SPECIAL DX NUMBER

RADIO NEWS

MARCH
25 Cents

and

Radio Call Book Magazine and Technical Review

Facts About DX Reception

A Publication Devoted to Progress and Development in Radio

Engineering
Service Work
Experimental Research
Industrial Application

Broadcasting
Short Waves
Television
Electronics

DX Reception
Set Building
Amateur Activity
Electrical Measurements

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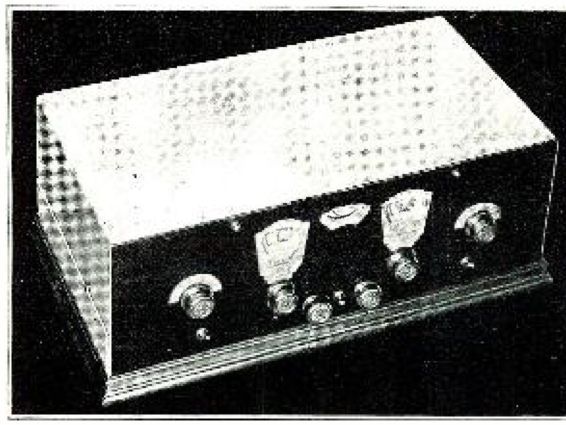
9 to 200 METERS



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COMMERCIAL TYPE

A SUPER POWERED RECEIVER DESIGNED FOR STRICTLY SHORT WAVE RECEPTION

Repeated requests from commercial operators, communication systems, broadcasting stations and hundreds of individuals prompted us to put months of work on the new R-9 commercial type receiver. A STRICTLY SHORT WAVE RECEIVER FROM ANTENNA POST TO SPEAKER JACK. Capitalizing on our years of experience in designing high powered receivers and utilizing the tremendous advantage of the new Litz wire duplex tuned amplifier of the DeLuxe SW-33.

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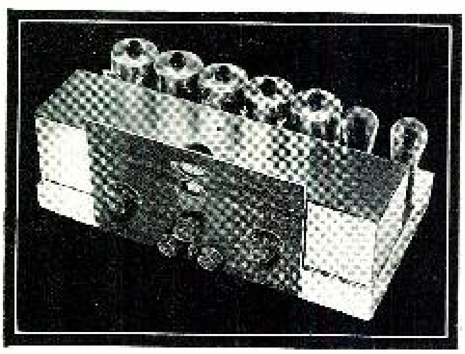
Visual Signal Indicator

Instantaneous Band Selection—5 groups

Double rectifying detector

Silent Tuning

And—NOW YOU CAN BRING THE WORLD OF RADIO RIGHT INTO YOUR HOME WITH THE NEW *Improved* . . .
LINCOLN DeLUXE SW-33



with even more amplification, more selectivity and sensitivity than we ever hoped to attain. Foreign stations are daily rolling into our laboratory, located in the heart of Chicago, with undistorted volume. Powerful locals are cut dead with fractional movement of the dial controlling the twelve tuned circuits.

Like everyone who first hears the DeLuxe SW-33, you will marvel at the heavy undistorted register and fidelity, as the result of the new balanced grid, double rectifying detector. Once you hear the tremendous power of this new model, you will understand why it so far outperforms the average receiver.

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REMEMBER—Lincoln receivers grace many of the finest homes in this country.

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The man who has directed the Home-Study Training of more men for the Radio industry than any other man in America.

Here are a few examples of the kind of money I train *"my boys"* to make

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"Soon after I began to do Radio work in full time I started a store known as the 'Chapin Radio Shop' and handled a large amount of repair work. I have made close to $2000 and if I couldn't get the Course over, $5000 couldn't take from me my N.R.I. data books and helps. I can safely say that the N.R.I. has kept me out of the throng of unemployed this year." CARL B. CHAPIN, Box 222, Edmeston, N. Y.

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"After finishing nine lessons I started doing some repair jobs and have since made $1500 in spare time. I have found that time of depression means more Radios to repair, because people have their old sets fixed, instead of buying new ones. Anyone interested in making more money, in spare time, will not go wrong by taking the N.R.I. training." J. B. MILBY, Box 95, Utica, Michigan.

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My Free Book gives you many more letters of N. R. I. men who made good in spare time or full time businesses of their own

SPECIAL FREE OFFER

Act now and receive in addition to my big free book, "Rich Rewards in Radio," this Service Manual on D.C., A.C., and Battery operated sets. Only my students could have this book in the past. Now readers of this magazine who mail the coupon will receive it free. Overcoming hum, noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, poor Audio and Radio Frequency amplification and other vital information is contained in it. Get a free copy by mailing the coupon below.

The world-wide use of Radio sets for home entertainment has made many opportunities for you to have a spare time or full time Radio business of your own. I give you instructions early in your Course for doing 28 Radio jobs common in every neighborhood. Many N.R.I. men make $5, $10, $15 a week extra in spare time almost at once. I show you how to install and service all types of receiving sets. I give you Radio equipment and instructions for conducting experiments, for building circuits, and testing equipment, and for making tests that will give you broad, practical Radio experience. Clip the coupon below and get my free 64-page book, "Rich Rewards in Radio"—it gives you a full story of the success of N.R.I. students and graduates, and tells how to start a spare time or full time Radio business of your own without capital.

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Get ready Now for a Radio business of your own and for Jobs like these

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I Will Train You at Home in Your Spare Time

Hold your job until you're ready for another. Give me only part of your spare time. You do not need a high school or college education. Hundreds with only a common school education have won bigger pay through N.R.I. J. A. Vaughn jumped from $35 to $100 a week. J. E. McLaurine increased his earnings 100%. The National Radio Institute is the Pioneer and World's largest organization devoted exclusively to training men and young men by Home Study for good jobs in the Radio industry.

You Must Be Satisfied

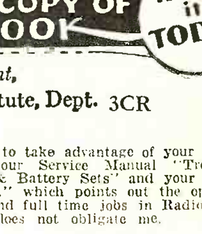
I will give you an agreement to refund every penny of your money if you are not satisfied with my Lessons and Instruction Service when you complete my Course. And I'll not only give you thorough training in Radio principles, practical experience in building and servicing sets, but also Advanced Training in any one of five leading branches of Radio opportunities.

My 64-Page Book Gives the Facts

Clip and mail the coupon now for "Rich Rewards in Radio." It's free to residents of the U. S. and Canada over 15 years old. It points out the money-making opportunities the growth of Radio has made for you. It tells of the opportunities for a spare time or full time Radio business of your own, the special training I give you that has made hundreds of other men more successful; and also explains the many fine jobs for which my Course trains you. Send the coupon to me today. You won't be obligated in the least.

Get **my new book It points out what Radio Offers You**

J. E. Smith, Pres.
National Radio Institute,
Dept. 3CR,
Washington, D. C.



SOME OF THE JOBS N.R.I. TRAINS MEN FOR

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- Installation Engineer of Broadcast Apparatus
- Operator in Broadcast Station
- Aircraft Radio Operator
- Operator of Airway Beacons
- Service Man on Sound Picture Apparatus
- Operator of Sound Picture Apparatus
- Aircraft Radio Maintenance and Repairman
- Recording Operator
- Serviceman on Television Sets
- Ship Operator
- Service Man on Public Address Systems
- Installation Engineer on Public Address Systems
- Sales Manager for Retail Stores
- Service Manager for Retail Stores
- Auto Radio Installation and Serviceman
- Television Broadcast Operator
- Set Servicing Expert
- Inspector and Tester in Factory
- Factory Service and Repairman
- Operator in Commercial Station

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Washington, D. C.

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Name..

Address..

