work that can possibly be done away with. Precautions of this sort will add selectivity and sensitivity to the receiver.

NOT all bus wire is tinned. The real tinned bar is satisfactory for wiring purposes but very often nickel-plated wire is palmed off on the unsuspecting purchaser. This kind is not desirable since the nickel-plating increases the resistance of the circuit. Resistance is all right in its place—in rheostats and potentiometers—but otherwise it should be kept at a minimum.

THAT old, discarded three-cornered file may be resurrected and with a few changes will serve as a tool of many uses in the radio lab. On a grindstone remove all traces of the file ribs and sharpen the three edges to a keen knife-edge. Panel holes may be enlarged with this instrument or with a handle on both ends it will serve as a scraper to smooth the rough edges of panels.

NO MATTER what size holes are to be drilled in a panel, drill all with a small drill first—then enlarge with the proper size drill for the holes to be made. This results in evenly centered holes and will reduce the wear and tear on your larger drills. Put a flat block of wood underneath the panel to prevent the holes from chipping around the edges.

MANY of the binding posts now on the market are made of some sort of composition, easily affected by heat. Before soldering connections to a binding post, remove the top, or cover the entire post with a wet cloth. This will prevent the post from melting or otherwise losing its shape.

AN OUNCE of prevention is worth a pound of cure, so follow the practice of the manufacturers and see that all socket nuts, transformer bolts, and other like parts are securely tightened before the units are permanently mounted in a set.

What News on the Radio Rialto?

Experiences Social, Radio, Mechanical, and General, of the Crew of Radio Broadcast's Covered Wagon, Direct from the Roadside

By CAPTAIN JACK IRWIN

ON A journey such as the Radio Broadcast Covered Wagon is making, it is difficult to confine oneself strictly to radio topics. The writer feels that his readers would rather read about some of the side-issues which can be counted as some of the most interesting features on a transcontinental tour such as ours.

Are we meeting with conditions that we anticipated? Yes and no. In the congested area surrounding Greater New York and extending beyond Philadelphia, we found the same happy, argumentative fans who rejoiced to meet us and swap stories of various circuits they had tried. We listened to variations on the same theme over and over again. In this area, practically the only source of complaint was of "blooping" receivers. Indeed, they have reason to complain. Throughout New Jersey and in the vicinity of Philadelphia, there was hardly an occasion upon which we set up our superheterodyne receiver that we did not have constant interference from radiating receivers. It was impressed upon us that the campaign against that type of interfering receiver which this magazine is making must be extended. Education in the use of non-radiating receivers, however lengthy a process it may be, is the only way eventually to eliminate this annoying source of trouble. A concerted educational campaign, together with close coöperation from manufacturers and reputable dealers would go far toward remedying the situation, which in the districts this Wagon has traversed are almost intolerable. Here is another method —an appeal to the better nature of the offenders. This fall and winter we will have innumerable radio shows and expositions throughout the United States. Those in charge of the exhibitions ought to make an effort to organize a campaign during the period of the radio exhibition season to bring the "blooper" users to see the error of their way. Again radio broadcasting stations could better conditions by periodically calling attention to the annoyance these sets cause to those in their vicinity. One thing this mobile laboratory has discovered is that nine tenths of those employing radiating receivers do not understand that they are offending and actually rail against their neighbors employing the same sets for interfering with their reception! We have endeavored, daily, to educate such innocent "bloopers" and point out that, if they are unable to change their receivers, they can at least so adjust their regenerative sets that a minimum of interference to their neighbors will result. Few, indeed, realize that the maximum amount of satisfactory regeneration is reached at the point just before the tube oscillates and that it is almost criminal, to allow persistent oscillation while searching for DX.



HOW THE LAUNDRY IS DONE

Captain Irwin spending part of a Sunday in necessary work. Earlier in the day from this camp in Pennsylvania, he listened to the services from St. Thomas' in New York. Dr. Stires preached on the subject "Cleanliness and Godliness Combined"

THE TRAIL WESTWARD

AFTER leaving the Metropolitan area of Philadelphia, we hit the Lincoln Highway directly on the trail westward. Beginning with Lancaster, Pennsylvania, we found radio folk were up against real hard luck.

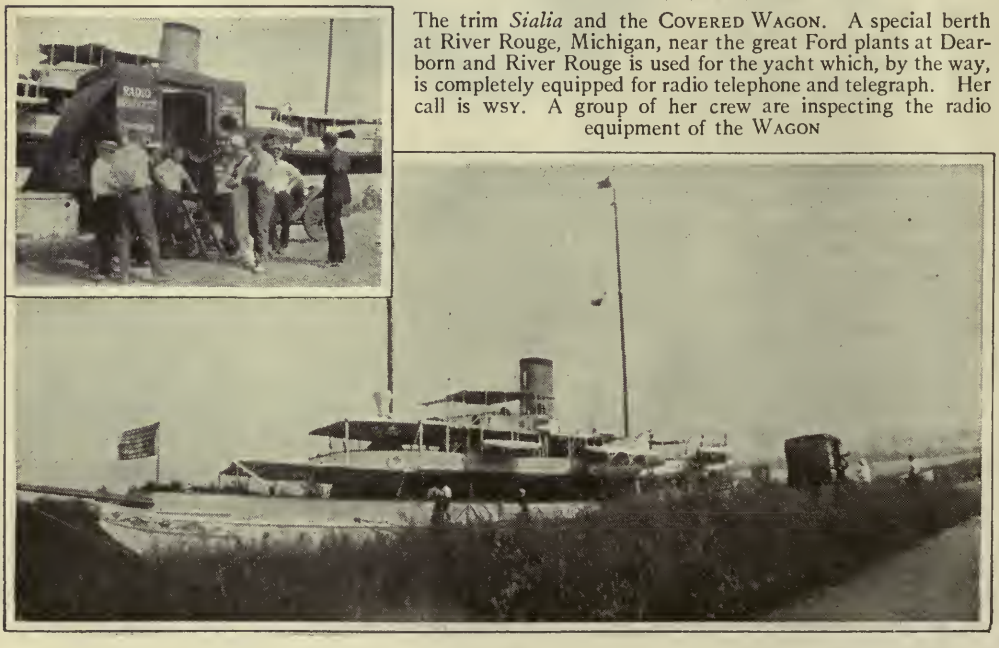
When we pulled in to the above mentioned city, almost the first fellow to greet us was a disgruntled fan who offered to buy our dinners if we could obtain results right where we were parked in the main thoroughfare of the town. Our eight-tube super-heterodyne was working like a charm. In other localities we dissipated the idea that such things as "dead spots," existed, we immediately took him up with the expectation of a good, free meal! A half hour later this fan went on his way, chuckling at us. We found the greatest source of "man-made" static we had ever heard. It was impossible to diagnose the cause, it was just one jumble of discordant noises which made the air crackle hideously. We learned later that this condition was general in the business and downtown residential districts of the city. The lighting and power plant is an ancient one with all overhead conductors. The only source of comfort the resident fans of this perturbed district have, is the rumor that the plant is to be modernized with underground conductors distributing both light and power. One enthusiastic experimenter had just graduated from a crystal receiver, to a six-tube super-heterodyne for which he spent several hundred dollars. He complained to the writer of the extraneous noises he had obtained, totally obliterating good strong radio signals. Another friendly fan had erroneously diagnosed his trouble as B battery faults, but the writer upon investigation discovered the noise to be nothing else than the old "man-made" static. His set was in perfect order, but the conditions surrounding his residence made it impossible to obtain the satisfaction that he should have with his excellent receiver. Such are the conditions that the good radio users of Lancaster and Harrisburg are up against. The same is practically true for the adjacent smaller towns.

RADIO AND REAL ESTATE VALUES

WHILE pursuing this line of investigation in Pennsylvania, I learned to what influence faulty generators and power conductors had when leasing or selling real estate was considered. While parked in a quiet neighborhood in one of the larger cities, a gentleman approached the WAGON and asked how the reception was in that particular vicinity. Upon learning that it was fairly good and freer from interference than in other localities in which we had demonstrated in the same city, he expressed gratification. It appeared that he was the real estate operator handling property in that district and that prospective buyers or lessees invariably asked if radio reception was good in that neighborhood. It transpired that "man-made" static was so prevalent in the town that real estate values were affected. This gentleman assured us

HENRY FORD'S SEA GOING YACHT

The trim *Sialia* and the COVERED WAGON. A special berth at River Rouge, Michigan, near the great Ford plants at Dearborn and River Rouge is used for the yacht which, by the way, is completely equipped for radio telephone and telegraph. Her call is WSY. A group of her crew are inspecting the radio equipment of the WAGON





A WAYSIDE CAMP

Of the Covered Wagon and its crew of two. George A. Eckweiler, Captain Irwin's assistant, is in the foreground, behind an old Pennsylvania tree

that it was not an isolated inquiry from a particularly enthusiastic fan, but that such inquiries were very frequent. He thought probably the same inquiries were made in every community. I had to confess that his was the first case of which I had heard when the fate of a piece of property depended upon radio conditions. This example illustrates what poor conditions exist in certain communities for broadcast reception. The elimination of the causes of "man-made" static will be compulsory once the pocketbook of property owners is affected.

THE INTERFERING CASH REGISTER

PURSUING the hunt for unnecessary interference in a certain western Pennsylvania city we ran across an amusing case, but nevertheless a serious one from the point of view of the man with the receiver. Discussing the cause of interference in this particular spot with a nearby resident, he explained that he had no cause for complaint except one. It seemed that he was the fortunate possessor of a well-known make of super-heterodyne receiver which gave him excellent results until the man in the store under him installed a new cash register operated by a small electric motor. Since that time his satisfaction and contentment had disappeared as he now listened to radio signals interspersed with the ringing up of sales on his neighbor's cash register. He further explained that the busiest time appeared to be when the best features of the various programs happened to be "on the air." However, he added that his interfering friend closed before DX came on!

TOURISTS AND PORTABLE SETS

SPEAKING with several of my friends who are radio dealers in New York, I gathered that the sale of sets for portable use had received a decided boost this summer. This was further borne out by the large amount of space devoted to these sets in both the newspaper radio columns and in magazines. I have camped with hundreds of well equipped automobilists who are touring the continent, and to date have found but one carrying a radio outfit, and that a simple crystal unit carried by a boy in a party. If many portable sets are in existence, it would seem that they are carried to more or less permanent camps and that the strictly auto camper has no use, or perhaps, space, on his overloaded car for what he may regard as a luxury. For this reason, the advent of Radio Broadcast's Traveling Laboratory into a camp peopled with tourists is always a welcome event. They are astounded at the results obtained from a mobile station and with the apparent ease with which loud, clear signals are obtained without the use of antenna or ground.

Many a comment I have heard that "next year we must carry a radio." We are besieged with visitors, often to such an extent that it becomes embarrassing. Imagine, for instance, when you are changing into your other shirt, the flap of the wagon will be swept aside and a delightful, cheery voice ask, "Say, Mister, how about a little jazz!" But seriously, I have found that the possession of a radio outfit in good working order induces a wonderful friendliness from your fellow campers in quiet spots. The owner of a radio set in a tourist camp attracts much attention and is the means of meeting some intensely interesting people from all over the country.

AND WE HAVE OUR TROUBLES

MANY of my friends have assumed, after visiting the COVERED WAGON, that it is a mission devoid of trouble. Is there a man in the radio game who can truthfully say that he can manipulate six different receivers, in turn, and not run against seemingly inexplicable faults in one set or another? Add to those six sets, a housing on four wheels propelled over more or less rough roads, and your radio troubles will correspondingly increase. During the earlier stages of our journey, we were comparatively free from such annoyances, due, of course, to the smooth roads of closely populated areas. During that period we had no hesitation in coupling up one of our sets and expecting instant results. However, as our journey progressed, we found the road shocks increased and, correspondingly, our radio faults occurred more frequently.

An old friend of mine always insisted that a "law of cussedness" existed! I can assure him, if these columns meet his eye, that undoubtedly he is correct. Our experience would indicate a most pronounced law of that discription. Now we never attempt to display our wares in public without first staging a rehearsal in some secluded spot in order first to ascertain how much damage bumps and ruts have caused *en route*. Our instrument tables are slung upon springs. An abundance of sponge rubber is employed to resist road shocks, nevertheless, a broken inaccessible connection is very frequent. Invariably this occurs at the most inopportune time. An instance of this inopportunity recently occurred when we were the guests of the Kiwanis Club of a certain city. This club maintains a camp for boys in a most delightful spot in their attractive city park. We had been accorded the hospitality of the camp and the privileges of the "old swimmin' 'ole." At noon I had given, by request, a talk to the boys and concluded with a promise that we would entertain them with a radio concert that night at our camp.



THE WAY A RADIO LECTURE ENDED

Captain Irwin and a group of the sons of members of a Kiwanis Club of an Eastern city in swimming. The boys had previously shown much interest in the radio equipment aboard the WAGON and Captain Irwin told them about it, and some of his interesting experiences "in the old days" of wireless



AT DETROIT

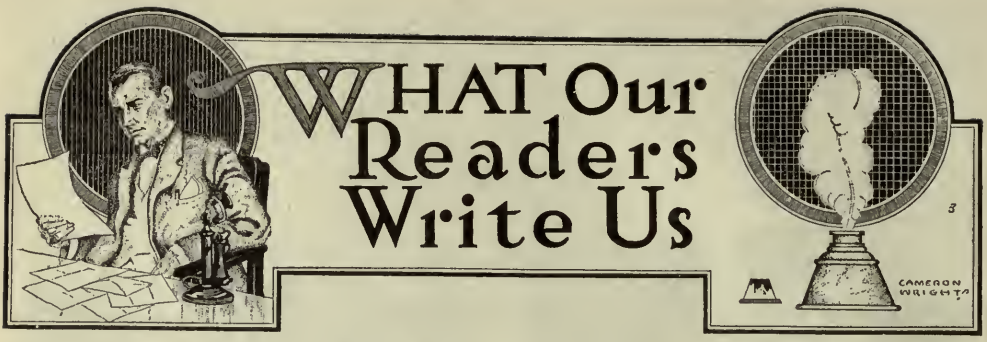
The WAGON parked alongside the Detroit River during the time the September motor boat cup races were held. Progress of the event was followed by a broadcaster in a motor boat. Captain Irwin took part in the announcing

"TROT OUT YOUR RADIO"

AT THE appointed time a half hundred real, healthy young Americans descended upon us and with lusty cries demanded that we "trot out our radio." Anybody who has had much acquaintance with youth ranging from ten to fifteen years of age will surely sympathize with us when I confess that the alleged expertness of both Mr. Eckweiler, who accompanies me, and myself, failed to make that set "perk"! There is no more critical audience in this world than a bunch of American youngsters. On this occasion, the inexplicable part of the trouble was that there was no apparent fault and after the boys had departed and retired to bed, the set suddenly decided to work wonderfully. To make matters worse, the following night found us in the same camp with the worst static storm I have heard in progress. Do you think that group of boys believed our old static alibi? But there isn't much need of answering this question.

EPILOGUE AND EPISODE

NOR are all our troubles on this expedition radio ones. Of course tire troubles are to be expected. But who would look for a punctured tire caused by a gramophone needle on top of Mount Tuscarora? Yet that is what we experienced. Some misguided tourist had taken a phonograph along instead of a radio receiver and cast the discarded needle directly in our path! Another amusing episode not connected with the radio side of our journey was caused by an innocent enough appearing bug called the Japanese Beetle. It is not so innocent as it appears. The Department of Agriculture lists it as one of the most destructive pests ever to find its way into our fields. Just after leaving Philadelphia we were stopped on the highway by state police who began to search our wagon. I facetiously remarked "We haven't a drop in the house" thinking they were searching for prohibited beverages! To my huge surprise they confiscated all our vegetables which we had stocked a few miles back at a ridiculously low price! We were then allowed to proceed, but only a few hundred yards further on was a well stocked vegetable stand, doing a land office business! Nobody can convince the crew of this wagon that that stand is not run by the Pennsylvania State Police! That night a stray dog stole our supply of ham. Yes—life on the COVERED WAGON is great!



A Marvel in a World of Marvels

NEW receivers and new equipment of all sorts and descriptions come piling into the office every day, but the technical and editorial staff was greeted the other day by an incoming piece of "new equipment," the like of which had never before been seen. We have seen many designs of portable receivers, but never before has any swimmed into our ken which combined the features of the horse age, the automobile age, and the radio age. The accompanying letter and photograph tell the story better, it is quite certain, than any of these rather breathless words here.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR:

Confident, as you are, that the millenium had been reached when you announced your "Knock Out" series, we are keenly desirous of taking the puff out of your sales by presenting to you herewith one of our MOXIE DX RADIO RECEIVERS. Designed for us by the Hunchback of Neutrodyne, it represents a life's endeavors among the many closed doors in the realm of science. It is very much more than a toy. It is an electrical instrument calculated to satisfy the demands of the most critical brass pounder and yet ornamental enough to minimize, if not to prevent entirely, the "*re*-radiation" of the whiniest kind of wife. This little MOXIE DX RECEIVER is a veritable globe-trotter, too. We can, if pressed, produce a certified letter testifying to the reception of 2LO via Pekin, China. Our little set is daily causing the users of supers to abandon the Christmas tree type of tuner for ours. We do not desire to upset a struggling industry, however, and do not wish to have our circuit published. For quality of reproduction the MOXIE DX RECEIVER is unsurpassed. The crystal used is a chip from one of the priceless toe rings of old King Tutankhamen. Major White at the ringside comes in like Mozart's 666th overture. We regret exceedingly that we cannot place one in the hands of Zeh Bouck before he sails to Europe, for our receiver is especially efficient on water. If you can induce him to design resistance-coupled radio-frequency and audio-frequency amplifying circuits for it, we are confident that you will be able to announce another "Knock Out" before Christmas. Seriously, though, try your antenna circuit with this little gem. You are in for a continuous series of surprises.

Yours very truly,
The Moxie Company
F. B. Walker, New York.



THE RECEIVER ON WHEELS

Complete without reservation, what with horse, driver, rubber tires, binding posts to match and a shiny crystal

P. S. The writer wishes to take this opportunity to include his check for $5.00 in payment of a subscription for RADIO BROADCAST. It may interest you to know that he is doing so largely because of Zeh Bouck's barrage attack on the advertisers and users of one-tube squealers.

What are the Ethics of Radio?

IN THE "March of Radio" for July appeared an editorial about a New York church which broadcast a Holy Communion

service. At the time, in New York, there was a considerable amount of criticism. The writer of the letter printed below takes exception to the editorial, which he thought was directed against the broadcasting of church services. As a matter of fact, the editorial deplored the broadcasting of the Communion service and questioned the advisability of sending this most sacred ceremony of the church into the air. Church broadcasting itself seems to be thoroughly established, for even in the early days, KDKA, the first broadcasting station to go on the air, in the sense that we now think of broadcasting stations, sent out the services of a certain Pittsburgh church. It is a new art, radio, as has often been observed, and its ethics are slowly being developed.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR:

I read the announcement of your $500 Prize Contest, "Who Is to Pay for Broadcasting?", in the July RADIO BROADCAST.

Well, who pays for anything? Who pays for the double page ads, in the daily papers and magazines that cost thousands of dollars for a single insertion? Radio is simply the latest method of advertising, as your article "Holy Communion By Radio" on page 221 of

Columbus, Ohio, ...192.....

.....

Radio Station .....

.....

Gentlemen:-

Your programme ..... between the hours of .....and..... M. Eastern Standard Time was received by me on my Radiola Super-Heterodyne. It came in ..... and I especially enjoyed .....

.....

.....

I thank both you and the artists.

THE COLUMBUS SLATE CO., WHOLESALE ROOFING SLATE 16 E. Broad St., Columbus, O.

H. W. WEBB, 233 Preston Road, Columbus, Ohio.

AN APPLAUSE CARD OF GOOD DESIGN

the same issue admits. The buying public pays, of course, and always has paid, or the advertiser goes out of business. Why should there be any objection to church advertising?

At the end of the editorial mentioned, I find, "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."

Wrong! You cannot force radio where it is not welcome. A twist of the wrist and it is gone. I catch my news or music just the same while church services are going on. Such services are no bother to any one who does not wish them. You sit back in your comfortable steam-heated apartment and take life easy. Consider those who are not so fortunate, those who are miles from any means of transportation, who haven't even a flivver, and if they have one, the roads are so bad that they dread a trip over them. These folk may have their little radio set and can enjoy their religious services, if they are welcome, or jazz, as their wills dictate. After all, it is a matter of opinion.

G. K., San Francisco, California.

Another Applause Card Design

ALL radio listeners are by no means as lethargic as some of the distressed program managers of broadcasting stations would have us believe. One of the best reasons for this conviction is the increasing number of listeners who are having their own applause cards printed. Perhaps the broadcast listeners have taken a leaf from the well-filled book of the amateurs who have long been in the habit of sending each other printed cards announcing that the station of the recipient had been heard. At any rate, the writer of this letter sent us one of the cards he sends to broadcasters who please him. His design may suggest a similar one to other listeners.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR:

A recent letter in "What Our Readers Write Us" on applause cards has made me think that the least we of the listening class could do is to write the broadcasting stations in appreciation.

I have made a form, as per copy inclosed, and have had them printed on postal cards. I keep them on my radio table to use when anything extra good comes in.

If enough listeners will do the same, it may give the broadcasters and artists the proper encouragement.

H. W., Columbus, Ohio.

Who Was the First to Broadcast?

EVERY once in a while the discussion starts about who was the first to broadcast. Mr. Cannon's letter raises a point which should interest other experimenters who were carrying on wireless telephone tests about the same time as he was. We suggest that those who are interested write Mr. Cannon directly. Without entering into the discussion our-

selves, it is interesting to recall that Dr. Lee De Forest was carrying on experiments with wireless telephony from a studio at 103 Park Avenue, New York, in the spring of 1908, when he broadcast "Cavaleria Rusticana" from the stage of the Metropolitan Opera House.

Editor, Radio Broadcast
Doubleday, Page & Company,
Garden City, L. I.

Dear Sir:

One hears off and on quite a bit of discussion as to who really ran, in a practical manner, the first broadcasting transmitter.

This interests me, as I have quite an inclination to believe that this station handled the first phone of this type. During the months of December, 1916, and January and February, 1917, I ran quite a regular schedule from 9:30 p. m. to 10:30 p. m. Press was broadcast. Phonograph records were sent out and several instrumental artists contributed.

The range of transmission was about two hundred miles maximum. The modulation compared very favorably with that of the stations of to-day. There were only about a dozen special tubes in existence I believe, and the ones I used would now be rated at about fifty watts. Our efficiency was low, naturally.

I have numerous documents to prove the above contention and wonder just where my station ranks among the first of broadcasters.

George C. Cannon,
Radio Station 22K
183 Drake Avenue,
New Rochelle, New York

Captain Irwin and the "America"

Editor, Radio Broadcast
Doubleday, Page & Company,
Garden City, L. I.

Dear Sir:

I was interested in Jack Irwin's article "At Sea with the *America*." It recalled some pleasant memories to me. Just a short time before the *America* sailed, I was down at Atlantic City and rebuilt the United Wireless radio station on the Million Dollar Pier. Operator Miller, whom Irwin mentions, was at that time assistant operator. It is a far cry from those days to Radio of to-day. When one considers the few stations at that time and the difficulty of getting through the New York radio traffic jam from a vessel at sea, the change is marvellous. I have several times come up on a coastwise steamer and seen the operator try to get his stuff through and finally deliver it by personally taking it to the office when the ship docked. In those early days when a fellow wanted some wireless material, he had to make it. However, I remember getting New York regularly at Sterling, New Jersey, thirty miles from the city, with a paper-tube inductance, a carborundum detector, and an 80 ohm standard phone receiver. What a splash a Roberts circuit would have made in those days!

A. A. Weiss, Copperhill, Tennessee.

Radio Comes to Tennessee

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

Dear Sir:

I think from the first time I ever heard of a radio I was interested and anxious to own one. But not so with my husband. He felt that it would be money wasted. After some talking, I finally persuaded him to buy third interest in a community radio which we could keep only a third of the time.

We missed the set so much when the other partners had it that finally we had a discussion at home as to whether or not we could afford to buy one right then and there. However, all my arguments were settled speedily when one night we heard Daniel Macon, that great banjo player who is known all over the country, as the Dixie Dew Drop. He is an old friend of ours, but we had lost account of him for a few months. We bought a new radio at once and, needless to say, we have enjoyed hearing Uncle Daniel playing through our listening-in to him, almost as much as we did when he was in our own home.

It is impossible to tell the pleasure the radio has given us. There are only six radios in our area of thirty square miles. So quite often, we invite our friends in to enjoy a good program of music or lecture of some special interest. The weather forecasts were broadcast last spring when almost everyone around had large numbers of little chickens. If there was to be bad weather, I would call to my nearest neighbors and telephone the others. In that way, we could get our chickens up and saved much work and worry.

We have a friend who cannot walk and who hasn't been outside her own home for two years. Every few Sundays, we carry our set to her home. The only way she can hear a Church service is when we bring our set to her. She says that it seems like Church in her own home, not only are the sermons splendid, but we get such beautiful singing. They are mostly old sacred songs that we all know and love.

My son is only five, but he never retires until nine o'clock when we get the chimes playing "Old Kentucky Home" from Louisville. They never grow old.

Mrs. W. H. T.,
Christiana, Tenn.

The Importance of the Radio Amateur

The High Place the Experimental Operator Occupies—How High and Low Alike Have Each Contributed Their Share to Radio Development

By Dr. W. H. ECCLES, F. R. S.

I MIGHT remind you of what you all know, that the Radio Society of Great Britain exists for the benefit of those who practise or study wireless for its own sake, whether or not they happen to make any money by part of their work in the subject. Meetings are held for the inter-communication of scientific information, for mutual instruction and assistance, for bringing together people interested in wireless, and for the circulation of ideas of all sorts by all feasible means. During the last few years the influence of the Society has rapidly extended as the result of the enormous growth of public interest in wireless, and also as a result of the policy of affiliating societies scattered throughout the country; and thus the Radio Society has found itself becoming, almost in spite of itself, the center of the amateur movement of the whole country. Therefore, in addition to the functions which I have just enumerated, the Society is confronted with the task of holding the amateur movement together in the most difficult times this movement has yet experienced. It is also faced with the task of watching political and other circumstances that are likely to react upon the amateur. Almost simultaneously with these duties there came the need for taking over the management of an ambitious program of work projected by the British Wireless Relay League and for helping the inauguration of the Schools movement. The former piece of work was separated as the Transmitter and Relay Section, and the latter has become the Schools Radio Society and holds the rank of a section of the Society as defined by the new rules. Both these new burdens on the Society are nation wide in their scope, and meet needs that were strongly felt.

In carrying out these tasks, the Society finds itself in the midst of two great popular currents which affect its future very deeply. First, there is the increasing use of wireless for public and commercial message services and for the distribution of entertainment by the broadcast. The latter, of course, is a newcomer, and yet it overwhelms the older use enormously. Besides this, there is the increased public interest in wireless science chiefly as the result of the arrival of the broadcast. The former current is making the spectrum of usable wavelengths more and more tightly packed, leaving less room for each user, including the amateur. The second current, *i.e.*, the increasing popular interest in wireless generally, is bringing more and more persons into the ranks of the student and the experimenter. Many a holder of a constructor's license is turning his attention to a study of the subject and is already a recruit, of greater or less merit as the case may be, to the ranks of the amateurs. Thus we have the rather unpleasant result that there are more amateurs than ever before, and they have to be accommodated inside a narrower region of

Fishing in the Electrical Ocean

Some one is going to write a fascinating story some day, and it is going to be called "The Romance of the Radio Amateur." The realm of wireless has from the very beginning been explored by enthusiastic, deadly earnest, and often, very gifted persons who were held in it much more from the love of it than because of any mere money they might gain. As Dr. Eccles points out in this very interesting article, which by the way, was an address to the Radio Society of Great Britain, "A man cannot always explain to you why he keeps rabbits." No more can the wireless amateur tell you why he loves the art. Dr. Eccles is a well-known and respected English scientist and his story will be read with interest by broadcast listener and confirmed amateur alike. And, to misquote Kipling, all radio amateurs, no matter in what country they live, "Are sisters under the skin."—THE EDITOR.

the spectrum than would have been available before.

TWO BIG PROBLEMS

IT SEEMS to me that in consequence of these new circumstances, there are two big problems immediately in front of the Society. One is to ensure that the amateur and student of wireless telegraphy obtains his rightful share of the spectrum in accordance with his relative importance among all the other users of wireless. The other big job for the Society is to help in the establishment of order among the users of wavelengths appropriated to the amateur transmitters and the broadcast listeners. Regarding the rights of amateurs to bands of wavelengths, there are many people, I believe, who say that amateurs have no right at all to any wavelengths, presumably because they are not making money out of it. Ours is a nation of shopkeepers, and this attitude of mind is to be expected from such a nation, but it is the duty of this Society to show the nation that the work of the experimenter is worthy of encouragement from the point of view of the long-sighted shopkeeper and the industrialist.

THE TWO TYPES OF WIRELESS AMATEUR

THERE are two main types, it seems to me, of wireless amateur. First, there is the man who wants to construct apparatus and see it work; and, secondly, there is the man who wants to experiment in and practise the art of communication by wireless. The first type of man is at home with many other mechanical and electrical hobbies, and I addressed this Society last autumn in the endeavor to show that he was, in virtue of his hobby, a very useful member of the community. The second type of amateur follows his hobby because he simply dotes upon the doing of it. He cannot explain his affection for it any more than another man can explain why he keeps rabbits, for instance, or still another man explain why he goes fishing. I confess that I myself cannot conceive why anybody does either of these latter things unless it be that the men in question consider rabbits or fish to be delectable articles of food. I am always particularly perplexed by the angler, though I respect his, to me, unfathomable motives; but I think I can sympathize with and understand the passion of the wireless amateur who goes fishing in the electrical ocean, hoping to draw a congenial spirit out of the unknown depths. This type of amateur sits in his laboratory and sends out a little message, baited with 10 watts, say, and then listens with beating heart for a response from the void. Usually his cry is in vain. He draws a blank. But sometimes he hears, mixed up with his heart throbs, a reply from another "brass pounder" calling him by his sign letters. What a thrill! And when the response is faint and seems to come from very far away, with what excitement does he struggle to maintain touch? I can imagine the anxiety and enthusiasm with which he deciphers the Morse, say, of an American amateur, is overpowering; and I can imagine the despair with which he battles against the demons of fading and interference. I can feel it is a very exciting and thrilling sport, but it is more than that. It teaches a wonderful skill in manipulation, and it screws up the efficiency of the apparatus and the man to the highest pitch. The DX man, striving to get across enormous distances with minute power, becomes far more expert than the professional operator.

AMATEURS AND THE WAR

I REMEMBER very well that men of this type altered the whole standard of transatlantic reception during the War. After the United States came into the War the receiving stations on the Atlantic coast, particularly the large station at Otter Cliffs, which many of you have heard of, were manned by young fellows practised in DX work. They succeeded marvelously, and read a record number of words per day. At that time Lyons was enlarged by the addition of a bigger arc, and Bordeaux, just after the close of the War, was brought into operation with another arc, and these men succeeded so marvelously in receiving the messages transmitted that the Government experts of the United States came to the conclusion, and announced very emphatically, that at last the Atlantic was conquered, and that it was possible to ensure a regular uninterrupted twenty-four hour service per-day in summer and winter, without delays, by the aid of such transmitting stations as the arc station at Lyons. Then came demobilization and the DX men went home from the Atlantic coast. Their phones were picked up by the orthodox operators, the standard of reception fell immediately, and so, as far as I know, has not yet risen to its former glory. It will not, I think, rise to the same height with the same apparatus again.