City.................*State*.............. "M"

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Associate Editor

JOHN M. BORST
Ass't Tech. Editor

RADIO NEWS

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Associate Editor

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Broadcast Editor

JOS. F. ODENBACH
Art Editor

VOLUME XIV | March, 1933 | NUMBER 9

CONTENTS

(*Cover Design by Morey*)

RADIO CALL BOOK SECTION

DEPARTMENTS

Published Monthly by Teck Publications, Inc., *Washington and South Avenues, Dunellen, N. J.*

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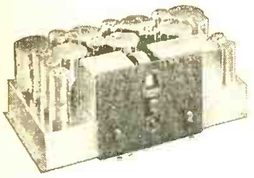
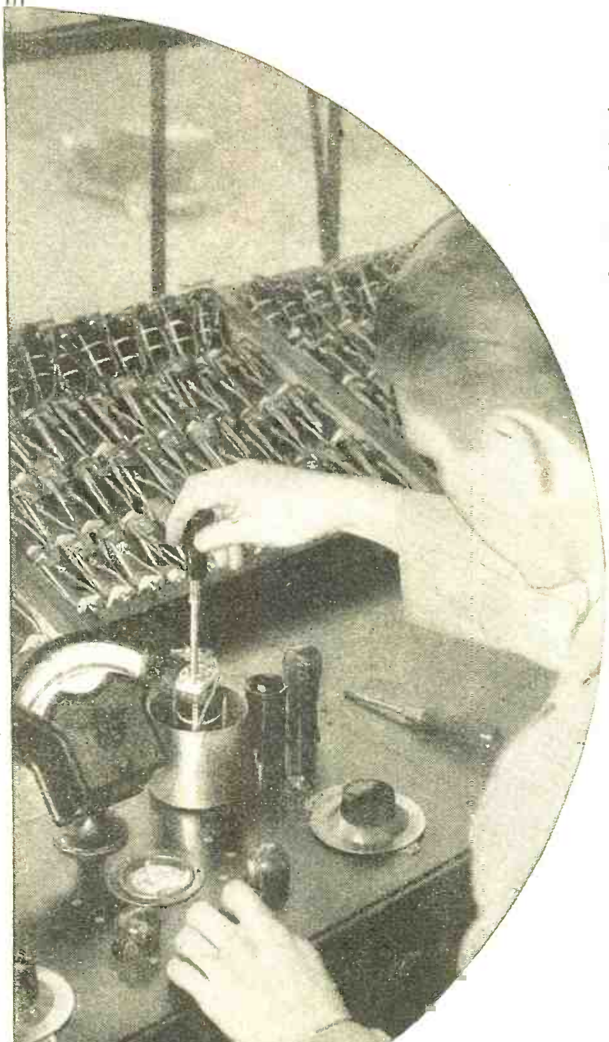
ONLY SCOTT *Laboratory Technique* GIVES SUCH RECEPTION



The chassis of the SCOTT ALL-WAVE DELUXE is a thing of beauty. Finished in gleaming chromium plate it is dust-and-weather proofed to keep its tremendous power always ready for service. Within this chassis is the perfection resulting from tests such as the one shown at the right—which matches coils to their antennae exactly within the third of a turn of wire.



Of both Foreign *and* Domestic Stations

SCOTT Laboratory Technique begins with advanced engineering design . . . follows exacting specifications for every component part . . . includes custom construction by specially trained technicians who test and retest to assure the degree of perfection that gives SCOTT ALL-WAVE DELUXE Receivers the right to the title of "World's Finest Radio Receiver."

And how the SCOTT ALL-WAVE DELUXE lives up to its title! A twirl of its single dial brings magic music and the sounds of foreign tongues from stations 10,000 miles away as readily as it gives superior reproduction of familiar programs from homeland stations. Utter simplicity in changing from one wave band to another . . . just the turn of a switch—no plug-in coils, tapped coils or bothersome connections.

Tone . . . Sensitivity . . . Selectivity? What would you expect from a receiver known as "the world's finest"? Millions of words from us would bear less weight than the enthusiastic praise of SCOTT owners. More than 19,000 logs of foreign receptions have come to us from them within a year. In trial after trial SCOTT receivers continue to break all records for distance reception . . . for needle point selectivity . . . for gorgeous tone richness unrivalled in radio.

Before you buy any radio receiver learn all about the finest one . . . that is warranted to give true world-wide reception and every part of which (except tubes) is guaranteed for five years. You will be pleasantly surprised to find that, in spite of its custom-built superiority, a SCOTT ALL-WAVE DELUXE may be purchased for no more than many models of ordinary receivers.

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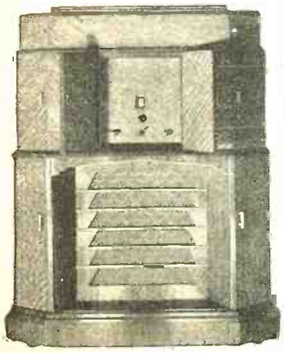
The New
IMPERIAL GRANDE
Console

Fittingly this newest addition to the group of distinctive SCOTT Consoles offers the most exquisite console for the world's finest receiver.



The 15-550 METER SCOTT ALL·WAVE *Deluxe*

Mail THIS COUPON FOR *NEW* BROCHURES

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Send me, without obligation, complete information about the new SCOTT ALL-WAVE DELUXE, including your new Brochures, "PROOF" and "The Creation of a Masterpiece."

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The Editor—to *You*

IS radio reception from distant stations in the United States, as well as from Canada, Mexico, Central America, South America and other continents all over the world, possible in average locations in the United States today? After reading the articles featured in this issue, it is the Editor's opinion that our readers will no longer be in doubt on this subject. Both on the broadcast band and the short-wave band, an enormous amount of confirmatory evidence has been uncovered (during a six-month survey of this field of radio activity) by the staff of RADIO NEWS.

* * *

IN this issue there are featured a number of articles dealing with pertinent information for the DX fan to enable him to understand the problems of practical DX reception on all wavelengths.

* * *

HERE are a few questions that often come to the mind of the beginner in the short-wave and DX field: What kind of equipment in the way of receiving apparatus is necessary? When is the best time to listen for distant stations during the day or night? What particular wavelengths are received best in the morning, in the afternoon or during the hours of darkness? How can fading of distant signals be ameliorated or eliminated? When is the best time to listen for London, Rome, Paris, Australia, Buenos Aires, Caracas, Bogota, Geneva, Zeesen and many other short-wave international broadcasters? What is the best method to go about tuning for DX? How can reception of a foreign station be verified? At what dial settings will a given station be found? What time of day or night is it in a foreign country, at a given time in our home location? What is the actual airline distance between the location of the station being received and our home location?

* * *

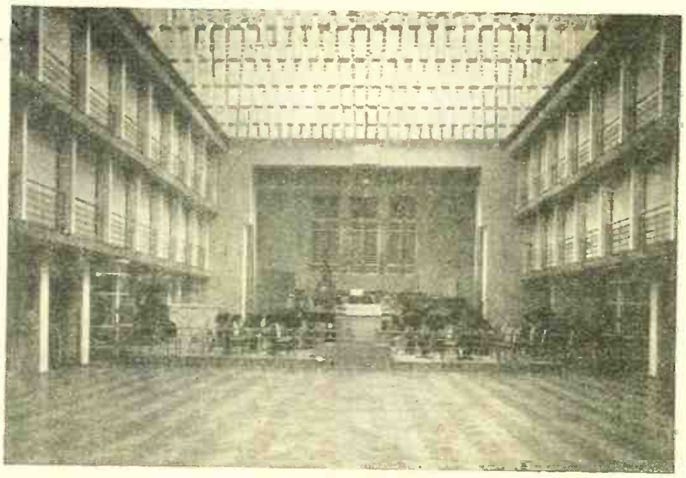
THESE are questions the Editors feel are answered in this issue—and the coming three issues will contain other much-needed information for DX fans that will enable them to get the most out of the thrill of DX work.

* * *

IN Mr. Taylor's article in this issue, the results of a survey of the whole situation are contained. In the article by Mr. Reeks, the author gives some much-needed data on short-wave DX reception. The frontispiece of this issue is given over to a world equidistant projection map that can be used for determining distances. On page 522 is a radio time chart of the world. An article by Mr. Long tells of the design principles of long-distance receivers. The call list on page 539 gives information on the principal European stations on the broadcast band. And the three leading articles in the Radio Call Book Section give descriptions of long-distance receiving sets, in various price ranges, suitable for satisfying the DX fancies of any potential listener.