THE IMPORTANCE OF DX WORK

AS ANOTHER example of the utility of this DX work, consider the recent results achieved by a small band of private workers

who, during the last month or two, have been trying to find lanes under the Heaviside layer, across the Atlantic. You all know the success which has been attained with short wavelengths throughout an unexpected number of hours in the twenty-four. I do not doubt that if these amateurs had left the problem alone we should to-day be ignorant of its possibility. It might have been many years before these facts would have been revealed in the ordinary course of things. The feat is not an easy one, as is shown by the fact that if they could have done it, some of the commercial wireless companies would certainly have made very profitable advertisement out of it. Moreover, the governments on both sides of the Atlantic maintain large staffs of men, some of whom have very little more to do than listen in to signals. I am thinking of the naval and military and air forces particularly, in France, in America, and in this country. These facts escaped their notice and, indeed, would have been regarded as incredible.

From all this I deduce that in wireless, as in many other pursuits requiring concentration and skill, the best results are often achieved by men who are not brought up to work at it for a living. This holds good in yachting, in cricket, in marksmanship and many other sports. It holds still further, in my opinion, in the sciences and in the applications of science; and especially in the scientific hobbies, including, of course, amateur wireless, which, in addition to its fascination as a sport, possesses also the qualities of immediate importance in commerce and of utility in national emergency. It is quite conceivable that these discoveries of the properties of short waves may be of great commercial service, and certainly might be of immense military significance in time of war.

The last time I addressed you—last autumn—I paid most attention to the merits of the class of wireless amateur who is fond of his hobby because he can make and work something, and I tried to show you that he deserved the support of every intelligent citizen, and certainly of this Society, which is largely constituted of him and by him. I said nothing of this other kind of man, however, partly because there was no time, and partly because it did not occur to me that such remarkable results could be achieved by him in the immediate future. I am therefore specializing on this other type of wireless man to-night in the hope of showing you that the "fisherman" type, if I may call him so, is worthy of his salt, worthy of our support and encouragement, and merits the granting of every possible facility that we can find for him.

The Importance of the Radio Amateur

". . . I can imagine the anxiety and enthusiasm with which he deciphers the Morse, let us say, of an American amateur, is overpowering, and I can imagine the despair with which he battled against the demons of fading and interference. I can feel it is an exciting and thrilling sport, but it is more than that. It teaches a wonderful skill in manipulation, and it screws up the efficiency of the apparatus and the man to the highest pitch. The DX man, striving to get across enormous distances with minute power, becomes far more expert than the professional operator. . . ."

INEXPERIENCED AMATEURS

I HAVE been speaking so far—both last autumn and this evening—of the best of the amateurs who form, I believe, the larger portion of the membership of this Society and the Affiliated Societies. But there are others, and many of these lack skill and produce considerable interference with military and naval services and sometimes with broadcasting services. Amongst these must be included the kind of amateur who uses 20 or 30 watts to establish communication between himself and a friend a mile away, and thereby agonizes everyone within 20 miles. Then there is the amateur who blares forth, without provocation or excuse, recitatives from corrugated gramophone discs; there is the amateur who never listens in either before or after shooting his bolt; there is the man who specializes in apparatus comprising every possible error of design and who emits the broadest possible band of waves. Perhaps many of these sinners know not what they do; others there are who do know, I think, what they are doing, and do it almost, one might say, of malice aforethought. Many of this class have no call sign, and others use fancy call signs, and there are others, again, who use other people's call signs, a tribe that is quite unlicensed. Besides these there are other nuisances, but I am going to refer to them a little later in another category.

The state of affairs represented by what I have just said appears to be getting worse

rather than better. You will remember that we formed last autumn a Transmitter and Relay Section, and that we gradually built up a scheme of relay work in different parts of the country. The almost inevitable result of the attempts to get relay chains working was a crop of reports that so-and-so was washed out by somebody else breaking in on the same wavelength with some gramophone tune or something of that kind; or that somebody had been interrupted by a person using his own call sign illegitimately. The state of affairs, as I say, seems to be getting worse rather than better. There are three parties interested in this matter. There is the amateur who wants to do his work in a reasonable manner; there is the broadcast listener who is very often on the same waveband as these interrupters; and then, last but not least, there are those who are using wireless for transmitting messages on government service or for commercial purposes. Of these three or four parties who are injured by the erratic type of transmitter, the Government and commercial users have become tolerably free because they have developed means of taking care of themselves, and, moreover, they can place good apparatus in the hands of skilled operators. The broadcast listener is the next in order of martyrdom, but his interests are being ably protected by the British Broadcasting Company, which, in this aspect, is a solid single-minded organization for looking after the broadcast listener. The real martyr is, I think, the true amateur of the kind that forms the bulk of our Society. This man, when broadcasting began, bound himself of his own initiative by a self-denying ordinance to refrain from transmitting during broadcasting hours on the wavelengths that would interfere with broadcasting reception anywhere. In addition to this sacrifice of his experimental time, he found also that if he lived near a broadcasting station he could do no experimental reception during the time the broadcast station was running, on account of the width of band natural to a telephonic station. His work, therefore, became postponed until after 11 o'clock at night. This left the British Broadcasting Company to deal with the inconsiderate or anti-social transmitter who sometimes disturbs the peace. But once these people were scared, they transferred their energies to the post-broadcasting hours, with the dire result that the self-disciplined amateur finds himself at 11 o'clock at night in the midst of a perfect thicket of noise, in many cities, at any rate.

THE EVIL RADIATING RECEIVER

DURING the past year the British Broadcasting Company has kept in close touch with our late Honorary Secretary, Mr. McMichael, and have sent him copies of many of the complaints which they have received from disturbed broadcast listeners. Mr. McMichael started last March a scheme for mobilizing local wireless societies in the work of tracking and, if possible, eliminating the disturbers; but he found, I think, that it would require much labor and much money to carry out thoroughly any scheme of this kind, and I think that in the end his efforts gradually tapered off on account of the sheer impossibility of the task. Even in districts where it has been possible to trace and stop one howler, two or three new ones have started up for each one stopped. The reason is that the rapid expansion of broadcast listening brings in some new beginner with a valve set every day or every week, according to the district, and the beginner requires time to learn the set. Some of them learn to adjust it silently and to leave it alone within a month; but the weaker vessels take six months, and have then not yet concluded.

Lately I looked through a batch of recent letters of complaint of programs spoiled and I tried to diagnose in each case the probable source of the trouble. About three quarters of the disturbers seemed to be valve learners, but they, as a source of irritation, disappear in a few weeks or months. A small fraction were chronic crystal ticklers who, if very near to sensitive neighbors, cause great mental distress. I daresay that many of you know that if your next-door neighbor insists on scratching his crystal while his antenna is oscillating strongly under the broadcast waves, he radiates every scratch to you and spoils your music and language. To these people one can only quote Lord Palmerston and say: "Why can't you leave it alone?" But it seems to be too much to ask human nature to leave well enough alone, for even after obtaining an excellent rendition they say to themselves, "I wonder if it would be better if I turned that knob a little farther," and so it goes on.

With these classes of disturbers very little can be done by any society like ours, or by the Government, or by the British Broadcasting Company. We in this Society have seen enough of the complaints and looked at them carefully enough to be sure that the stopping of that trouble is as great a problem as suppressing the piano-playing of a neighbor or

suppressing the nocturnal cat. It is just a nuisance, and it may have to be tackled in due course under the common law as a nuisance. As a rule the common law has succeeded in adapting itself in due time to deal with all newly invented nuisances that civilization brings; but to return to the analysis of complaints of broadcast listeners, I think about ten per cent. of the disturbances are due to amateur transmitters, and under ten per cent. due to wilful interference. You will, I think, agree with my seemingly harsh diagnosis of the latter category, the wilful interferer, when I tell you that in the interferences sometimes recorded, the interpolations consist of remarks, at apparently appropriate points of the sermon, of such words as "rats!" Now, of course, that cannot be accident, it is someone with a transmitting set and a gramophone who is intentionally creating a nuisance. I say that less than ten per cent. of the broadcast complaints seem to come into the category of wilful disturbance.

MEETING THE COMPLAINTS

CASES like this do, in a sense, concern the wireless societies, and they must be grappled with if we can trace them to our membership, but the cases where the genuine amateur transmitter is interfering with the broadcast listener is in a different category and requires special consideration. In the first place, many of the complaints of the broadcast listener arise because his apparatus is so badly designed or constructed that though it is tuned to 365 meters it is easily disturbed by a transmitter at 180 meters, for example. From the scientific point of view, the remedy is simply a filter circuit in the listener's antenna; but from the popular point of view, the amateur is a person who is merely playing with wireless, and when the would-be listener to the broadcast concerts comes near to him and installs poor apparatus, the assumption is that it is the amateur who must shut down. This, of course, is a gratuitous assumption that the broadcast listener has a stronger right to install poor apparatus than the transmitter has to transmit on a reasonably sharp wavelength. But it does not follow that because a man listens in to, is it Uncle Jeff (?), that he is therefore a better citizen than an experimental transmitter. But that kind of thing has always haunted scientific inquirers. Entertainment, for instance, is, to unthinking people, much more important than any possible good, national or social, that may flow from a scientific study or hobby. This has been the attitude of the crowd toward the discoverer and investigator throughout all history. In all such cases those who know better have had to combine and fight those who know nothing. In this particular case we are combining as a society, but we can only meet the unreasonable complaints of the ill-equipped amusement seeker by our being sufficiently strongly organized to demand impartial inquiry and to insure a just decision. On the other hand, we can meet the justifiable complaints of the other users of wireless, and can obtain more time for ourselves and clearer times for ourselves, by getting every well-intentioned amateur to join our Society or an affiliated society, and after that establish a code of honor and a system of self-discipline amongst ourselves.

THE RESULTS OF THE $500 BROADCASTING CONTEST

WILL be announced in a forthcoming number of RADIO BROADCAST. Over eight hundred manuscripts were entered in the contest and the task of selecting the best is proving a difficult one for the judges. The contest judges are Professor J. H. Morecroft, President of the Institute of Radio Engineers, Powel Crosley, Jr., President, the Crosley Manufacturing Company, Frank Reichmann, of the Reichmann Company, Chicago, Senator Royal S. Copeland, New York, and Harry Chadler, Publisher, Los Angeles TIMES.



THE WHB RADIO ORCHESTRA
Whose lilting dance music floats out to receptive radio listeners all over the nation

"Meet" the Radio Voices from Kansas City

A Bit About Some of the Popular Artists Who Broadcast from WDAF and WHB

By ERLE H. SMITH

A BITTER war is on in the ranks of radio listeners of the "Heart of America" city—Kansas City. Unconsciously and yet not unwillingly, whole groups of these radio partisans have fallen into clans. And in many homes, radio dealers say, arguments have grown so heated that it has been necessary to install a receiving set for each radio fan in the household as a final effort to lure the dove of peace back to a permanent roost on the domestic antenna.

For it develops that the listeners-in of Kansas City in common with those of many other cities have their favorite ether performers just as decidedly as theater goers have their stage favorites. And when WHB and WMAJ are on the air at the same time and Sallie craves to listen to the Sweeney orchestra, Bill is out of luck for that lecture on wave traps over WMAJ. So Bill has his receiving set, be it ever so humble, and Sallie has hers and there is peace in the domicile of the listeners and, I think, a smile on the face of the radio dealer.



NELL O'BRIEN
Who gained great popularity at station WHB. She is a soprano

LOCAL RADIO FAVORITES IN KANSAS CITY

OUTSTANDING among the radio favorites of Kansas Cityans are the *Kansas City Star's* "Nighthawks." The regular "Nighthawk" entertainers, known from coast

to coast and Gulf to Lakes, are the Coon-Sanders orchestra and Leo Fitzpatrick, Radio Editor of *The Star* and "Merry Old Chief" in charge of the midnight frolics of the "Nighthawks" in the grill of a downtown hotel. The "Merry Old Chief" also appears before the microphone in *The Star's* studio as "R. A. Dio" in regular weekly minstrel programs.

The "Nighthawk" programs were among the first attempts at midnight broadcasting on a regular schedule six nights a week and have been running full blast every night except Sunday for nearly two years. Listeners-in, picking up the "Nighthawk Frolic" and writing or otherwise communicating with the WDAF station are enrolled on the membership roster of the "Nighthawk" organization and awarded membership cards. The roster includes thousands of names.



THE RADIO TRIO

Often heard from WDAF, at Kansas City. Carson Robinson (left), Steven Cady (center), and Harry Kessel

Ranking second in popularity with Kansas City listeners in the ranks of the WDAF entertainers is the Radio Trio, composed of Carson Robinson, Steven Cady, and Harry Kessel. Mr. Robinson is a pianist and whistler, if not of note, at least of great popularity, and has written several "blues" song hits and chimes in with his effective baritone when the trio is singing ensemble. Mr. Cady has an excellent tenor voice, and Mr. Kessel is the trio's "lead" and usual soloist.

Assisted by "R. A. Dio," the trio gives a popular program weekly over WDAF, which, judging from the hundreds of letters pouring into the office of *The Star's* radio editors, indicate nation-wide approval.

The station of the Sweeney Automotive and Electrical School, WHB, claims to be the first broadcaster west of the Mississippi River to employ a regular orchestra. George C. Parrish, known among music critics of the Southwest as one of the most able and versatile pianists in Kansas City, is director of the orchestra. The popularity of Mr. Parrish's orchestra is



LEO FITZPATRICK

Radio editor of the *Kansas City Star*, WDAF, and "Merry Old Chief" of the *Star* "Nighthawk Frolic" programs



ELIZABETH R. HINTON

A popular soprano at station WHB



JOE SANDERS (left) AND CARLETON COON
Leading lights of the Coon-Sanders "Nighthawk" orchestra who regularly play at station WDAF. Mr. Sanders is a pianist and composer. Mr. Coon is the trap drummer. Both have excellent voices

proved by the great quantity of enthusiastic letters that are received by the Sweeney station weekly from all sections of the western hemisphere.

The Sweeney orchestra is probably one of the most popular dance combinations with Kansas City listeners-in. Far-away owners of neutrodyne and super-heterodyne sets nightly notify the Sweeney station that they are concentrating on bringing in WHB "strong" to provide music for dancing. And then, Mr. Parrish and John T. Schilling, the WHB announcers, get their heads together and release some of the "steppin'est" music that travels through the ether from what the local boosters call the "Heart of America" city.

Miss Nell O'Brien and Mrs. Elizabeth Ranson Hinton, sopranos, are popular radio stars appearing exclusively before the microphone of WHB. Both have exceptional voices, and nights when they are on the programs are certain to be busy ones for the telephone operators at the Sweeney switchboard, for its "Please have Miss O'Brien sing" this and "Please have Mrs. Hinton sing" that.

And so it goes with the radio listeners of Kansas City and the surrounding territory.



JOHN T. SCHILLING
Announcer at WHB, at Kansas City, the Sweeney Automotive School

They have their radio favorites and they keep the telephone wires warm telling the two large broadcasting station operators just what they desire to hear.

A REPORT FROM THE RADIO PILGRIMS

ABOARD the RADIO BROADCAST COVERED WAGON, in charge of Captain Jack Irwin, will be a feature of this magazine for December. Captain Irwin relates his impressions of radio life in the Great Lakes district. His "Log of a Radio Hobo" is worth reading.

Modern Receiving Circuits

The Function of the Crystal Circuit—The Types of Regenerative Circuits—Receivers Using Untuned Radio-Frequency Amplification—The Super-Regenerative Circuit and Its Value—The Inverse Duplex

WHAT MAKES THE WHEELS GO 'ROUND: VIII

By WALTER VAN B. ROBERTS

AS AN excellent conclusion to Mr. Roberts's discussion of the workings of the various elements of receiving circuits, the present article, the eighth in his series: "What Makes the Wheels Go 'Round," discusses in very clear fashion some of the most generally used receiving circuits. This series of informative and exceptionally lucid explanatory articles can be read with profit by every broadcast listener, even he who feels his technical knowledge is perhaps a little better than the rest.—THE EDITOR.

FIGURE 44 shows the simplest possible receiving set. Tuning is sufficiently well accomplished by a switch connecting to different taps on an inductance coil of any type. A cylindrical coil with a sliding contact is often used. This type of receiver is very good for reception of stations up to about 25 miles distant provided there is no interference. It is about the least selective of any radio circuit and cannot tune out interfering signals

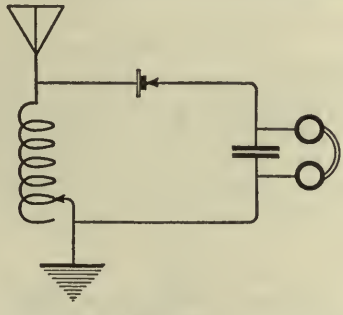


FIG. 44

A simple crystal receiver. Probably the least selective of any circuit in use

even if on a different wavelength. Fig. 45 shows a two-circuit or loosely coupled type. The sensitivity is about the same as that of the single circuit but there is considerably better selectivity. Any circuit using a crystal is subject to the nuisance of having to keep the crystal in adjustment. Some crystals jar out of adjustment very easily and a search must then be made for a "sensitive spot."

66. SIMPLE DETECTOR CIRCUITS

A VACUUM tube may be used instead of a crystal in either of the above circuits, thus eliminating the trouble of finding a sensitive spot. Otherwise the results will be about the same, except for a gain in selectivity. See Figs. 46 and 47.

67. REGENERATIVE CIRCUITS

THE chief advantage in replacing the crystal by a tube is the possibility of using regeneration. Figs. 48 and 49 show regeneration accomplished by inserting inductance in the plate circuit of the tube. If this is a

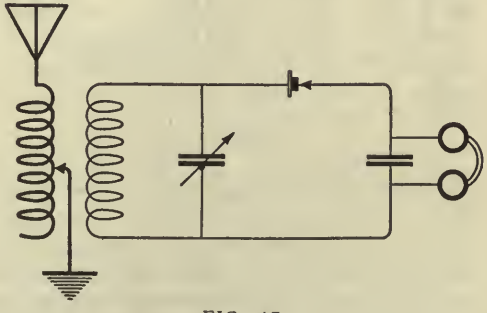


FIG. 45

An inductively coupled crystal circuit. Both antenna and detector circuits are tuned and hence the circuit is more selective. Receivers based on this circuit were standard for many years until the vacuum tube came into general use about 1915

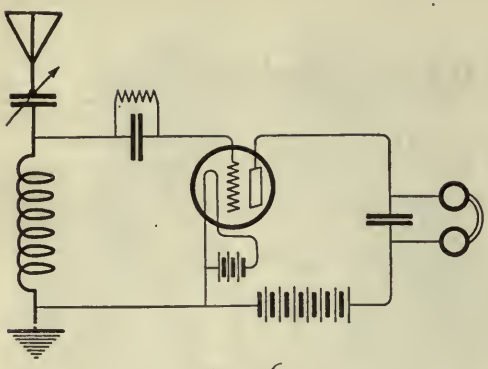


FIG. 46

A simple vacuum tube circuit, in which the tube does not oscillate, but is used as a rectifier, serving the same purpose as the crystal detector in Figs. 44 and 45. Note that the antenna and detector (or secondary) circuits are conductively coupled

small fixed coil it is coupled to the grid coil and acts as a tickler. If it is not brought up near the fixed coil it must be a variable inductance, i. e., a variometer. The two circuits shown are called the single-circuit and the three-circuit method of using regeneration. This nomenclature is obviously inconsistent but it is customary. The two are equally sensitive and for differentiating between equally faint signals of nearly the same wavelength they are almost equally selective, but with the three-circuit arrangement, it is possible to shut out strong local stations of considerably

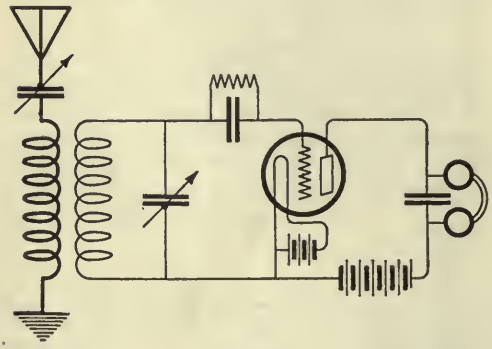


FIG. 47

The same circuit as Fig. 46 except that the antenna-secondary coupling is inductive

different wavelength while the single circuit cannot do this. The single circuit is easier to tune properly, but if allowed to oscillate it is usually radiating more energy from the antenna and hence causes worse interference —that is, the familiar squeals that are often heard while the neighbors are tuning-in. For this last reason there is a growing sentiment against the use of single-circuit regenerative receivers in thickly populated regions or indeed, anywhere else.

There are a great many apparently different regenerative circuits in use, but the above are the standard forms. No one kind is any more sensitive than any other if properly built, as the sensitivity is determined by the tube. Single-circuit receivers are usually built with an eye to the best possible selectivity. They

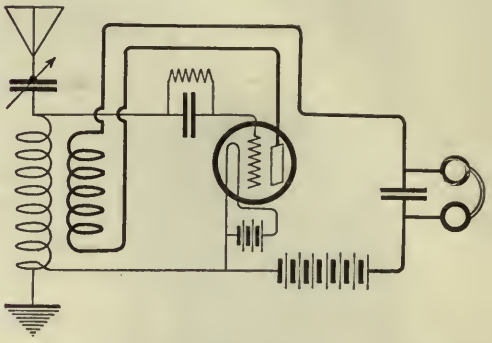


FIG. 48

The circuit of Fig. 46 with the addition of a "tickler" coil, whose purpose is to make the tube detector oscillate, increasing the sensitivity of the circuit. It is a malignant radiator of energy. Sometimes called a "blooper"

are made very "stiff," that is, the antenna is tuned with a large inductance and a small capacity and a comparatively low short antenna (not more than 150 feet over all) is recommended.

68. UNTUNED RADIO FREQUENCY TRANSFORMER SETS

WHERE greater sensitivity is required some form of radio frequency amplification is necessary. Fig. 50 shows a typical three-stage transformer-coupled R. F. amplifier with potentiometer stabilization. Receiving sets of this type are not very selective

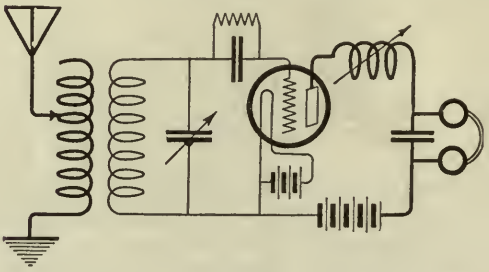


FIG. 49

Regeneration is secured by the use of the variometer in series with the plate of the tube. Simply Fig. 47 with the variometer added

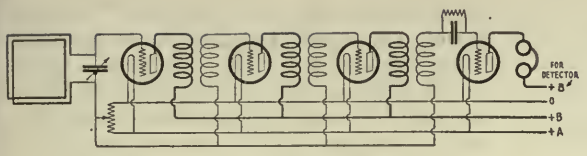


FIG. 50

A radio-frequency circuit with air-core transformer coupling between the amplifier tubes. Note the stabilizing potentiometer

as there is only one tuned circuit to do the selecting. They are easy to operate as the tuning condenser and the potentiometer are the only controls. They are subject to the limitations imposed by the transformers in the matter of range of wavelengths that can be received. Unless an arrangement for plugging in different transformers is provided, the range is usually only about two hundred meters. (From 300 meters to 500 meters for example.)

69. THE NEUTRODYNE

FIG. 51 shows a typical neutrodyne arrangement. Only two stages of amplification are used because three condensers are enough to tune. As each of the three transformers is fairly selective, the result of using all three at once is very good selectivity. An open type antenna is used (this, however, need not be large. Thirty feet or so strung around a picture moulding gives good results except for very weak signals) because a loop is likely to have energy fed back to it from the transformers, which are not usually shielded. They could be shielded, but they are usually cylindrical and set at such angles with each other that they do not feed back to each other.

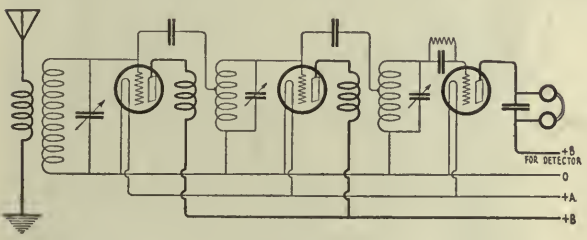


FIG. 51

A neutrodyne arrangement

70. ABOUT SUPER-REGENERATION

WHERE loud signals are required from a loop and the number of tubes is limited to one or two, super-regeneration rules the field. Super-regenerative circuits are not very selective and hence not very good for working through interference, but where the desired signal is the strongest incoming ether disturbance in its region of wavelengths, a loop and a single tube can be made to work a loud speaker as well as about three tubes used any other way. The principle of super-regeneration is explicable qualitatively by a mechanical analogy. A clock was used in a previous article as an analogy to give an idea of the mechanism of an oscillator circuit. We shall use the clock again. Suppose it to be wound up but the pendulum is placed carefully in its lowest position and left there. The clock will *not* start itself. But now suppose puffs of air come along at the proper interval to start the pendulum swinging slightly. Once it starts ever so slightly, the ideal spring and escapement mechanism we have assumed cause its swinging to increase even if the puffs of air stop coming in. The oscillations of the pendulum "build up" and in due time the amplitude of swing reaches a limit determined by friction, air resistance, etc. But if we confine our attention to a sufficiently short period of time after the swing starts to build up we will find that the amplitude attained during this time is proportional to the strength of the incoming puffs of air. At the end of this period let the pendulum be stopped and set again at its lowest point so that the whole thing can take place again. By this arrangement, a great deal more swinging is done by the pendulum, on the whole, than if the clock were not wound

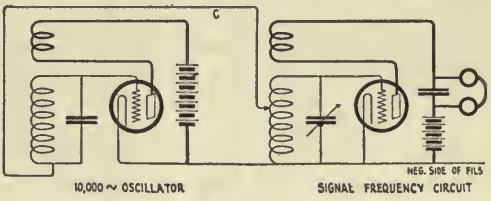


FIG. 52

The super-regenerator. When the low-frequency oscillator grid is negative, the connection "c" between the two oscillators has no effect, and oscillations build up at signal frequency. During the half cycle when the grid of the low-frequency oscillator is positive, oscillations are damped out of the signal-frequency circuit just as if its own grid were positive. The signal is picked up by a loop connected across the tuning condenser

up, in which case the pendulum would only swing the very small amount caused by the air puffs alone.

In the electrical case we have a circuit all set to oscillate, but "balanced" so to speak so that some incoming ether wave is required to start oscillations building up. The amplitude to which oscillations build up during, say, one twenty thousandth of a second, is proportional to the strength of the incoming signal. The circuit automatically extinguishes the high-frequency oscillations in itself every ten thousandth of a second and "rebalances" itself for another start. Thus, on the average, there is a good deal of high-frequency current in the circuit, and as the amount is proportional to the incoming signal strength at any time, its rectification by the curvature of the tube's grid potential-plate current characteristic yields the signal ready for the loud speaker (unless it is desired to filter out the 10,000 cycle note that is due to the periodic interruption of the oscillator circuit).

Another way of looking at the action of super-regeneration which may seem simpler to some, is to consider the action as mere multi-stage radio-frequency amplification performed by a single tube by the simple process of connecting the secondary of the transformer back to the input of the same tube instead of the input of another tube. A small impulse comes into the grid of the tube and is amplified and fed to the primary of a transformer, the secondary of which feeds it back to the grid. It then makes another round trip, and another, and another, and sooner or later would grow so great that the tube could no longer amplify it any more. But before that happens, the interrupting mechanism comes into play and wipes it out entirely. The interrupting mechanism then stands aside, figuratively speaking, and lets the tube amplify whatever is supplied to its grid for another twenty thousandth of a second or so, then steps in and quiets everything down again. Thus on the average there is much more radio-frequency current than the incoming radio waves alone could produce without help.

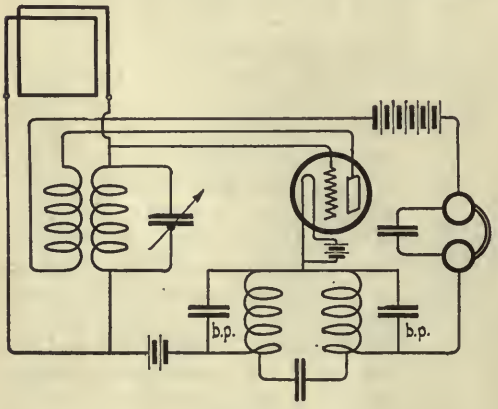


FIG. 53

The super-regenerator. Both low-frequency and signal-frequency oscillator circuits are attached to the same tube. The signal-frequency circuit is at the top of the diagram. High-frequency oscillations pass readily through the bypass condensers B-P. The low-frequency circuit (here a Hartley, with or without mutual inductance between coils) is supposed to be oscillating all the time. During part of each cycle the grid and plate potentials favor the building up of high-frequency oscillations in the upper circuit, but during the other part, conditions are unfavorable and cause oscillations, if any have built up, and die out again

The reason that super-regeneration works best at short wavelengths is that the time between interruptions is then enough for a large number of round trips and the current can build up to large values before being interrupted. The interruption frequency cannot be lowered to less than about ten thousand per second or it becomes annoyingly audible.

Three systems for doing the interrupting are—

(1) making the grid so positive, once every ten thousandth of a second, that the oscillations are killed as explained under stabilization by potentiometer in radio-frequency amplification,

(2) by periodically cutting off or reducing the amount of plate potential and allowing the oscillations to die out, and

(3) by combining these two methods.

The first and the third are recommended, the third having the advantage of using only one tube. The second is difficult as the oscillations do not always die out rapidly enough by themselves even when the plate potential is reduced far below the value necessary to make oscillations build up. It is important not to have any tuned circuits around in which oscillations can persist, as they will re-excite the oscillator even if no signals are coming in. For this reason the selectivity can not be improved by the ordinary loose coupling of tuned circuits, although advantage may be had by operating the set in the same room with the lead-in of a tuned antenna. Fig. 52 shows the first system, 53 the third.

71. PRINCIPLE OF REFLEXING

WHEN a tube capable of amplifying a strong signal is used merely to amplify a weak one, its power-amplifying capability

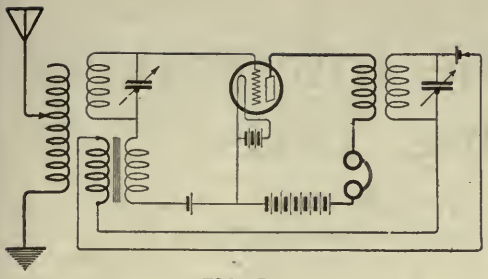


FIG. 54

A simple reflex circuit, using a crystal detector. The one tube in the circuit acts both as a radio- and audio-frequency amplifier

is not being made efficient use of. "Reflexing" is a system for getting more out of a tube by making it amplify two things, the incoming signal at radio frequency, and the detected, or audio frequency current. So long as the variations of grid potential due to both frequencies are each of small amount, neither interferes with the other. Fig. 54 shows a very simple reflex circuit using a crystal detector. The radio-frequency current after being amplified is fed by means of a tuned transformer to the crystal. The audio-frequency current is then fed to the grid and amplified, the phones being in the plate circuit of the tube. The frequency of the radio current is so much greater than that of the audio that the two kinds of current are easily separated whenever necessary. Fig. 55 shows the flow of energy in diagrammatic form. Fig. 56 shows the energy flow in a two-stage amplifier.