* * *

THE photograph reproduced on this page shows the main studio of the Nordische Rundfunk, A. G., which is a sort of parent company for the various broadcasting stations at Hamburg, 806 kc.; Bremen, 1124 kc.; Flensburg, 1319 kc.; Hanover, 530 kc.; and Kiel, 1292 kc., in Germany. Broadcasts from this studio can be switched to any of these stations. It is reported that the station at Hamburg is being increased in power to 150 kw., using two new 300 kw. tubes. The studio illustrated contains an orchestra platform on a huge elevator which can be raised above the floor or sunk below at will, as well as a great radio organ, the grillework of which can be seen in the central background. Notice the queer hangings on the ceiling, designed to eliminate reverberation. It is possible that some of our listeners will be able to pick up one of these stations.



* * *

AND now we are coming into a period replete with the most excellent results for reception of DX stations on the short-waves. The later Winter months, the early Spring and all Summer long, short-wave stations will be pounding in with louder signals and more consistent volume, with less fading that at any other time during the year. Now is the time for those potential listeners on the short waves to get started, to obtain their equipment for short-wave reception. Now is also the time for the "dyed in the wool" DX enthusiast to overhaul his equipment, test his tubes, revise his antenna installation, so that he will get the best results possible during these exceptional months of short-wave activity. Now is the time for him to lay aside the small short-wave regenerative receiver and obtain a modern set using the superheterodyne principle that will bring in these stations reliably without sending forth into the ether the squeals and whistles of the earlier type sets.

* * *

AND here is an unexcelled opportunity for the wide-awake serviceman. There is hardly such a service worker who has not been asked by many of his clients what there is to short-wave possibilities and what kind of equipment would be necessary, if it *is* possible. The modern serviceman knows this situation and should be ready and eager to advise his clients along these lines; just what sets are suitable; what are the most reliable tubes and accessory equipment for this use. The serviceman can serve in an advisory capacity, and also can furnish this equipment and keep it in repair, at the same time making his legitimate profits from this worth-while service. It is our recommendation that service workers center their activity, during the coming months, on this field that has already proven so profitable during the early Winter months.

* * *

COMING over the Editor's desk this month are a number of interesting letters from readers all over the world. Two excerpts follow:

* * *

"FOR the past few years I have been steadily buying RADIO NEWS, as I find it one of the finest sources of information on matters that I am interested in."
—Lewis J. Lenny, Bronx, N. Y.

* * *

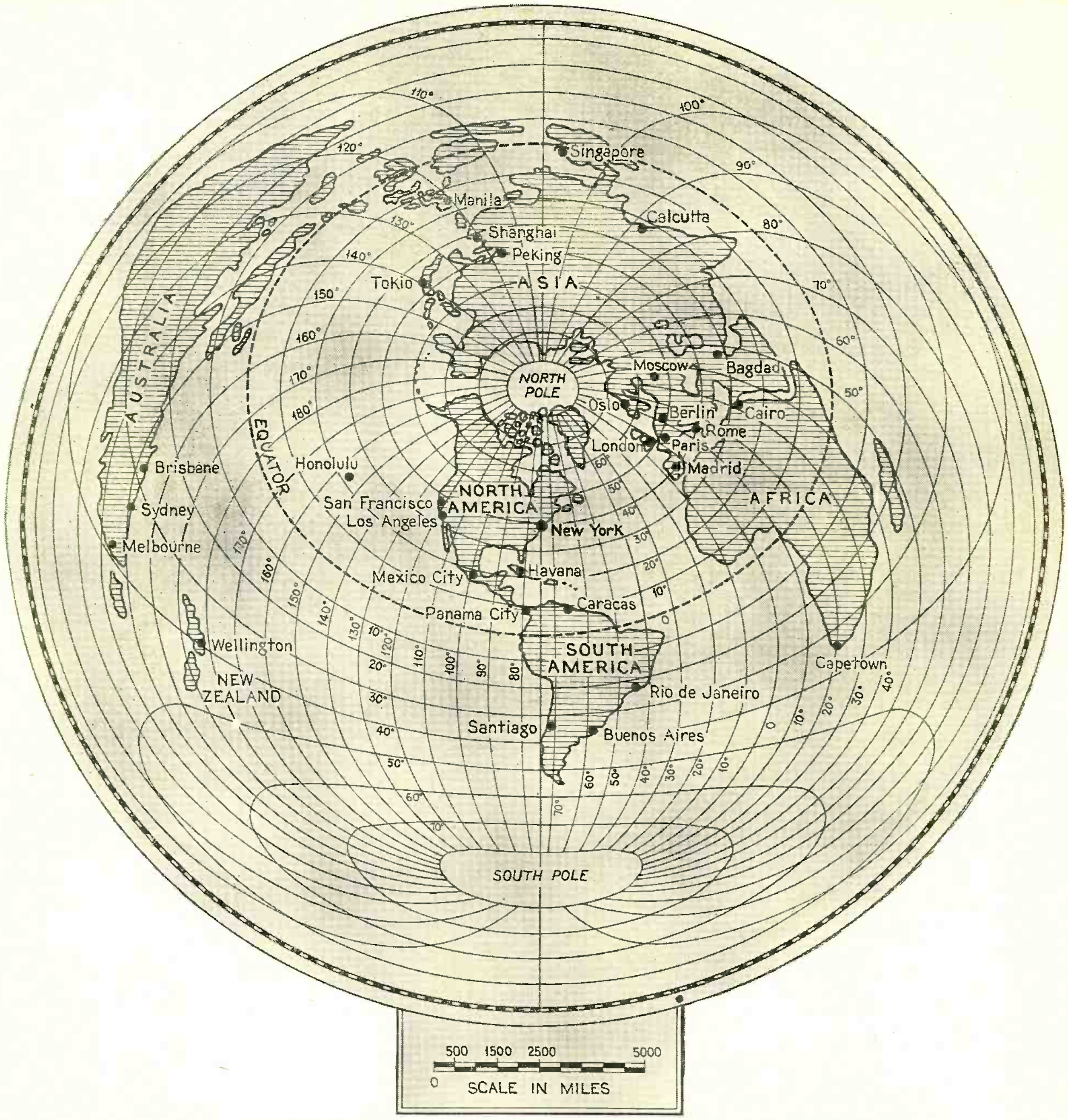
"I HAVE devoured every article for the past few months on custom-built radio set analyzers. The last one described beats them all. RADIO NEWS is a necessity to me to keep abreast with the times."—J. Y. Smith, Sparkman, Ark.

* * *

THE Editors acknowledge with thanks the hundreds of additional letters that are received each month from readers and appreciate their comments and suggestions.

* * *

Lawrence M. Cockaday



"Distance Lends Enchantment"

In the realm of "DX," a term which in radio parlance means "long distance," the actual distance in miles is the yardstick of accomplishment. The distorted map shown here permits direct measurement of the mileage between New York and any point in the world, or from any point in the world to New York, without calculations or computations and with an ordinary ruler the only instrument needed. To use the map, first find the distance in inches between New York and the desired point, multiply this figure by the miles per inch shown on the scale on the chart and the answer will be a close approximation to the exact airline distance between the two points.

Distances from points other than New York can in many cases be closely approximated by reference to New York. To determine the distance between San Francisco and Melbourne, Australia, for instance, the distance from Melbourne to New York is found and from this is subtracted the distance from San Francisco to New York. The distance between San Francisco and a point in Africa would be obtained in the same manner, except that the mileage between San Francisco and New York would be added to the distance from New York to the African point. An important feature of this map is found in the fact that one can easily see the shortest straight-line path from any point in the world to New York, and the exact direction of such a path. Thus, it is surprising to learn that radio signals from Tokio or Manila pass almost directly over the North Pole in their path to New York, whereas most people think of such signals as coming to New York from a westerly point, probably passing over Los Angeles en route.

Based on map furnished through courtesy of General Electric Co.

Radio News

VOLUME XIV — March, 1933 — NUMBER 9

Facts About DX RECEPTION

Finding many fans skeptical about transoceanic reception of broadcast programs on the 200-550 meter band, RADIO NEWS recently concluded an investigation of DX possibilities, the results of which are reported here

By S. Gordon Taylor

RADIO DXing, though a babe in arms as compared with the venerable pastimes of St. Andrews and Isaak Walton, nevertheless in the minds of many seems to have established itself in somewhat the same class so far as extreme claims made by some of its followers are concerned. As a matter of actual fact, there is probably far more excuse for the stories of radio reception than there is for tall tales of "the fish that got away" or of the "birdies," "eagles" and "broken par" so frequently encountered among the followers of the other two sports, what with the possibilities of honest error in misunderstanding call letters and so on.