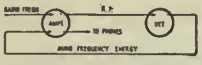


FIG. 55

Diagram of the current flow in a reflex circuit

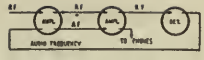


FIG. 56

Diagram of the energy flow in a reflex circuit where the energy is amplified through two audio stages

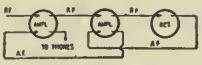


FIG. 57

The inverse duplex arrangement, which is an elaboration of the reflex idea

72. THE INVERSE DUPLEX SYSTEM

A REFINEMENT of reflexing as shown above is the arrangement called the inverse duplex, shown in Fig. 57. It is obvious that the tube carrying the least radio frequency energy is the one that handles the greatest audio-frequency energy, and vice versa. Thus the point of overloading is not reached so soon. Also, as the audio energy is not fed directly back to the first tube, any accidental radio-frequency feed back that might occur along with the audio feed back will not be so likely to cause oscillations.





T. M. STEVENS

Assistant Traffic Manager of the Radio Corporation of America. Mr. Stevens has charge of the radio message traffic operation of the many passenger and cargo ships controlled by this company

Final Plans for the International Broadcasting Tests

News of Importance for Every Radio Listener in the Outline of RADIO BROADCAST'S Tests for 1924

By ARTHUR H. LYNCH

THERE is little time left for you to get ready for the international broadcasting tests which are to take place between November 24th and 30th, inclusive. For the first time you will have an opportunity to test the possibilities of your receiver for picking up long distance broadcasting, under the best conditions obtainable.

RADIO BROADCAST carried on a similar series of tests last year and hundreds of listeners in the United States and Canada were able to pick up parts of the programs from England, while our English friends were even more successful in picking up our programs. If you remember, there were many prominent speakers in this country who said a few words for our English friends and prominent Englishmen spoke to us. The reception of the English stations in this country could hardly be called a complete success, even though we have had verified reports from American listeners who were located as far west as Washington State. We have every reason to believe that the tests this year will be even more successful and, having this in mind, we have set out on a rather enlarged program.



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HUGH S. POCOCK

Editor of the London *Wireless World and Radio Review*, who is working in close coöperation with RADIO BROADCAST in directing the second international broadcasting test. Mr. Pocock has charge of arrangements for England and the Continent and is working with Captain A. G. D. West, assistant chief engineer of the British Broadcasting Company

The principal difficulty in connection with the tests last year was the very limited time we had to get them under way and the failure on our part to recognize until it was too late, the terrific amount of detail work the tests would involve. Most of communications were with Hugh S. Pocock, Editor of *The Wireless World and Radio Review* (London), whose hearty coöperation made it possible for us to work so closely with the British Broadcasting Company.

The time for preparation was so short that most of our communication with the American broadcasting stations had to be done by telegraph, and if you remember, even that method of communication proved futile in several instances because the managers of stations had important events scheduled for the hours of the test periods. Other broadcasters were not convinced that the listeners in their audience were as much interested in attempting to pick up London as they were in hearing some really good music from the home station. For the first few nights of the tests, many of the broadcasting stations in this country and Canada did not shut down and it was only by telegraphing them individually that we were able to secure a comparatively quiet ether for the last night.

Then, too, in the larger cities and other comparatively thickly populated areas there was a terrific amount of interference caused by radiating receivers. Interference of this nature was so great in the vicinity of New

York, Boston, Chicago, and several other cities, that even those in the suburbs found it difficult to hear anything but the squeals. Many newspapers published editorials criticizing the "bloopers" unmercifully.

There were many other reasons for our not having scored a complete success, but they are of little interest now, other than object lessons, and we are making every effort to surmount the difficulties and there is every reason to believe that we will do it.

WHY WE LOOK FOR SUCCESS THIS YEAR

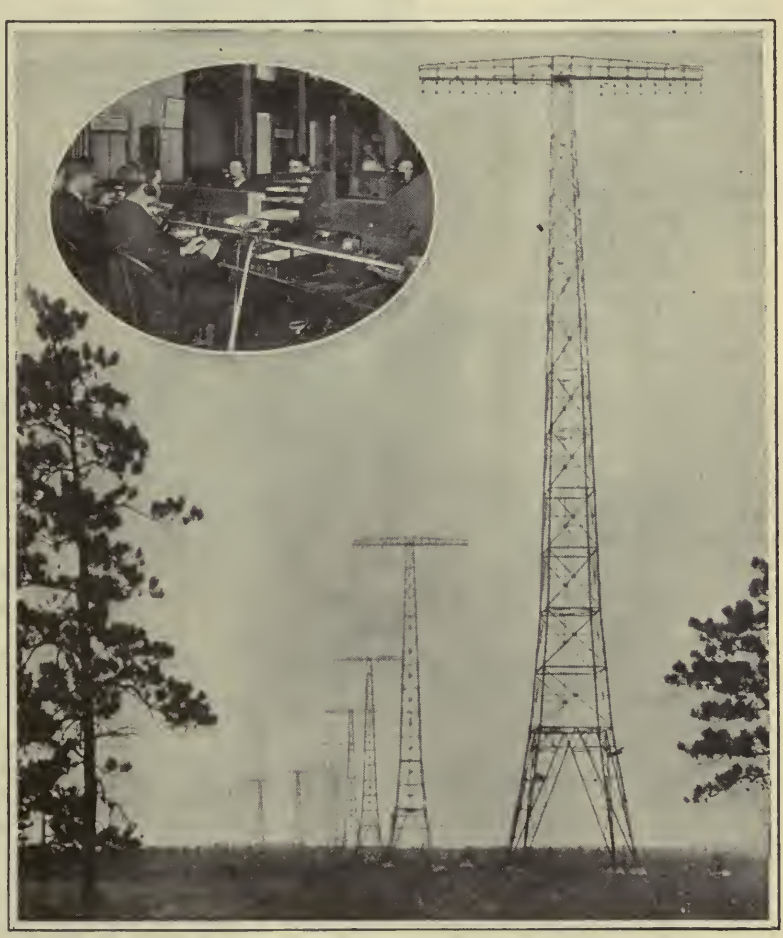
IN ENGLAND, we still have the active cooperation of Mr. Pocock and Captain Eckersley of the British Broadcasting Company as well as the additional effort of the Radio Retailers' Association, of which Clifford and Clifford are the Honorable secretaries, and the Radio Trade Association of New York. L. A. Nixon is Secretary. All are working together, to make every possible wheel move in the correct direction and without either lost motion or friction.

In Canada, Jacques Cartier, Manager of the *La Presse* Broadcasting station, at Montreal is doing his best to coordinate the efforts of the Canadian stations.

In Cuba and Porto Rico we have been able to enlist the services of PWX, 2MN, 2BY, Havana, 6KW, Tuinucu, Cuba and WKAQ.

In this country no effort is being spared. A circular letter, addressed to every broadcasting station in the United States has resulted in replies having been received from most of the important broadcasting stations in the country. The larger stations have signified their intention to take part in the transmission tests and even the smaller stations, which do not feel that there is a possibility of being heard by European listeners, have very generously volunteered to keep off the air during the periods during which we will attempt to hear from Europe.

Captain Jack Irwin, who is piloting RADIO BROADCAST'S COVERED WAGON across the country in an effort to reduce the amount of



HOW THE NEWS WILL REACH ENGLAND

The masts of Radio Central of the Radio Corporation of America at Riverhead, Long Island. Direct radio telegraph communication will be maintained through the Broad Street control office (in the insert) direct from the RADIO BROADCAST Laboratory at Garden City to the office of the British Broadcasting Company in London. When the English programs are heard, the flash will go from a telegraph key at the magazine's laboratory which will signal the English company a fraction of a second later in their London offices

interference from power lines, etc., has visited a number of broadcasting stations and told the story of these tests to thousands of listeners, to say nothing of the manufacturers and dealers with whom he has discussed our plans.

Other members of RADIO BROADCAST's editorial staff have visited broadcasting stations in the Eastern, Middle Western parts of this country and a portion of Canada. In almost every instance these talks have been brought to a close by an exortation to the listeners to prevent their receivers from squealing during the tests and it is hoped that these requests will be complied with.

Since last year the British and other European stations have been improved greatly, and there is little doubt but that many of them will be heard throughout North and South America this year.



JACQUES N. CARTIER

Manager of station CKAC, *La Presse*, Montreal, who will work with RADIO BROADCAST in arranging the international broadcasting tests as director of Canadian broadcasters during the tests

VAST IMPROVEMENT IN RECEIVERS

DURING the past year there has been a marked improvement in the design of receiving apparatus used in this country. For instance, there were but few neutrodyne receivers in operation during the tests last year and many of them were home-made and not very well adjusted. We have learned a lot about the neutrodyne since that time and there is no reason why hundreds of them will not pick up the other side this year. This is particularly true, if the detector is made regenerative, which may be done without a lot of trouble.

Then, it will be remembered that but little was known of the super-heterodyne, except by the old-timers, and it is expected that there will be many "supers" focussed on Europe during the coming tests. Many of them will be successful. And right here it may be well to say a word about the operation of "supers."

Where it is necessary to use an outside antenna with a super-heterodyne in order to insure proper signal strength, there is something the matter with it. Where an outside antenna is used, it is folly to waste tubes and batteries with a "super," there are other receivers capable of similar results, with a great saving. There is every reason to believe, from the tenor of the reports we receive from our readers, as well as from our own observation, that many of the English stations will be picked up this year on our own Two-Tube Knock-Out Receiver. It is gaining in popularity because it performs extremely well, is easy to build and is very, very economical. Where an antenna is used, it is doubtful that many home-built superheterodynes will be able to boast a better performance record.

Nearly every newspaper in the country has printed something about these tests, and we wish to express our appreciation for this coöperation. It is also gratifying to be able to tell you that the General Electric Company, which coöperated so thoroughly with us last year is doing the same thing this year. Then, too, it would be almost impossible for us to keep in close touch with the other side, during the tests, without seriously interfering with the program, if it were not for the assistance given us by the Radio Corporation of America. This corporation has arranged to have a direct wire connecting our receiving station at Garden City and its New York office, and thus connected with Europe via its high power radio telegraph circuit.

The Westinghouse Electric and Manufacturing Company has also agreed to take an active part in our tests and has promised that all of its stations will conform to our schedules

as well as arrange special programs for our foreign friends.

To outline the plans of the various companies which are coöperating with us would be a tremendous task and space does not permit, so it may be well to confine our description to a few of the preparations we are making ourselves.

PREPARATIONS AT GARDEN CITY

RADIO BROADCAST'S Laboratory is situated about three hundred feet from our main building and was erected principally to house the elaborate receiving equipment used by those engineers who came out last year and set up their outfits beside our own. Here there will be a direction finding loop antenna, of the Bellini-Tosi type about eighty-five feet high. There will also be a number of smaller loops, for use with various receivers. The Lab. will, as we have stated, be in direct wire connection with the Broad Street office of the Radio Corporation of America, as well as in telephone connection with our main building, and radio telephone communication with the two or more field stations we are placing on the seashore about ten miles from our main building.

At the field stations there will be as complete equipment as is necessary, and we expect to use several of the Knock-Out Receivers as well as a series of super-heterodynes. At these field stations there will be radio telephone transmitters, operated on short waves to communicate with the Lab. The reason for using radio telephone is to permit us to use a shack right on the shore and as far from telephone, telegraph, trolley wires, and whistling receivers as it is possible to get. The location of our field stations has not yet been decided, because their choice must be made after covering the ground with a portable super-heterodyne receiver in an automobile. This work is under way and all the preliminary work will be done before this magazine gets in circulation.

Licensed operators of RADIO BROADCAST'S staff will be in charge of the field and Lab stations and will keep the wheels moving properly. A number of receiving sets are to be installed in the field stations by independent engineers, in the same fashion as last year, and a number of receiving sets of various kinds will be located in various sections of the country with direct wire connections, so that immediate reports may be made to our lab station, which will be the center of activity, just as it was last year.

It is impossible for us to keep you properly informed of the developments, as they occur through our own pages, so we have arranged a weekly press release service, which goes to all the broadcasting stations and the newspapers. From these bulletins you may secure all the necessary information concerning wavelength, power, and so forth of the foreign and American stations taking part in the tests. If you are successful in hearing the foreign stations, write, or wire Test Editor, RADIO BROADCAST, Garden City, New York, giving us as much definite information as possible to aid us in preparing the official report of the tests. We cannot undertake to verify all of the foreign programs.

A SHORT ANTENNA RECEIVER

FOR some little while we have been watching for a receiver which would perform in good style with a short piece of wire for an antenna and employed standard coils and parts. Such a receiver would, we felt sure, make a very good portable. We have it and it is an extremely good one. It is a 4-tube set and will be described in RADIO BROADCAST for December, by G. H. Browning of Harvard University. A how-to-make-it article of great interest and value.

The Facts About Resistance

Answering Your Unasked Questions about Potentiometers, Grid Leaks, and Rheostats in Receiving Sets. A Where, When, Why, and How Article

By THOMAS O. SHEARMAN

THERE are three fundamental units in radio, upon which are based all the various types of receiving circuits. They are inductance, capacity, and resistance. While inductances and condensers have been perfected to a high degree, and are used as the important factors in most radio circuits, very little has been said about the variable resistance, yet if properly utilized, it plays a very important part in obtaining better results from present-type equipment. Resistances are used in receiving circuits as

Variable Grid Leak — B-Battery Control
Rheostat — Radio-Frequency Amplifier
Potentiometer — Audio-Frequency Amplifier
Audio-Frequency Filter and Tone Modifier

THE VARIABLE GRID LEAK

TO UNDERSTAND properly the variable grid leak, it is necessary to know just what happens when it is placed in the grid circuit of the detector tube. This action is as follows: When the filament of a vacuum tube is brought to incandesence by the A battery, a large quantity of negative particles (electrons) are liberated from the filament, and if the grid and plate connections are left open, the electrons will fall back on the filament so that a state of equilibrium will exist. If, however, the positive terminal of a B battery is connected to the plate, the negative charges instead of returning to the filament will be attracted to the positively charged plate in accordance with a fundamental law of electricity, which states that, "like charges repel each other while unlike charges attract." This invisible stream of electrical energy acts as a conducting path for the B-battery current which flows steadily and uniformly.

Situated between the filament and the plate is the grid element, and it is the action of this member which causes fluctuations in the plate current by controlling the action of the electronic stream. When the grid is connected to the antenna circuit in the usual manner through the grid condenser and the circuit tuned to resonance with the incoming radio-frequency currents, it will acquire a positive and negative charge according to the positive and negative cycle of the incoming radio-frequency wave.

Assuming the first part of the cycle impressed upon it to be positive, a small amount of the electrons given off by the incandescent filament will be attracted to it, and the plate current will be unaffected, but on the negative part of the cycle when the grid acquires a negative charge, the electronic stream will be practically blocked.

This action can be more clearly understood by Fig. 1, where A represents a radio-frequency impulse caused by the closing of a key in a spark transmitter, thus at O the condenser begins to charge and reaches its maximum at point 1 whence it again decreases to zero at point 2, the same action takes place at 3 and 4 but is of opposite polarity.

The positive charge impressed upon the grid causes a small amount of the electrons to be attracted to it at each positive charge which will also cause a negative voltage to accumulate upon it. If the tube is of the high-vacuum type and the socket constructed of perfect insulating material, there will be no possible way for this negative charge to leak off of the grid and will completely repel the flow of

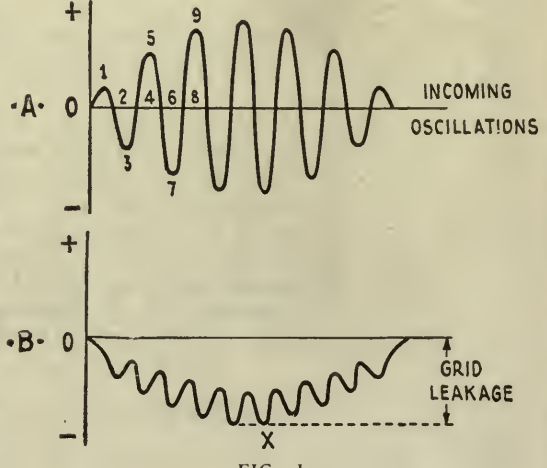


FIG. 1

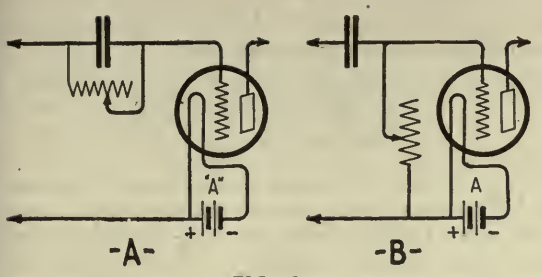


FIG. 2

electrons from the filament, thereby causing the tube to "block." This action is shown as a dotted line X in Fig. 1B. To prevent this accumulation of negative voltage upon the grid, a high resistance is placed either across the grid condenser or from the grid to one terminal of the filament as shown in Fig. 2 A and B, this resistance should be of such a value that it will prevent the radio-frequency carrier wave from leaking off. It would allow only the modulated audio-frequency wave to leak off at the proper moment; when this occurs the grid potentional curve will follow the modulations of the incoming oscillations as shown in Fig. 1B.

Because of its high resistance the grid leak is measured in megohms, (Meg is the Greek prefix for one million,) so when a grid leak is said to be of five megohms value it means five million ohms. Various types of tubes when operated as detectors require different values of grid leakage; this range usually is between one half to five megohms and for this reason it is advisable to equip the receiving set with a variable grid leak, but in purchasing this kind there are four important points to be considered if good results are to be expected, they are as follows:—

Mechanically Correct
Non-Microphonic
Non-Hygroscopic
Uniform Vernier Action

If the variable grid leak becomes microphonic, a rasping sound will be heard when it is adjusted and may continue as long as the set is in operation. When the leak is composed of an india-ink line or some other hygroscopic material and left exposed to the surrounding atmosphere a certain amount of moisture will be absorbed, decreasing its resistance.

This effect will be quite noticeable on a damp day and will cause the grid leak to become quite unstable in operation.

Quite a few variable grid leaks have been placed on the market which are mechanically imperfect. In some, after a few turns on the handle, the resistance range was changed entirely since the lever rubbed off the resistance material. The grid leak soon became inoperative. Others composed of a semi-fluid material soon dried out and became useless. Faults such as these in the variable grid leak are so hard to find that it is advisable to purchase the best possible.

PROPER METHOD OF CONNECTING THE VARIABLE GRID LEAK

THE most satisfactory type of grid leak is one which is conveniently mounted on the panel with the rest of the controls. The connection should be as shown in Fig. 2 B where the terminal farthest away from the panel is connected to the grid and the terminal nearest the knob is connected to one leg of the filament. In this way the hand comes near to the neutral filament side instead of the grid and therefore prevents hand capacity effects.

THE RHEOSTAT

THE most familiar use of resistance in radio-receiving circuits is as the rheostat for controlling the filament intensity. To understand the importance of the rheostat one must have at least an inkling of its technical function; this is briefly as follows. A metal as well as all other substances is composed of a vast number of electrons which are continuously in a state of vibration. When heat is applied to the metal the movement of its electrons is so increased until they break away from the metal and travel away from it at a high velocity, this velocity depending upon the plate voltage. If the amount of energy which heats the metal (which in the case of the vacuum tube is the A battery) is increased, the number of electrons emitted is also increased, until we

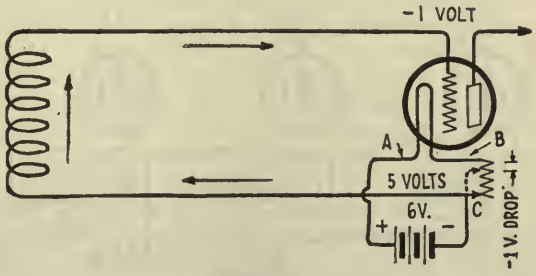


FIG. 3

reach the point of incandescence where a further increase in temperature will cause the metal filament of the tube to vaporize. When this happens the tube "burns out" and is useless.

The function of the rheostat is to give accurate control over the voltage and current passing through the filament. The temperature of the filament governs the flow of electrons from it. Thus the rheostat serves two purposes. First it protects the vacuum tube, when properly adjusted, and prevents an excessive amount of current from flowing through the filament. For example, the storage battery type of vacuum tube operates at five volts while the storage battery delivers six volts (in practice this will be found to be a little less due to the discharge and load applied to the battery), therefore the resistance in the rheostat must absorb the remaining volt. This is shown in Fig. 3 where the rheostat is placed on the negative terminal of the storage battery lead, and is so adjusted that only five volts are applied to the filament terminals A and B, while the other volt is dropped across the rheostat resistance B and C. The second action of the rheostat is that this one-volt drop across the rheostat resistance is applied to the grid of the tube through the filament return lead, and causes the tube to operate at its proper point on its characteristic curve, provided that the plate voltage is about 45 volts. When it is more than this it is usually necessary to use a greater voltage upon the grid, and this is had in the form of a C battery of three or four volts.

The three important factors to be considered in purchasing a rheostat are:

Mechanical Construction
Current-Carrying Capacity
Resistance Range

In the wire-wound type of rheostat, the mechanical construction is quite important, and the trouble most often encountered with some now on the market is in the action of the lever when it passes over the resistance wire.

If this lever action is not perfectly smooth, a clicking sound will be heard, especially when controlling the detector tube. And if the contact of the lever is too light, the surface of both the resistance wire and lever will oxidize and collect dust which will offer a high-resistance contact and cause the tube filament to flicker. In the compression type of rheostats there should be no side play. The action of the thread should be perfectly smooth.

The current-carrying capacity of the 30-ohm wire-wound rheostat, due to the smaller-gauge wire used, is not sufficient to carry the filament current of the UV-200 or other high-current consuming tubes. The compression type of rheostat in most cases will handle all of the receiving tubes now on the market.

When the voltage and current at which the tube operates is known the correct-size rheostat can be determined. The normal voltage of the UV-201-A is 5 and current .25. By dividing the voltage by the current we obtain the filament resistance, which is 20 ohms. A rheostat having a maximum resistance of 20 ohms or more will give sufficient working range. If three of these tubes were to be used in parallel and all operated from one rheostat, the resistance required would be about one third or about 7 ohms.

In the article entitled "A Knock-out Three-Tube set" in the February number of Radio Broadcast three UV-199 tubes have their filaments connected in parallel in the circuit shown, as in the usual manner, and have an automatic filament jack for each of the tubes, while a 10-ohm rheostat is connected to the common negative terminal, and the filament voltage indicated is 4.5 volts.

The UV-199 filament voltage is 3 volts and the current is .06 ampere. When one divides the voltage by the current, the filament resistance, 50 ohms, is obtained. When the first jack is closed by plugging in, we have a circuit as shown in Fig. 4A, where 1 is the fila-

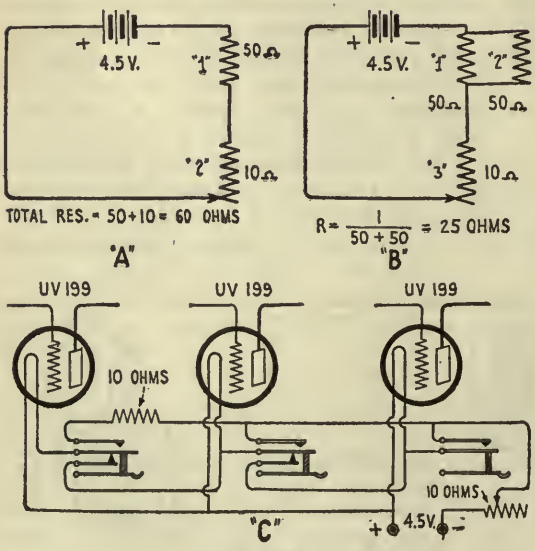


FIG. 4

ment resistance which is constant and 2 the variable rheostat. When its full 10 ohms resistance is in the circuit, a current of .015 ampere is flowing through it, and .06 ampere is flowing through the filament of the tube.

Thus it is seen that the rheostat resistance of 10 ohms is sufficient to absorb the extra 1.5 volts of the 4.5-volt battery and thus give the filament 3 volts which is its correct amount, but there is absolutely no chance for any filament current variation below this value, for as soon as the rheostat resistance is decreased the filament voltage will be increased beyond its normal rating, therefore a 10-ohm rheostat for controlling one tube is inadequate.

When the second jack is closed, which lights two tubes, we have a circuit as shown in Fig. 4 B where 1 is the first tube filament resistance 2 the second tube resistance in parallel with the first, and 3 the variable 10-ohm rheostat in series with the complete circuit. The total filament resistance of the two tubes is reduced to one half of that of one, or 2.5 ohms, while the total current consumed by them is doubled, or .12 ampere. About .08+ of an ampere will flow through the two tube filaments and .04+ ampere through the 10-ohm rheostat, thereby leaving .04+ of an ampere for filament variation, which is quite sufficient.

When the last jack is closed the three tubes light. Their total filament resistance is about 17 ohms, and the amount of current consumed .18 ampere, and the 10-ohm rheostat is

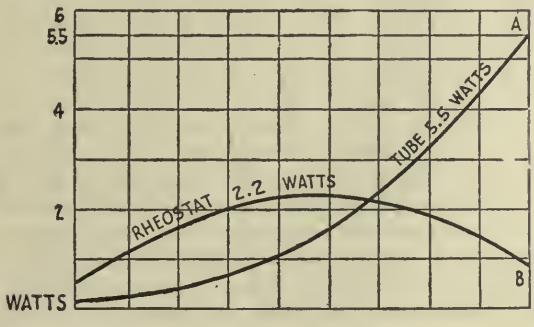


FIG. 5

quite sufficient to give full control over the three tubes.

The only change then necessary for the successful operation of the tube filaments either individually or all together, is that shown in Fig. 4C where a fixed resistance of 10 ohms is inserted in the negative lead of the filament jack of the first tube, this giving 10 ohms possible variation of the filament of this tube.

The layman usually thinks that when the rheostat is turned down and the filament

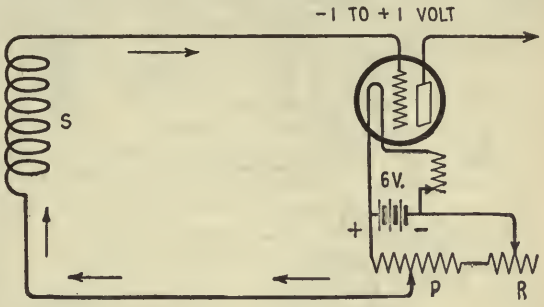


FIG. 6

temperature decreased the current originally used for lighting the filament is then being wholly absorbed by the rheostat. This however is not true as only a small amount of the battery current is being dissipitated in the rheostat. This is shown by the set of curves in Fig. 5 which were taken from an actual test on a UV-200 detector tube and plotted directly in watts, which is the electrical unit for energy. (This is obtained in direct-current circuits by multiplying the current in amperes by the voltage).

Curve B Fig. 5 represents the watts consumed by the rheostat. It reaches its maximum value when half of the applied voltage is dropped across it, its value then being about 2.25 watts, while the maximum wattage consumed by the tube filament (Curve A) is 5.5 watts.

The consumption of electrical energy in the rheostat can never equal that of the vacuum-tube filament.

THE POTENTIOMETER

THE potentiometer in receiving circuits controlls the grid potential and may be used to vary the plate voltage of the detector tube. This second possible use of the potentiometer will be discussed in detail under the heading of *B-Battery control.* For controlling the grid bias in radio-frequency amplifiers the potentiometer has proved most helpful, for in radio-frequency amplifying circuits which are not neutralized there is a feedback action (caused by the transfer of energy from plate to grid—via the tube capacity) which will cause the circuit to oscillate. By varying the grid bias we can control these oscillations and Fig. 6 shows a potentiometer connected

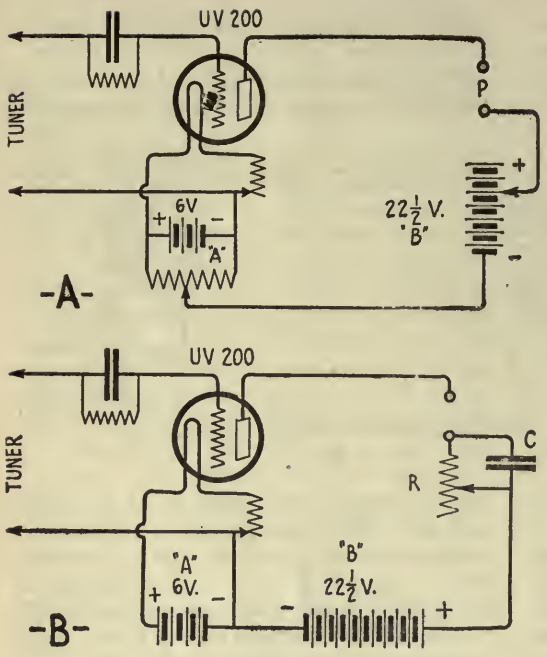


FIG. 7

across the A battery. Its middle movable arm makes connection to the grid through the coil S. In reality it utilizes the voltage drop across the rheostat and applies it to the grid as one volt negative or one volt positive in respect to the filament, or any value between these two.

R is a rheostat of about 6 ohms placed in series with the potentiometer and allows a finer vernier action. When dry cells are used as the A battery, it is advisable to use a potentiometer of from 400 to 600 ohms, as one having less resistance than this will cause the battery to deteriorate in a short time due to the quite considerable current that will flow through a low-resistance potentiometer.

THE B—BATTERY CONTROL

THE most sensitive detector tubes now on the market are the ones containing a small amount of gas, such as the UV–200. When the filament liberates electrons, as described under the heading of Variable Grid Leak, it sends them forth at a certain velocity and unless attracted to the plate by the charge on it maintained by the B battery they will fall back upon the filament. As the plate potential is increased, the electrons are attracted to it at a speed corresponding to the increase in plate voltage, and at a critical point the atoms of gas, which are in the way of the electrons, loose one of the electrons of which they are composed, and then become positive electrical charges and are termed ions. Due to their larger size they offer a much lower resistance path for the B-battery currents, and if too many become ionized the current will become so large that the grid will be unable to control it and the tube will block which can usually be detected by the blue glow around the plate.

It is therefore necessary to accurately control the plate voltage just below the point of excessive ionization, where the signal intensity is high. The two methods for doing this are shown in Fig. 7, where A is the potentiometer across the A battery. The middle movable arm connects with the negative terminal of the B battery. When the arm is moved toward the positive terminal of the A battery (1), the 22½ volts of the B battery are placed in series with the cells of the A battery; if this is of the six-volt storage-battery type, when the lever has reached (1) the total B-battery voltage will be 6 +22½ volts or 28½ volts. For values lower than 22½ volts a tapped B battery must be used, and the plate connected to the lowest tap. Then the range will be from 16½ to 22½ volts.