However, it is not the intention of this article to make odious comparisons or reflect on the grand old games of our forebears, but rather to concentrate on our own DX game. Among other things, an attempt will be made to establish certain facts concerning the possibilities of long-distance reception, to refute some of the common ideas concerning the limitations of broadcast-band DX and to show that there is a probability that many of the doubted records are actually authentic.

As the result of a letter written by a reader and published in RADIO NEWS, making certain claims of long-distance DX reception, quite a number of other readers took occasion to criticize the reported accomplishments as being gross exaggeration, and some even stated that such reception was utterly impossible. For those who are interested, the letter, written by Mr. George Lilley of West Chester, Pennsylvania, will be found on page 108 of the August, 1932, issue of RADIO NEWS. In this letter Mr. Lilley stated that from his home he received programs from stations in Japan, Italy, South America, Hawaii, Ausralia, Bermuda and New Zealand, all on the 200-550 meter band.

Before publishing this letter the editors of RADIO NEWS had taken reasonable steps to check the authenticity of this reception and to determine to their own satisfaction that such accomplishments were possible. However, when readers questioned the possibility, it was deemed advisable to carry the investigation further.

The conduct of this investigation offered a number of complications. It was believed that ordinary letters of verification sent out by broadcast stations could not be considered conclusive proof of reception. Something more definite than this was required to provide the necessary evidence. The only real method of getting at the facts seemed to lie in arranging for actual demonstrations of foreign reception, particularly reception from trans-Pacific countries. This in itself offered quite a problem, because it is a recognized fact that such reception is not an every-day occurrence and a dozen demonstrations might be arranged before a time was found when reception conditions would be suitable.

Inasmuch as it was desired particularly to check the claims made in the letter referred to above, the most logical course of procedure appeared to lie in arranging with its writer to stage a demonstration. Accordingly one of Mr. Lilley's critics, Mr. A. H. Brackbill, living in a neighboring town in Pennsylvania, was asked to sit in at this demonstration, as a witness for RADIO NEWS. It was felt that Mr. Brackbill would prove to be an especially satisfactory witness. Because of the critical attitude he had taken, it was certain that he would demand nothing short of absolute proof before he would be convinced.

10,000-Mile Broadcast Reception

The demonstration was arranged to begin at midnight, October 29th, and continue through to daylight of the next day.

Shortly thereafter reports were received from both men covering the demonstration, which took place as scheduled. It is hardly necessary here to go into complete details concerning these reports. The fact remains that they agreed in the essential details and, what is most important, Mr. Brackbill admitted hearing the Australian station 4BH, Queensland, Australia, operating at a frequency of 1380 kilocycles or 217 meters with antenna power of 600 watts; 2BL, Sydney, Australia, operating at a frequency of 855 kilocycles or 351 meters, with a power of 5000 watts; and 4QG, Brisbane, Australia, operating at a frequency of

760 kc. or 395 meters with a power of 5000 watts. In addition to this, KERN, a 100-watt station in Bakersfield, California, was heard as well as several other West Coast stations. In Mr. Brackbill's report, he stated as follows (referring to the three Australian stations listed above):

"I am of the firm opinion that they were Australians beyond a doubt. I believe now that he (Lilley) can get them, and I believe he can get them better than he did yesterday morning, because while the weather was perfect, it was a bit too cool. There was a little static at first, but by the time the Australians came in the weather was okay all around.

"I am fully satisfied with the results and Lilley was perfectly honest in every way. I have no more to say on the subject except that he is honest in his claims of Australians and was perfectly willing to give the demonstrations."

Mr. Brackbill did not, of course, hear any European stations, because during the early morning hours it would be daylight in Europe and reception would therefore be out of the question. He gave it as his opinion that it would be impossible for Mr. Lilley to get European or South American stations during their regular broadcast periods or at any time during the evening while the American stations are occupying every channel.

There were some instances in which the two men did not agree. This was due to Mr. Brackbill's unwillingness to credit Mr. Lilley with any reception until he was thoroughly satisfied concerning its authenticity. The real important facts brought out by the demonstration were that it *is* possible to hear Australia on the broadcast band and that Mr. Lilley's claims as published in his letter in RADIO NEWS last August were justified, at least so far as his most distant claims were concerned. Inasmuch as it was his claim of Australian reception that his skeptical critics questioned particularly, it was not considered necessary to require further demonstration from him. In this respect it was considered fortunate that so much had been accomplished in a single demonstration.

If any further evidence of the possibility of bringing in trans-Pacific stations is required, it can be found in the experience of a large number of real DX enthusiasts who during the proper seasons of the year bring in a number of Australian, Japanese, Hawaiian and New Zealand stations. Some of them succeed in doing so only on rare occasions, others with a fair degree of consistency. One example is found in the experience of Mr. C. H. Long, the author of an article which appears elsewhere in this issue. In his article he explains the degree of consistency with which he has been able to receive various stations at extreme distances. Quotations from two letters of verification which he received are presented in the present article. These are quoted to show not only that reception from Australia is possible, but that Australian stations of relatively insignificant power can be brought in understandably.

Super-Power Not Essential

An interesting illustration of how well low-powered stations sometimes reach the United States from Australia is found in a copy of a reception log given herewith. This is a log of a program heard from 4TO as copied by Mr. Long on November 23, 1932, in Winston, Missouri, and mailed to RADIO NEWS a day or two later. 4TO uses *maximum power of only 200 watts* and operates on a frequency of 1170 kilocycles or 256 meters. It is located at Townsend, a suburb of Sydney, Australia.

5:38 a.m.—Announcer advertising. Next number, "Waltz in A Major."

5:39 to 5:41—Orchestra in number announced. Announcer. "—play record—"

5:42 to 5:45—Orchestra, strings prominent, fast time. Announcer.

5:46 to 5:52—Man speaking as announced. Nursery tale. A mother-in-law story. "First record is entitled . . ." At 5:49 an orchestra record strikes up for a moment. Directions for some absurdity. "That's all. Good night." Announcer.

5:53 to 5:56—Orchestra, popular selection semi-Hawaiian style. Announcer.

5:57 to 6:01—Man singing semi-popular selection, piano accompaniment. Announcer, "The first number of the group will be fox-trot played by Joe (Stewart?)."

6:02 to 6:04—Orchestra in fox-trot, vocal refrain by man. "One More Kiss and Fond Good Night."

6:04 to 6:07—Orchestra in second popular dance number, man in vocal refrain. "It's the Girl" (that makes life worth while, etc.).

6:07 to 6:10—Orchestra in third popular dance number, man in vocal refrain.

6:10 to 6:12—Orchestra in another popular dance number. Announcer. "This concludes our program for tonight. This station is now closing down until . . . tomorrow. . . . Amalgamated Wireless Australasia Limited. . . . Good night, everybody."

6:14—Orchestra in one stanza of "God Save the King." Station off.

Verifications of Broadcast Band

Quotations from letters written fying reception of their pro- Kansas City, Missouri. It is of these were both low-power sta- meter band. The letters make grams and announcements

Dear Mr. Long: *February 19, 1932.*

We have to congratulate you most heartily on your most excellent reception of January 7th last, when you sent us a correct report of a period extending over an hour of the 4BC transmission of January 7th.

We have most carefully checked each item you heard, and there is absolutely no doubt that you received our programme, and you will be surprised to know that at that moment our transmitting power was only 180 aerial watts, as we are only at the moment increasing power to our full licensed allocation of 600 aerial watts.

Within the next fourteen days we will be operating on our full licensed power, and when you receive this letter we would be most grateful if you would carefully observe our signals again on the wavelength of 262 metres, or 1145 kilocycles, and let us know of any difference you may observe in the transmission received at your end.

CHANDLER'S RADIO SERVICE,
(Signed) R. F. Roberts, Studio Director.

Importance of Good Location

Location, of course, plays a rather important part in the successful reception of stations thousands of miles distant. This does not necessarily mean that for successful reception one must live in an isolated rural district, because there is plenty of evidence that trans-Pacific stations are being received right in New York City and in other congested city areas. The author is frank to say that he cannot claim credit for such reception, for the reason that the temptation offered by a warm, comfortable bed at 5 o'clock in the morning is too great to resist. It is believed that real long-distance reception is possible in any locality that is reasonably good from the radio standpoint and is likewise reasonably free from local electrical disturbances of the man-made static variety.