The second method is to insert a variabe resistance directly in series with the B battery, having a range of from 20 to 15,000 ohms, the voltage can then be varied from about 8 to 28½ volts and a tapped B battery will not be required. This is shown at Fig. 7B with a condenser of .001 mfd. capacity shunted across it for bypassing the radio-frequency currents.

THE RADIO-FREQUENCY AMPLIFIER

THE radio-frequency amplifier may be coupled by high resistances instead of the more usual transformers. Resistances, when used in this manner give very good quiet amplifications on wavelengths above 1,000 meters, but below this wavelength the amplification falls off and at the broadcasting wave frequencies it operates very poorly.

THE AUDIO-FREQUENCY AMPLIFIER

A MORE successful use for the variable high resistance is in the audio-frequency amplifier circuit, where it has the advantage over transformer-coupling because it amplifies all of the audible frequencies with the same degree of amplification, and when the tubes are worked at their proper point on the characteristic curve, the amplification will be free from

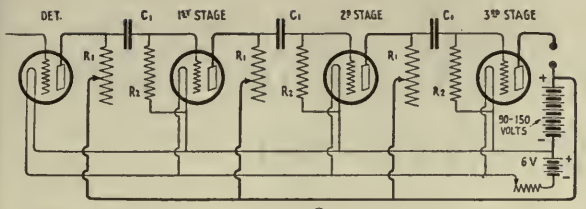


FIG. 8

all distortion. The amplification per stage will not be so great as when transformer coupling is used, but this may be compensated for by the advantage in being able to use three or four stages of amplification without howling.

Fig. 8 shows a three-stage resistance-coupled audio-frequency amplifier. The coupling resistances are variable high resistances having a range of from 10,000 to 100,000 ohms, the fixed grid leaks, R2, about 2 megohms, depending upon the tubes used and the audio-frequency bypass condensers, C, should have a capacity of .01 mfd.

In operation the resistances R1 are adjusted until they match the tube impedance, or when the greatest amount of volume is obtained. The plate voltage should vary from 90 to 150 volts, and it may be necessary to insert a C battery in each stage.

AUDIO-FREQUENCY FILTER AND TONE MODIFIER

THE amplification ratio of the average two-stage audio-frequency amplifier using transformers, is about 1400 to 1. It is therefore to be expected that any local noise, such as that caused by a discharged A or B battery, or mechanical vibration of the receiving set, will be amplified to this high value and is sometimes mistaken for static.

If after disconnecting the antenna and ground the noise continues, one can be certain that the trouble is local. New batteries with the proper protection of the set from mechanical vibration would be the remedy.

Another simple method of reducing unnecessary noise in the audio amplifier is to shunt the last stage of the amplifier input with a variable high resistance having a range from 100,000 ohms to 2 megohms. The proper connection is shown in Fig. 9, and for convenience of adjustment a variable grid leak with such a range is mounted on the panel with the rest of the controls.

Many amplifiers where the transformers are close together and the grid and plate connections parallel, with improper plate voltage or grid bias, will under most conditions emit an audio-frequency whistle which becomes quite annoying. Rather than reconstructing the amplifier which, in most cases is quite impossible, a variable high resistance is used as shown in Fig. 9; if the whistle still continues, another variable high resistance across the first transformer input, as shown at A, Fig. 9, when properly adjusted will in most cases absorb all audio-frequency oscillations.

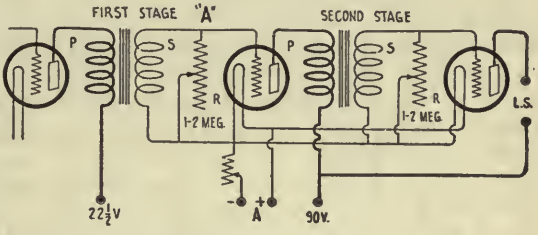


FIG. 9

Another use for the variable high resistance in the amplifier is to prevent distortion. Since many broadcasting stations now are using high power, there is a tendency for amplifiers to become overloaded. A vacuum tube will amplify a certain amount of energy and if this amount is exceeded distortion occurs. This could be prevented by decreasing the plate voltage or filament current, but this would mean retuning the whole circuit. A more practical method is to use a variable high resistance as described above, for by its use the proper amount of energy passing into the tube may be regulated thereby giving clear undistorted amplification.



Avoiding the Squeal in Your Regenerative Set

Simple Instructions on How to Tune Your Receiver so That It Will Not Radiate—Some Golden Rules for the Broadcast Listener

By A. K. PHILLIPI
Westinghouse Electric and Manufacturing Company

THE opportunity afforded the public to-day to listen to good concerts and speeches by men prominent in all branches of science and industry without having to leave their own homes was, a few years ago, unthought of. But how many of you listening-in are sure that your listening-in is not preventing some other person from enjoying some radio program? By this I do not mean that you should lend them your receiving set, but that you, by the improper manipulation of your set, are causing a disturbance in the air that interferes with your neighbors' proper reception of the program.

How many of you, never having driven an automobile, would go to a dealer and buy a car, get in, and drive away, without first being instructed in driving and handling the car? Such a person would be considered a public nuisance and would soon be arrested.

While a person operating a radio set who does not know just what he is doing with it can not endanger the lives or property of others, yet he can cause much annoyance and greatly mar the pleasure of others. The majority of people are good sports and play the game fairly. Those who do cause these radio disturbances are usually those who are unfamiliar with the operation of their receiving units.

When a receiving set of standard make is bought, an instruction book which tells how to operate the unit is generally included with the equipment. A careful study of this book will give the purchaser a fair idea of what to do and how to do it, in order to get the best results as well as to cause the least interference possible while tuning-in the desired station.

It is impossible for all of us to be electrical engineers or radio electricians. Neither can we all be automotive engineers or auto mechanics yet thousands of people drive their own cars in such a way that they bother no one.

Radio listeners are not all good sports, but the majority of them are, and the reason they so often cause disturbances in the air is because they are not generally aware that they do so. It is my purpose to point out some of the things to do and what not to do when tuning-in, so as to prevent disturbances which can be heard by other listeners.

The Wail of a Lost Soul

Need not be heard from hosts of single-circuit regenerative sets if they are intelligently operated. If the user keeps his detector tube adjusted just below the point of oscillation during reception, no wails, squeals, howls, or other sounds not of this earth will be produced such as to drive even the listening minister next door to unbecoming profanity. It is easily possible for the average listener-in, even though he be untutored in the occult ways of radio, to use his single-circuit regenerator in a most harmless and neighborly fashion. The time is not far distant when single-circuit regenerative sets will have disappeared from the radio horizon, but as long as they are in use, their users ought to know how best to operate them so the sets will do as little harm as possible.—THE EDITOR.

HOW TO TUNE-IN—MORALLY

FIRST of all, the radio set should be of a good design. Secondly, it should be connected up properly. We now turn on the filaments of the tubes to their proper brilliancy which varies with the different types of tubes used. With the tickler or amplification dial or pointer turned to zero, we next move the tuning dial or dials slowly from left to right listening for signals. If no signal is heard, the tickler or amplification dial should be advanced

slightly from the zero position on the dial, and again the tuner dials should be turned slowly over their range. Should a signal be heard but faintly, the tickler should be advanced as far as possible without causing a hissing sound, which indicates that the tube has passed the point of greatest regeneration and is oscillating. These oscillations produce the same effect as another transmitting station sending out signals. They are heard by other receiving sets and are known as "birdies." The tickler should be turned back until the signal is cleared up or even a little past that point, for a too strong signal may cause the detector tube to break over and oscillate again.

The best way to make sure your detector tube is not disturbing others is to plot a tickler diagram. This is done as follows: after the tubes are lighted to the proper brilliancy, the tuner is placed at zero and the tickler is advanced until a click is heard. At this point the tube starts to oscillate. Then mark down the readings in two columns, one marked tickler and the other, tuner. Next the tuner is advanced one large division, and again the tickler is advanced until the click is heard, and these readings should be taken. This procedure is carried out over the entire tuner scale, and it can readily be seen that, with the use of this set of readings, one will be able to set the tickler or amplification pointer to a division just below the oscillating point.

Now it is possible that the click or breaking point of the tube may not be heard by merely turning the tickler. If so, the operator should tap the antenna post with his finger, and, when the tube is not oscillating, he will hear only a single click. As soon as the tube starts to oscillate, the operator will get a click when he touches the antenna post, and another click when he takes his finger from the post, or in other words a double click. Now it is not advisable to do this during the program period but the experiment should be tried during the day when there is least chance of disturbing others.

The ideal regenerative receiver and antenna will have what is termed a flat tickler curve. By this we mean that it will be possible to put the tickler at a certain point and turn the tuner any place and be at maximum regeneration without causing oscillation. If the set has this characteristic, much less trouble tuning-in stations without annoying others will be experienced.

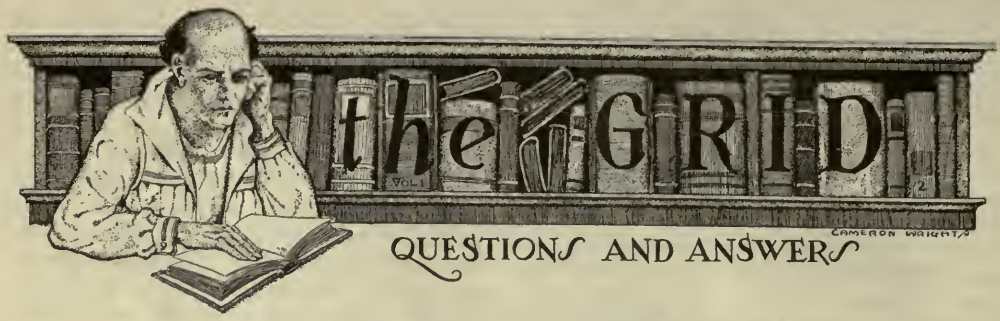
YOU DON'T HAVE TO DISTURB THE NEIGHBORS

THE reception of signals at "zero beat" causes more interference than any other method of tuning and should be discouraged. The results obtained are not at all satisfactory unless one juggles the vernier or tickler dial. Each movement of either dial causes the detector tube to transmit weird signals and those in turn are heard by all local listeners. Again the varying strength of signals may cause the detector tube to flop in oscillation from one side or the other and ruins the program not only of others near by, who may be listening, but of the person tuning the set as well. The crystal type of radio receiver, as well as those having one or more stages of radio-frequency amplification, cause no disturbance of this kind.

Let me say that it is possible, with the cooperation of all radio listeners, to clear the air of "birdies," or the "wail of lost souls," if each and every one of us will take precaution to see that our detector tubes are not oscillating. To do so demands that we all to the best of our ability observe the golden rule.

A GOOD SINGLE DIAL REFLEX

LIVE manufacturers and dealers in all parts of the country have realized the sales possibilities of RADIO BROADCAST'S Knock-Out Series. They know we have built up tremendous demand for non-radiating receivers of above average quality. They know that there is a ready market for any receiver we recommend to our readers and some of them have been working night and day to produce improvements for us. One such receiver will be described in our December number by Mr. John Clyde Davidson who is Consulting Engineer for a number af Radio manufacturing companies.



QUERIES ANSWERED

How Can I Build a Crystal Receiver? . . . . . T. S. L., Flushing, L. I., N. Y.
Will You Explain the Correct Use of Solder?. . . . . C. P., Philadelphia, Pa.
How May Additional By-pass Condensers be Used in the Roberts Circuit? . . . . . M. C. G., London, England
Will You Publish the Formula for Converting Wavelengths in Meters, into Kilocycles, and Vice Versa? . . . . . A. L. L., Birmingham, Ala.
What Stations May be Depended Upon as an Aid in Calibrating Receivers and Wavemeters? . . . . . Wm. T. M., Brooklyn, N. Y.

THE CONSTRUCTION OF A CRYSTAL RECEIVER

IN THIS day of "supers," neutrodynes and reflexes, we still receive inquiries for construction data for the simple crystal receiver. And rightly so, for this marks the inclusion of another fan within the ranks of radio.

One of the most simple receivers consists of an antenna, ground, tapped inductance coil, crystal, fixed condenser, variable condenser, and phones.

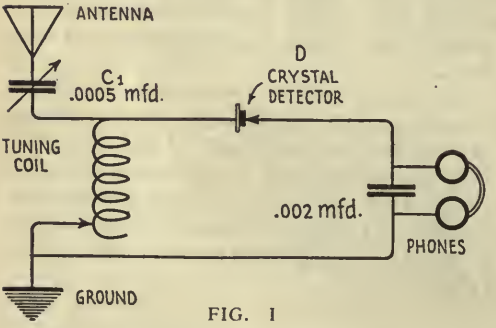


FIG. 1

This set will not operate a loud speaker. See Fig. 1.

The coil is wound as follows: On a tube 3½ inches in diameter and 6 inches long, wind 120 turns of No. 20 DCC wire tapped every ten turns. This is the only part that has to be home-made. A crystal detector could easily be made, but at the prevailing prices it is cheaper and more convenient to buy one.

The parts may be mounted upon a panel or upon a flat board. Use bus bar wire for connecting and solder all joints. The several diagrams and sketches show the details of construction. See Fig. 2.

Roughly, this receiver will not have a range to exceed 25 miles and is primarily intended for use in a large city boasting several local broadcasting stations.

To operate this crystal receiver, connect the antenna, ground and phones to their respective binding posts and set the tap switch upon one of the taps, then, slowly rotating the condenser dial, adjust the point of the detector catwhisker upon the crystal until a sensitive spot is found. To select a station having a different wavelength, it is only necessary to readjust the tap switch and condenser setting. With a little practise the operation of this receiver is easily mastered.

SOLDER—AND HOW TO USE IT

IN PRACTICALLY every receiver made, solder is used to insure a permanent and electrically perfect connection between wires. Soldering, by the way, may be considered a form of brazing. The forms of flux that are used to clean and prepare the wires for joining are deserving of more thought than the constructor sometimes gives.

For radio use, the best solder is "half and half," that is, half tin and half lead. In bar form it is unwieldy. In strip form, solder is most easy to use.

Hard solder, having an unequal proportion of lead and tin, is quite difficult to use. A great amount of steady heat must be used to insure a perfect joint. In radio wiring where a small iron is generally used it is hard to get steady heat because an iron of this size loses its heat very rapidly.

Good soldering cannot be done unless the soldering iron is clean. Often, when the iron is left in the flame too long, it becomes red hot. When it cools it is covered with a black oxide coating. To remove this coating and clean the iron, place it in a vise and file it until it is bright, then wipe it upon a chunk of sal ammoniac. This restores the iron to its original brightness. Apply solder to the tip until it is entirely covered. The iron is then ready to use.

Do not put the tip of the iron in the flame as this will burn the part which does all the work. The rear part of the iron should be placed in the flame and since it is larger, it will retain the heat longer.

There are three classes of soldering fluxes: dry, paste, and fluid. Powdered resin may be mentioned under the first class, but is not especially good, for the resulting joints are caked, dirty, and imperfect.

Paste fluxes are good when used intelligently. Very little flux is necessary for a good connection. Flux is a cleaning agent and when a heated iron is brought near, the flux melts and flows over the

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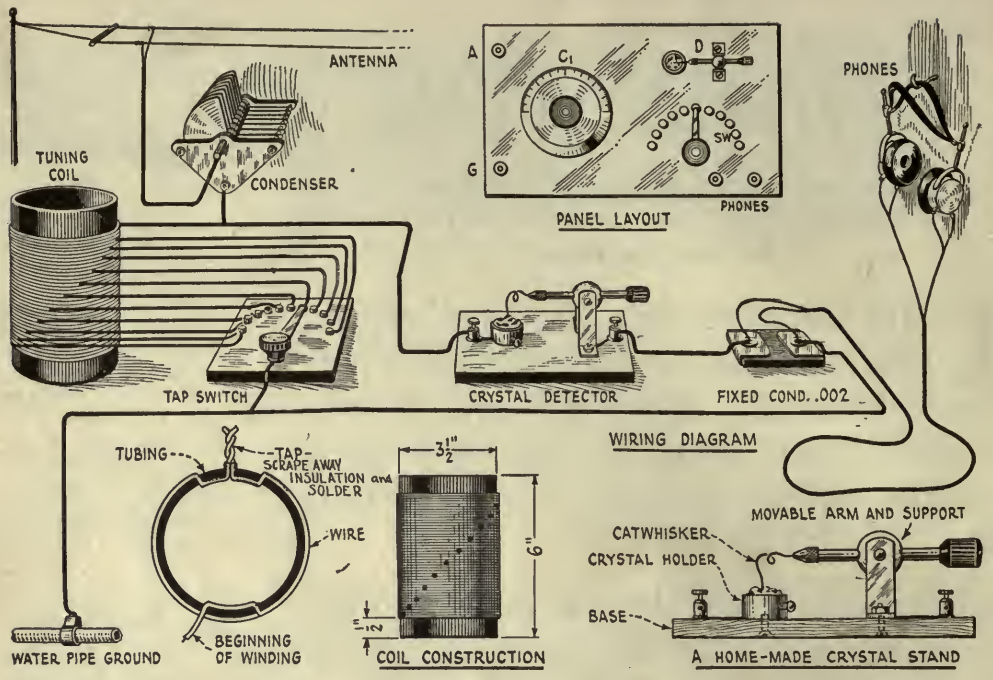


FIG. 2

metal and other parts. When too much is used it veritably flows all over the parts and in some cases, when one is soldering switch taps, this spreading solder and flux forms a leak between adjacent taps great enough to impair the efficiency of the receiver.

Liquid flux is also generally used with success when not too much is applied to the joint. When used in profusion it boils and spatters over adjacent parts causing current leaks, etc.

The most common form of liquid flux may be prepared by "killing" muriatic acid. This "killing" process is accomplished by immersing slices of zinc in the muriatic acid and letting it remain until all the bubbles due to the chemical action have disappeared.

Another liquid solution that has proved worthy may be prepared by mixing a quantity of powdered resin in alcohol to a consistency resembling molasses.

Some of our readers have had difficulty in soldering wire having an enamel insulation. It seems that the trouble has been caused by some of the enamel remaining upon the wire and preventing a perfect connection.

One of the easiest ways to remove the enamel from wire is as follows: Fill a thimble with alcohol. Heat the tip of the wire to be cleaned in a flame until it is cherry red, then quickly plunge it into the alcohol and remove. Result—a clean wire easily soldered.

KILOCYCLE-METER CONVERSION TABLE

THE Department of Commerce specifies radio station assignments in both kilocycles and meters. The tendency of radio engineering practice is to use and express frequency in kilocycles rather than wavelength in meters. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current in the antenna repeats its flow in either direction in one second. The smaller the wavelength in meters, the larger is the frequency in kilocycles. The numerical relation between the two is very simple. For approximate calculation, to obtain kilocycles, divide 300,000 by the number of meters; to obtain meters divide 300,000 by the number of kilocycles. For example, 100 meters equals approximately 3000 kilocycles, 300 m equals 1000 kc, 1,000 m equals 300 kc, 3,000 m equals 100 kc.

For highly accurate conversion the factor 299,820 should be used instead of 300,000. The Department of Commerce has prepared a table, which may be obtained upon application. The table is based on the factor 299,820, and gives values for every 10 kilocycles or meters. It should be particularly noticed that the table is entirely reversible; that is, for example, 50 kilocycles is 5996 meters, and also 50 meters is 5996 kilocycles. The range of the table is easily extended by shifting the decimal point; for example, one can not find 223 in the first column, but its equivalent is obtained by finding later in the table that 2230 kilocycles or meters is equivalent to 134.4 meters or kilocycles, from which 223 kilocycles or meters is equivalent to 1344 meters or kilocycles. Briefly, the formula for computing kilocycles and wavelength is as follows:—

For finding the wavelengh, when the number of kilocycles is given $\lambda = \frac{V}{KC}$

For finding the number of kilocycles when the wavelength is given $KC = \frac{V}{\lambda}$

KC = Kilocycles

λ = Wavelength in meters

V = Velocity of electromagnetic waves (300,000 or, to be exact, 299,820)

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A BY-PASS CONDENSER FOR THE ROBERTS RECEIVER

A DISTINCT addition and improvement to the Roberts circuit has been made by the placing of a .00025 mfd. condenser across the secondary of the reflex audio transformer and the C battery. With this arrangement, a by-pass is provided for the radio-frequency currents and, it is roughly estimated, the efficiency of the receiver has been improved by as much as 60 per cent. The value of condenser given here will undoubtedly vary with the type of transformer used, etc., so it is well to experiment with several values to select the one being found most successful. Fig. 3 shows diagrammatically, the position of this condenser in the "first tube" circuit.

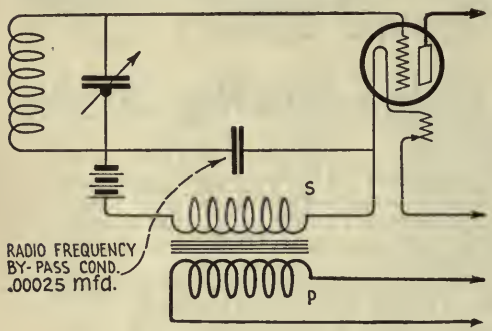


FIG. 3

STANDARD FREQUENCY STATIONS

AS A result of measurements by the Bureau of Standards upon the transmitted waves of a limited number of radio transmitting stations, data is given in each month's *Radio Service Bulletin* on such of these stations as have been found to maintain a sufficiently constant frequency to be useful as frequency standards. There may be many other stations maintaining their frequency just as constant as these, but these are the only ones which reached the degree of constancy shown among the stations upon whose frequencies measurements were made in the Bureau's laboratory. There is, of course, no guaranty that the stations named below will maintain the constancy shown. As a means of maintaining constant frequency, the highpower low-frequency alternator stations listed below have speed regulators. Most of the broadcasting stations listed use frequency indicators (one-point wavemeters) and maintain a maximum deflection of the instrument on the frequency indicator throughout the transmission. These broadcasting stations, with rare exceptions, vary not more than 2 kilocycles from the assigned frequency. The transmitted frequencies from these stations can be utilized for standardizing wavemeters and other apparatus by the procedure given in Bureau of Standards Letter Circular No. 92, "Radio signals of standard frequencies and their utilization." A copy of that letter circular can be obtained by a person having actual use for it, upon application to the Bureau of Standards, Washington, D. C.

Station	*Owner*	*Location*	*Assigned frequency (kilocycles)*	*Period covered by measurements, months.*	*No. of times measured.*	*Average deviation from assigned frequency.*	*Greatest deviation from assigned frequency since July 15, 1924*
						Per cent.	*Per cent.*
NSS	U. S. Navy	Annapolis, Md.	17.50	12	86	0.2	0.1
WGG	Radio Corp. of America.	Tuckerton No. 1, N. J.	18.85	12	102	0.2	0.1
WII	Radio Corp. of America.	New Brunswick, N. J.	22.04	11	85	0.2	0.1
WSO	Radio Corp. of America.	Marion, Mass.	25.80	12	90	0.3	
WWJ	Detroit News.	Detroit, Mich.	580	12	41	0.1	
WCAP	Chesapeake & Potomac Tel. Co.	Washington, D. C.	640	11	58	0.1	0.0
WRC	Radio Corp. of America.	Washington, D. C.	640	8	40	0.1	
WSB	Atlanta Jnl.	Atlanta, Ga.	700	11	52	0.1	
WGY	General Elec. Co.	Schenectady, N. Y.	790	14	89	0.2	
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	890	4	9	0.0	
KDKA	Westinghouse Elec. & Mfg. Co.	E. Pittsburgh, Pa.	920	11	116	0.1	0.1

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THERE are Eveready Batteries for portable sets where small size and light weight are more important than long life. There are Eveready medium size batteries that come between the small and the large sizes. There are Eveready large size "B" Batteries that afford maximum economy and reliability of service when used with average one, two, three or four tube sets. And now there is a newer Eveready heavy duty, extra large size "B" Battery that gives similar economy to owners of multi-tube heavy drain receiving sets and power amplifiers.

For maximum "B" Battery economy, buy Evereadys, choosing the large sizes (Nos. 766, 767, 772) for average home sets, and the heavy duty, extra large (No. 770) for multi-tube heavy drain receiving sets and power amplifiers. For portable sets choose the Eveready No. 764 medium size, unless space is very limited, in which case choose the Eveready No. 763 small size "B" Battery.

Eveready "C" Battery

Eveready makes a long-lasting "C" Battery with terminals at 1½, 3 and 4½ volts. May also be used as an "A" Battery in portable sets.

Eveready "A" Batteries

Eveready offers you "A" Batteries for all tubes, both storage and dry cell. For storage battery tubes, use the Eveready Storage "A." For dry cell tubes, use the Eveready Dry Cell Radio "A" Battery, especially built for radio use.

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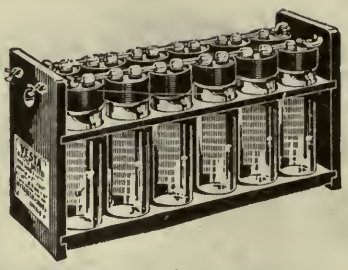
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New Equipment



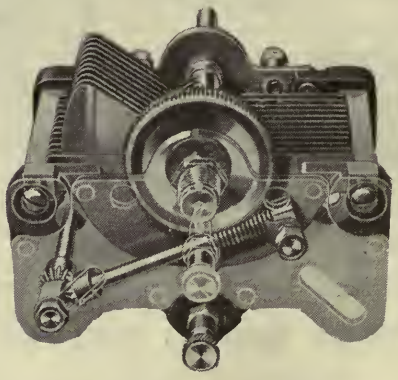
THE FRANCE SUPER-CHARGER

A multi-duty charger for both A and B batteries. A distinctive feature is its ability to charge up to 120 volts of storage B batteries in series. Rectification is by means of an improved vibrating unit with a positive action which eliminates sticking and burning of the contacts. Made by The France Manufacturing Company, Berea Road and W. 104th St., Cleveland, Ohio



VESTA B BATTERY

A B storage battery for radio use of sturdy construction. The elements are enclosed in heavy glass jars of ample size allowing room for plenty of electrolyte. The wiring is so arranged that they can readily be charged in multiples of 12, 24 or 48 volts. Made by the Vesta Battery Corporation, Chicago, Illinois



AMERICAN BRAND CONDENSER

A low loss condenser of good mechanical design and workmanship. It is made from a heavy stock of brass and the plates are spaced very evenly. It has a worm drive vernier with a ratio of 100 to 1 which insures accurate tuning. Made by the American Brand Corporation, 8 West Park St., Newark, N. J.

MIDGET BATTERY SWITCH



A very compact and useful unit for the radio set. The contact springs are of hard rolled bronze and are insulated from the metal frame. Only one hole is necessary for panel mounting. Made by The Yaxley Mfg. Co., 217 North Desplaines St., Chicago, Ill.



THE BRANDOLA

A six-tube, one dial receiver which gives very satisfactory results. Its simplicity of control is noted in that you have only one tuning dial to operate. Resistance-coupled amplification insures good tone quality. Made by The J. F. Brandeis Corp., 36 Oxford St., Newark, N. J.



★ The FADA Neutrola Grand

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An EXQUISITE instrument. Encased in beautifully finished genuine mahogany. A gem of the cabinet designer's art. A piece of furniture that will adorn any home.

Here in this new FADA Neutrodyne is a real achievement in receiving beyond anything you ever heard. Wonderful naturalness of tone. The high C of the coloratura soprano and the lowest bass of the human voice are reproduced precisely as sung. In selectivity the FADA Neutrola is remarkable.

FADA Neutrola Grand

The de luxe five-tube FADA Neutrodyne, with self-contained loud speaker. Receiver and cabinet in genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop desk lid that hides receiver when not in use. Price, exclusive of tubes and batteries, $295.

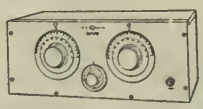
Ease and simplicity of tuning make it the ideal receiver for all the family.

The FADA Neutrola Grand is the finest of the complete line of FADA Neutrodynes, which includes a model to suit every taste, every radio requirement, every pocketbook. Three, four and five tube FADA Neutrodyne receivers in plain or de luxe cabinets are now available at your dealer's. See them today and make your selection.

You will never regret buying a FADA.

You have a range from $75 to $295 from which to select—six models, each extraordinary in results; each a remarkable value.

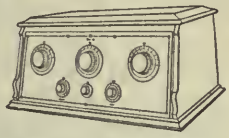
F. A. D. ANDREA, Inc.
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FADA Neutro Junior
No. 195
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FADA Radio

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FADA Neutroceiver
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Mahogany cabinet. Inclined panel and roomy battery shelf. 5 tubes. Price less tubes, batteries, etc.) $160.

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Among Our Authors

MARK SULLIVAN is a Washington correspondent for the New York *Herald-Tribune* and contributor of regular articles to the *World's Work*. His political pronouncements are read nationally with much interest because they are readable and authoritative.

JULIAN KAY is an old-time Middle West amateur who played with radio as soon as he was able to climb his grandfather's barn. He has been a ship operator for the Marconi Company, Kilbourne and Clark, the Radio Corporation, and the Shipping Board. During this "brass pounding" career he received three sos calls.



HANSCOM, JR.

ALLAN T. HANSCOM, in addition to being a graduate electrical engineer and radio merchandiser, is president of the Chamber of Commerce at Woonsocket, Rhode Island. He writes that he is a good Kiwanis member, a rather inferior tennis player, and as the final thrust, that he hopes to help elect Coolidge if he lives through the world's series. The photograph shows Hanscom, Jr., in a home made automobile.

FRED JAMES is a Canadian newspaper man whose typewriter and home are now in Ottawa. He was an infantry officer in the Canadian forces overseas and after being wounded, was sent back to France as official Canadian war correspondent. His despatches were later published in book form by the Canadian Government under the title *Canada's Triumph*. Mr. James admits that he combines an amateur interest in radio with his writing. Well, it can be done.



FRED JAMES



ERLE H. SMITH

RADIO came hard in the flying days at Sacramento and San Diego in the training days of the war," writes Erle H. Smith, from the office of the Kansas City *Journal-Post* where he is now features editor. Although he is pretty busy during the day, he finds time at night, he says, to listen to good radio entertainment from San Juan to Los Angeles on his five-tube receiver.



T. O. SHEARMAN

THOMAS O. SHEARMAN is a consulting radio engineer for various radio firms. Just now he is working on the manufacture of a new resistance unit. In the past he has done testing and experimental work for the Western Electric Company, the Lowenstein Radio Company, and the Electrose Insulator Company. He makes his home at Kew Gardens, Long Island.



A. K. PHILLIPI

A. K. PHILLIPI is now an engineer with the Westinghouse Company. For a span of four years he served as an apprentice machinist in the Navy. And when the Pittsburgh fogs cloud things up a bit, he writes that he finds time to rough it in the wilder or more wooded sections of Pennsylvania.



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The question is heard at every radio counter: "Is it a genuine Radiotron?" Almost every dependable manufacturer uses genuine Radiotrons in his sets. Everyone who builds his own knows enough about radio to know that nothing else but the genuine will do. And the man who replaces used-up tubes in his set knows that to get the same performance, he must have the same tubes—genuine Radiotrons only. So everybody asks "Is it genuine?" And asks to see the marks that prove it—the name "Radiotron" and the "RCA" mark.

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