Broadcast Receivers for Transoceanic Reception

Receiver equipment must, of course, be good. This does not mean that the receiver must necessarily have anywhere from ten to twenty tubes. Circuit efficiency is an extremely important factor. Also, if only headphone reception is desired, fewer tubes will naturally be required than is the case where one demands his DX at loudspeaker volume. It is naturally the thought that where exceptional long distances are covered, specially designed home-built or laboratory-built receiver equipment is an absolute essential. This fact was not borne out by the investigation covered in this article. To check on this point, inquiries were sent to a number of the officers or leading members of broadcast DX clubs, asking what receiver equipment these individuals employ in their DX reception. Strange as it may seem, only one of the nine from whom this information was received was using a home-built receiver.

International DX Reception

by two Australian stations, veri-
grams by a listener located near
particular interest to note that
tions operating in the 200-550
it quite evident that both pro-
were clear and understandable.

Dear Mr. Long: July 5, 1932.

We were very pleased to receive your letter of June 1st and greatly surprised to learn that you heard our book advertised over the air from 4TO, Townsville, Queensland (Australia).

Although we do not anticipate that you are likely to enroll for a course of instruction with us, yet no doubt you will be interested to learn the manner in which radio is taught in this country.

With regard to the Townsville Station, the aerial power is normally rated at 150 watts, but on occasion the power is increased up to 200 watts.

We are wondering what type of receiver you are using in order to receive such a station over so great a distance; it must certainly be a very sensitive set.

Particulars of the reception of the station have been attached to the book, which are forwarding. . . .

MARCONI SCHOOL OF WIRELESS,
(Signed) H. E. Buik, Superintendent.

Several of the others were using standard sets of well-known makes which had been especially "hopped up" to decrease stability and therefore introduce some regenerative action. The others were using one or another of the laboratory-built receivers now on the market.

A surprising fact developed by these inquiries is that most of the men to whom they were addressed had practically no technical knowledge of radio. At least two of the men who were using revamped standard receivers had not made the alterations themselves, but instead had the work done by local radio servicemen. One of them remarked in his comments that he had spent enough on the old receiver to more than pay for one of the modern highly sensitive and selective laboratory type jobs. On the whole, it seems that these laboratory-built receivers offer the best possibilities for real DX reception. This conclusion is based on the fact that a number of the DX fans have expressed the intention of shortly acquiring receivers of this type to replace those now in use. But this condition is a natural and logical one. Commercial receivers produced in large quantities cannot hope to attain the high standards of selectivity and sensitivity that can be built into a receiver which is made by hand following the most rigid standards of design, construction and individual inspection.

Any discussion of DX work would be incomplete without some mention of the necessity for patience and perseverance. It is quite possible for an ordinary radio fan to sit down at a receiver and obtain only mediocre results, whereas an experienced DXer, working with the same receiver and in the same location, might produce truly astonishing results. Patience is certainly a cardinal virtue when it comes to waiting out weak stations and in going back time and again to a given channel where a DX station is known to be working. More attention will not be given to this phase of the subject here, however, as this is covered in some length in other articles in this issue.

There are undoubtedly numerous DX fans who, like the author, are reluctant to stay up all night in the hope of bringing in the stations which are available only from 4 o'clock on. For these there is still plenty of opportunity for carving out some real DX records. Right through the heart of the evening there is plenty of opportunity for such work. There are numerous stations throughout the Middle and Far West which can be brought in, and numerous stations in Cuba, Mexico, Canada and Central America which operate on split frequencies and which can therefore be brought in between channels occupied by American stations, providing the receiver employed is one having adequate selectivity. During tests conducted in New York City, beginning late in November (1932), KFI of Los Angeles was heard 20 consecutive evenings. Several of these evenings this station was distinctly heard when WAIU, a Columbus station operating on the same channel, signed off at 7:45 p.m., E.S.T. Two evenings KFI was heard through WAIU before 7:00 p.m., E.S.T. This was made possible by the fact that both stations were operating almost exactly on their assigned frequencies and therefore caused no audible heterodyne.

One can shoot for stations located in "dead" territory. In New York City, for instance, it is easier to bring in West Coast stations than to bring in those from Nova Scotia, yet VAS can be logged on 685 kc. during the middle of the evening, providing one has sufficiently sensitive and selective receiving equipment to squeeze in between stations on 680 and 690 kc.

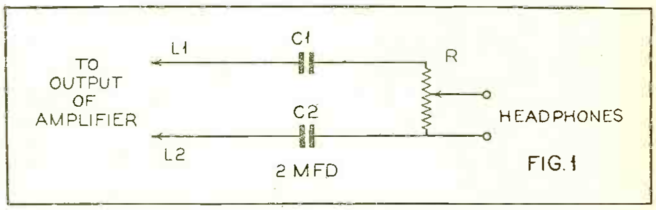
Daytime DX

There is, in fact, no hour during the day or night when the DX hobby cannot be indulged. During daylight hours one can always shoot for stations a few hundred miles distant. Mr. R. H. Schiller, president of the Transcontinental DX Club, was good enough to make a listening test during the afternoon of Sunday, November 13, 1932, at the request of RADIO NEWS. Operating a receiver at Hawthorne, N. J., he logged the following stations between the hours of 2:00 and 3:30 p.m.:

WEBR	Buffalo, N. Y.	100 watts
WFBR	Baltimore, Md.	500 watts
WHAM	Rochester, N. Y.	5000 watts
WRAX	Philadelphia, Pa.	250 watts
WRC	Washington, D. C.	500 watts
CKGW	Toronto, Ontario	5000 watts
WEAN	Providence, R. I.	250 watts
CHYC	Montreal, Quebec	5000 watts
WDRC	Hartford, Conn.	500 watts
WOWO	Fort Wayne, Ind.	10 M watts
KMOX	St. Louis, Mo.	50 M watts
WORK	York, Pa.	1000 watts
WCSH	Portland, Me.	1000 watts
WHAS	Louisville, Ky.	25 M watts
WBBM	Chicago, Ill.	25 M watts
WGR	Buffalo, N. Y.	1000 watts

Not satisfied with distance which daylight hours can produce on the broadcast band, one can always resort to the short waves, with the whole wide world as the happy hunting ground. Here again the laboratory-built type of receiver, capable of effectively covering the entire wave-band between 15 and 550 meters, offers a strong advantage—or a good broadcast receiver and short-wave adapter combination.

The value of providing for headphone reception in DX work cannot be overestimated, especially where the receiver is to be operated under normal home surroundings. This is not entirely a matter of convenience for the other members of the family, but in the case of very (*Continued on page* 567)



HEADPHONE CONNECTIONS FOR STANDARD RECEIVER

If a push-pull output stage is employed L1 and L2 are connected to the plate prongs of the output tubes by means of wafer adapters inserted under tubes. For a single output tube connect L1 to tube plate and L2 to chassis or ground. C1 and C2 isolate the headphones from the high d.c. plate voltage and should be 1 or 2 mfd. each. R is a 10,000-ohm potentiometer. A switch may be inserted in secondary of output transformer to cut out loudspeaker when using headphones

Radio Time Chart of the World

TODAY → | ← TOMORROW →

Longitude	Zone																								
EAST 180	1	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
" 165	2	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
" 150	3	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
" 135	4	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
" 120	5	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
" 105	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
" 90	7	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
" 75	8	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
" 60	9	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
" 45	10	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2
" 30	11	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
" 15	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
0	13	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
WEST 15	14	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
" 30	15	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
" 45	16	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
" 60	17	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
" 75	18	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
" 90	19	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
" 105	20	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
" 120	21	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
" 135	22	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2
" 150	23	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1
" 165	24	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12

← YESTERDAY →

TIME ZONES

Alaska
- Ketchikan ... 21
- Cordova ... 22
- Sitka ... 22
- Southern Portion ... 22
- Central Portion ... 24
- Aleutian Islands ... 24
- West Coast ... 24

Albania ... 12
Algeria ... 13
Angola, Africa ... 12
Arabia ... 10
Argentina ... 17
Auckland Island ... 2
Australia
- Western Australia ... 5
- Central Australia
  - Add ½ hr. to Zone 4 time.
- Northern Territory
  - Add ½ hr. to Zone 4 time.
- South Australia
  - Add ½ hr. to Zone 4 time.
- New South Wales ... 3
- Queensland ... 3
- Victoria ... 3

Austria ... 12
Azores Islands ... 15
Bahama Islands ... 18
Barbados Island ... 17
Bechuanaland ... 11
Belgium ... 13
Bermuda Islands ... 17
Bessarabia ... 12
Bolivia
- Add 27 min. to Zone 18 time.

Borneo
- British North Borneo ... 5
- Dutch Borneo:
  - Balik Papan
    - Add 20 min. to Zone 5 time.
  - Pontianak
    - Add 17 min. to Zone 6 time.
- Sarawak
  - Add ½ hr. to Zone 6 time.

Brazil
- Fernando Noronha Island ... 15
- Isle de Trinidade ... 15
- Bahia ... 16
- Ceara ... 16
- Esperito Santo ... 16
- Goyaz ... 16
- Maranhao ... 16
- Minas-Geraes ... 16
- Para ... 16
- Parana ... 16
- Parahyba ... 16
- Pernambuco ... 16
- Piauhy ... 16
- Rio de Janeiro ... 16
- Rio Grande do Norte ... 16
- Rio Grande do Sul ... 16
- Santa Catherina ... 16
- Sao Paulo ... 16
- Amazonas ... 17
- Matto Grosso ... 17
- Acre Territory ... 18

Bulgaria ... 11
Burma
- Add ½ hr. to Zone 7 time.

Cameroon, Africa ... 12
Canada and Newfoundland
- Labrador (coast)
  - Add 29 min. to Zone 17 time.
- Newfoundland
  - Add 29 min. to Zone 17 time.
- Labrador (interior) ... 17
- New Brunswick ... 17
- Nova Scotia ... 17
- Quebec (east of 68° W.) ... 17
- Ontario (east of 90° W.) ... 18
- Quebec (west of 68° W.) ... 18
- Manitoba ... 19
- Northwest Territories (eastern) ... 19
- Ontario (west of 90° W.) ... 19
- Alberta ... 20
- Northwest Territories (middle) ... 20
- Saskatchewan ... 20
- British Columbia ... 21
- Northwest Territories (western) ... 21
- Yukon ... 22

Canary Islands ... 14
Chile ... 18
China
- East Coast ... 5
  - Hoihau ... 6
  - Hong Kong ... 5
  - Luichow ... 6
  - Pakhoi ... 6

Colombia ... 18
Congo ... 12
Costa Rica ... 19
Cuba ... 18
Curacao Island
- Add 24 min. to Zone 18 time.

Czechoslovakia ... 12
Danzig ... 12
Denmark ... 12
Dominican Republic
- Add 20 min. to Zone 18 time.

Ecuador
- Guayaquil
  - Add 41 min. to Zone 17 time.
- Quito
  - Add 46 min. to Zone 17 time.

Egypt ... 11
El Salvador ... 19
England ... 13
Eritrea, Africa ... 10
Estonia ... 11
- Tallinn
  - Add 39 min. to Zone 12 time.

Fiji Islands ... 1
Finland (Soumi) ... 11
Formosa Island (Taiwan) ... 5
France ... 13
Germany ... 12
Gold Coast ... 13
Greece ... 11
Greenland ... 16
- Scoresby Sound ... 15

Guam Island ... 3
Guatemala ... 19
Guiana
- British
  - Add 15 min. to Zone 17 time.
- Dutch
  - Add 19 min. to Zone 17 time.
- French ... 17

Guinea, Africa ... 14
Haiti, Republic of ... 18
Hawaiian Islands
- Add 30 min. to Zone 24 time.

Honduras ... 19
- British Honduras ... 19

Hungary ... 12
Iceland ... 14
India
- Add 30 min. to Zone 8 time.
- Calcutta
  - Add 53 min. to Zone 8 time.
- Chattagong
  - Add 7 min. to Zone 7 time.
- Ceylon
  - Add 30 min. to Zone 8 time.
- French Establishments
  - Add 30 min. to Zone 8 time.
- Portuguese Goa
  - Add 30 min. to Zone 8 time.

Indo-China ... 6
Iraq ... 10
Ireland ... 13
Italy ... 12
Ivory Coast ... 13
Jamaica ... 18
Japanese Empire ... 4
- Korea (Chosen) ... 4

Java
- Add 20 min. to Zone 6 time.

Kenya
- Add 30 min. to Zone 11 time.

Latvia ... 11
Liberia
- Add 16 min. to Zone 14 time.

Libia ... 12
Lithuania ... 12
Luxemburg ... 12
Madagascar Island ... 10
Madeira Island ... 14
Malay States, Confederated ... 6
Malta Island ... 12
Mexico (except Lower California north of 28°) ... 19
- Lower Calif. (north of 28° N.) ... 21

Morocco ... 13
Mozambique ... 11
Netherlands
- Add 20 min. to Zone 13 time.

New Guinea Island
- Western Part ... 4
- Eastern Part ... 3

New Zealand
- Add 30 min. to Zone 2 time.

Nicaragua
- Add 15 min. to Zone 19 time.

Nigeria ... 12
Niger Territory
- Western ... 13
- Eastern ... 12

Norway ... 12
Nyasaland ... 11
Panama ... 18
Paraguay
- Add 23 min. to Zone 17 time.

Persia ... 9
Peru ... 18
Philippine Islands ... 5
Poland ... 12
Portugal ... 13
Puerto Rico ... 17
Rhodesia ... 11
Rumania ... 12
Samoa Islands
- Eastern (American) ... 24
- Western (British)
  - Add 30 min. to Zone 1 time.

Sardinia Island ... 12
Scotland ... 13
Senegal, Africa ... 12
Siam ... 6
Sierra Leone, Africa ... 14
Somaliland, Brit., Fr. and It. ... 10
Southwest Africa ... 11
Soviet Union (U. S. S. R.)
- Khabarovsk ... 4
- Kharkov ... 11
- Kiev ... 11
- Leningrad ... 11
- Moscow ... 11
- Minsk ... 11

Spain ... 13
Straits Settlements ... 6
Sudan, Africa
- Anglo-Egyptian ... 11
- French:
  - Eastern ... 13
  - Western ... 12

Sumatra, Dutch E. Indies ... 6
Sweden ... 12
Switzerland ... 12
Syria ... 11
Tanganyika, Africa ... 10
Tasmania, Australia ... 3
Trinidad, British ... 17
Tripolitania, Africa ... 12
Tunisia ... 12
Turkey ... 11
Ubangi Shari, Africa ... 12
Uganda, Africa
- Add 30 min. to Zone 11 time.

Union of South Africa ... 11
U. S. of America
- Eastern ... 18
- Central ... 19
- Mountain ... 20
- Pacific ... 21

Uruguay
- Add 30 min. to Zone 17 time.

Venezuela
- Add 30 min. to Zone 18 time.

Virgin Islands ... 17
Yugoslavia ... 12

Use of the Time Conversion Chart

THE time-conversion chart shown here makes it a simple matter to find the time in any country of the world, corresponding to any hour of the day, local time.

For convenience, the world has been divided into 24 zones, each running from North Pole to South Pole and 15 degrees of longitude wide. Each zone differs one whole hour in time from the next. In using the chart, the first thing to do is to find out in what zone you live by referring to the list above. It is suggested that you draw horizontal lines across the chart (*Continued on page 573*)

SOME PERTINENT INFORMATION ON

Short-Wave DX Reception

By W. H. Reeks*

Part One

NOW that short-wave broadcast stations are rapidly springing up all over the world and many of the largest manufacturers of radio receivers are putting on the market complete sets or adapters and converters for use in conjunction with standard receivers that can be satisfactorily operated by the average listener, the desire to "tune in on the world" has gripped the imagination of the radio public and is no longer confined only to those having a knowledge of the fundamentals of radio design.

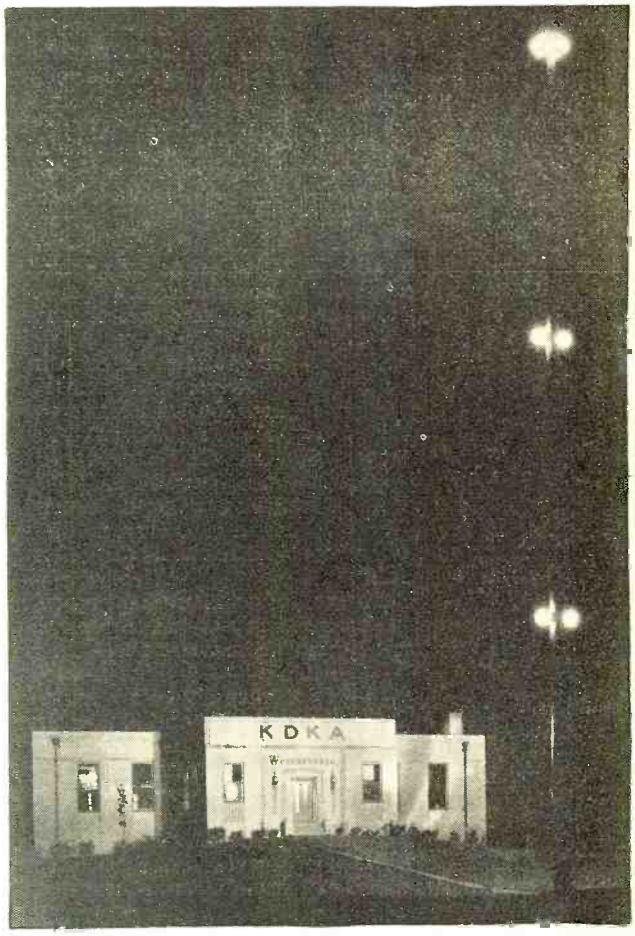
In many cases listeners have been led to believe that tuning in the short waves is merely a matter of twirling the dials and stations from every part of the globe come rolling in with local reception. Certain natural phenomena govern short-wave transmissions and subject them to various peculiarities. Distant stations that are heard during the day should not as a general rule be expected to be heard on the same frequency after darkness falls, those that are heard in the summer in many instances are not heard in the winter, and so on.

Listeners acustomed to DXing only on the regular broadcast band expect the best results after midnight. However, this is not necessarily the case on the short-wave spectrum and there is little possibility of DX under the present operating schedules of the distant stations for American listeners between the hours of midnight and about 5:00 a.m., as compared with the possibilities during the day and evening hours.

Various suggestions relating to the hours best suited for tuning on specified frequencies are offered from time to time. The theory has been advanced that best reception is obtained from distant stations operating on frequencies between 21,400 kc. and 15,800 kc. (13 to 19 m.) when daylight prevails at the receiving location, from those operating between 15,800 and 8570 kc. (19 to 35 m.) when dark at the transmitting location and light at the receiving location, and from those operating below 8570 kc. (above 35 m.) when total darkness prevails between transmitter and receiver. While this schedule holds true to some extent, definite conclusions cannot always be anticipated in actual practice.

EARLY TYPE SHORT-WAVE RECEIVER

This reproduction shows one of the first simple short-wave sets employing plug-in coils and capable of long-distance reception via earphones



KNOWN THE WORLD OVER

A night picture of a famous short-wave international transmitter showing the antenna mast which is luminescent with high-power discharge

Contrary to the generally accepted theory that stations transmitting on frequencies of 6250 to 6000 kc. (48 to 50 m.) are heard best while darkness prevails, particularly at the receiving end, Australians and New Zealanders hear American 48-50 m. stations in the morning and afternoon and report best signal strength at about 4:00 p.m., their time.

A paradox that has gained wide popularity among American short-wave listeners states distant foreign stations operating on frequencies of 12,000 kc. or higher (25 m. or less) cannot be heard satisfactorily after dark. That there is a pronounced effect of darkness on short waves is not to be disputed, and practically every American short-wave radio fan who has experienced the thrill of hearing the thunderous peals of Big Ben, the mighty chimes atop the houses of parliament in London, striking the midnight hour at 7:00 p.m. New York time and broadcast by G5SW in Chelmsford, England, on 11,750 kc. (25.53 m.), realizes that it is heard only at that period of the year when it is light at that hour in America and that it is unreasonable to expect to hear Big Ben over this station during the dark winter months. This is a most striking example of the effect of darkness on waves of 25 m. or less in length.

Although in general distant 12,000 kc. (25 m.) stations are not heard in America after darkness falls, nevertheless some interesting and exceptional results have been observed. At 1 a.m., June 17th, a station operating near this frequency in Hawaii was heard perfectly in Chicago. The time was given as 8:35 Honolulu Standard Time," which means that

* Foreign Correspondent, Chicago Short-Wave Radio Club.

darkness prevailed over practically the entire distance. A station in Rio de Janeiro on almost the same frequency has been heard perfectly in Chicago as late as 7:30 p.m. in March. In this case complete darkness prevailed over the entire distance.

The French Colonial station at Pontoise on 11,720 kc. (25.6 m.) has been heard in America regularly after dark, but by way of explanation it has been suggested that the reason for this phenomenon is due to the fact that the antenna is directed towards the French protectorates in Africa, causing the signal to pass the South Pole area, thence to America, maximum benefit of the effect of light being derived over this course at the time of year this phenomenal reception is reported.

According to the various results obtained in America, it has been concluded that it is more reasonable to expect a better signal on 12,000 kc. (25 m. band) after dark from the west than from another direction, considerably less signal strength from the south than from the west and a decidedly weaker, if any, signal from the east.

Of course, if a station uses directional or beam antennas or reflectors, the strength of the signal is affected, so this should also be taken into consideration. In cases where an antenna in Hawaii or Bermuda is directed towards Chicago, the Hawaiian or Bermuda station will in general be heard much better than the Californian or New York stations with whom they may be in contact, since in these cases the antennas in California or New York are usually directed away from Chicago; that is, towards Hawaii or Bermuda. Similar results are obtained in other cases, and, for example, telephony stations in Buenos Aires or Rio de Janeiro are often heard in Chicago much better than the New York end of the circuit.

While it is unusual for American listeners to hear distant stations operating on frequencies between 21,420 and 12,000 kc. (14 to 25 m.) after dark, it should not be concluded that it is absolutely impossible to hear them under certain conditions during the hours of darkness. In Africa, Australia and New Zealand, interception of transmissions on these frequencies after dark is not considered so phenomenal, as in those countries stations operating on frequencies ranging from 21,420 to 12,000 kc. (14 to 25 m.), located in Holland, Java, French Indo-China and Siam, are heard all night long.

It is quite evident that the location of the transmitter with respect to that of the receiver governs to a great extent what frequencies should be satisfactory for daylight reception and those that should be satisfactory for reception after dark.

So that those uninitiated to short-wave radio reception may more fully comprehend the various peculiarities and "exceptions to the rule" to contend with, it might be well to record here a few observations made in Chicago.

One morning in July, 1930, at about 7:00 a.m., a station in Australia was heard calling one in California. The Californian could not receive the transmissions from Australia, so communication was established through a station in New York, which relayed the signal to California. As time progressed the signal from Australia diminished in strength in Chicago and New York, but became audible in California, so that contact was made direct. Gradually the signal faded out completely in the Eastern States but steadily improved in the Western States. This is a typical example of what takes place in short-wave radio transmission and is the result of "skip-distance," the wave passing over one location, refracted by the Kennelly-Heaviside layer and received in a more remote location.

The phenomenon displayed by short waves in overcoming the curvature of the earth's surface was hypothetically explained by Kennelly and Heaviside, American and English scientists, as the result of a refracting or reflecting effect, and the existence of such a refractive medium having been definitely established, it became known as the Kennelly-Heaviside layer, more generally referred to as the Heaviside layer. It is imagined as an ionized region varying in height from fifty to five hundred miles above the earth's surface, and should not be thought of as a well-defined reflector but rather as a refracting medium, since radio waves, which differ from light waves only in length, are caused to be bent or refracted upon entering at an oblique angle a region of less electron density rather than deflected as though by a reflecting surface.

In short-wave transmission two waves are propagated, a ground wave that on the higher frequencies travels from thirty to fifty miles and a sky wave which travels skyward at an inclination and is refracted by the Heaviside layer, resulting in a skip-distance, which is the distance from the transmitter or the limit of the ground wave to the point where the refracted ray first returns to the earth. At a fixed layer height, skip-distance increases as the wavelength decreases and for a given wavelength the skip-distance increases as the layer rises. Since the earth's surface, particularly if wet, possesses reflective qualities, a radio wave after being refracted by the Heaviside layer may be reflected obliquely up again and again refracted.

Another typical example of skip-distance effect as observed from Chicago is to be found on the 12,000 kc. (25 m.) band. At certain hours W8XK in Pittsburgh, Pennsylvania, only 450 miles distant, is hardly audible or is not heard at all, while G5SW in England, I2RO in Italy and the French Colonial station at Pontoise may at the same hour be heard with perfect clarity and much volume.

The effects of skip-distance are equally applicable to other frequencies, and it is not uncommon to hear DJA, Zeesen, Germany, on 9560 kc. (31.38 m.) at an hour when W1XAZ in Springfield, Massachusetts, on 9570 kc. (31.36 m.), or W2XAF in Schenectady, New York, on 9530 kc. (31.48 m.), are barely audible. When local stations transmitting on the 6250-6120 kc. (48-49 m.) band are of poor volume and reception of them ruined by rapid fading, stations on practically the same frequencies located in South America may be coming through with excellent clarity and volume.

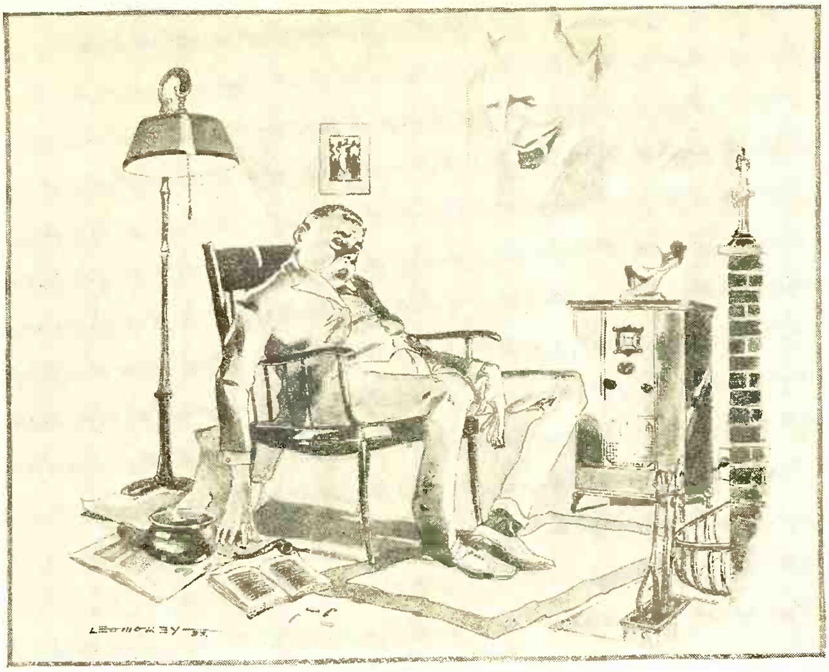
HEARD AROUND THE WORLD
Antennas of Radio-Barcelona, a station whose signals are known to many DX listeners

Listeners in Wellington, New Zealand, report poor reception of the broadcasts from VK2ME in Sydney, Australia, at an hour when Chicagoans are enjoying the best possible reception of the same program, the signal reaching New Zealand being distorted and "shaky" as the result of skip-distance and rapid fading.

Innumerable cases could be quoted wherein listeners in Chicago have intercepted with perfect results programs radiated by stations in Europe, Central and South America, Hawaii and other countries and intended for reception by receiving stations on the Atlantic and Pacific coasts of the United States for rebroadcast purposes, but which, due to skip-distance effects, were prevented being relayed or which were received so poorly as to cause the rebroadcast to be discontinued.

As has already been explained, the skip-distance effect depends upon the height of the ionized layer of air known as the Heaviside layer, and as the height varies, the signal strength varies. A great change may take place in an amazingly short period of time, as may be realized by a somewhat unusual example. One listener called another by telephone for the purpose of passing on the information that EAQ in Spain was transmitting a musical program for American listeners on 9870 kc. (30.4 m.) and coming in with tremendous volume. The listener called lost no time in tuning for the station, but it was only with difficulty that he located it, though the exact spot on the dial for that frequency was known. He later expressed surprise that they should have experienced such unlike results, but it developed that the first listener also had difficulty in again locating the station after returning to his set, so weak had the signal strength become during the few minutes intermission at the telephone.

The Heaviside layer may vary slowly in height and cause a slow disappearing and reappearing of (*Continued on page 574*)



SOME DX!!!

By J. E. Devenish

WE finished wiring up the set about six months ago. It was getting on towards 10 o'clock and my son Junior had hooked the set up and was giving the circuit the final check before putting it into operation. Just as I started warming up the tubes and turning the dial, he interrupted me with, "Look here, we have one wire connected wrong." However, as I turned the knob over a seemingly silent dial, I passed a clear but faint voice. "Funny," I thought. "I heard a voice even with the circuit connected wrong." I finally tuned it in, and there was a surprisingly vibrant and penetrating orator holding forth at great length.

"That's a funny one, way up there at the top of the dial," said Junior. "What language is that?"

"French," I replied. "Do you know what station it could be?"

"I don't know," he replied. "There is no station listed in the call book on such a long wave as this."

At this point I requested silence. The "Frenchman" was telling a story, and it was not the kind of story one expects to hear over the ether. As a matter of fact, I had heard the anecdote many years ago in one of the old-time Parisian cabarets. Recalling the rapidly approaching and sensational climax, I sent Junior off to bed. According to his school reports, the lad is no linguist, but the point of that story was so obvious as to be comprehensible to a deaf mute.

After Junior had retired I feverishly turned on the set and listened again to the voice of the French diseur. Evidently he had just arrived at the climax of another joke, for there were howls and roars of laughter and cackling of a remarkably queer nature. Finally there was silence, and the next voice that spoke was in English, telling one about the stock broker's daughter. I listened with growing amazement.

As the anecdote finished there was another guffaw of hoarse laughter, and at once a perfect babel of tongues broke out. Scraps of conversation in German and Italian, besides French and English and other unknown dialects floated from the loudspeaker.

What station was it? What were they broadcasting? Why so many languages? Why was it this station came through with a mistake in the hook-up of the receiver that would not get any other station? There were a dozen questions for which I could think of no reasonable answers.

No station signal or announcer's voice came to enlighten me, and always there was this queer jumble of tongues interspersed with sudden howls of laughter. After a while the Frenchman, who had been entertaining earlier, made his voice heard above the uproar and told another story as before. It was greeted with appreciative roars and the muffled pandemonium of a strange cosmopolitan nature continued.

Then there was a sudden hush, and a singer, whom I immediately recognized as "Uncle Henry," popular on many local stations a few years ago, sang. He was not announced and there was no mention made of his name, yet I was convinced that it was "Uncle Henry's" voice that was making the loudspeaker rattle.

Anyone who has heard him sing "In Cellar Cool" is unlikely to forget the experience. It was that kind of a man's man voice and, incidentally, if you have ever seen him, he was the kind of man that goes with that kind of voice—six-foot-three in his socks, and very much his own master.

His program went over very well indeed, and he must have been gratified with his reception. As he finished I heard a remark which I will remember all my life and which always leaves me in a welter of speculative thought.

"I say," a bored and plaintive voice was heard, "it's awfully hot down here, don't you think?"

At the time this gave me a clue. It must be a smoking concert. I could actually picture the whole scene. The hot, smoke-laden hall, the drinking, pipe-puffing men, the piano on the platform at the far end of the room. Undoubtedly that was it. But what station was it?

The theory was strengthened as other songs followed, some in English but mostly by foreigners. Now and then my old friend the Frenchman would tell another story, and once the whole gathering joined together in a chorus. The cosmopolitan nature of the company was extraordinary, for it sounded as though every nationality were represented.

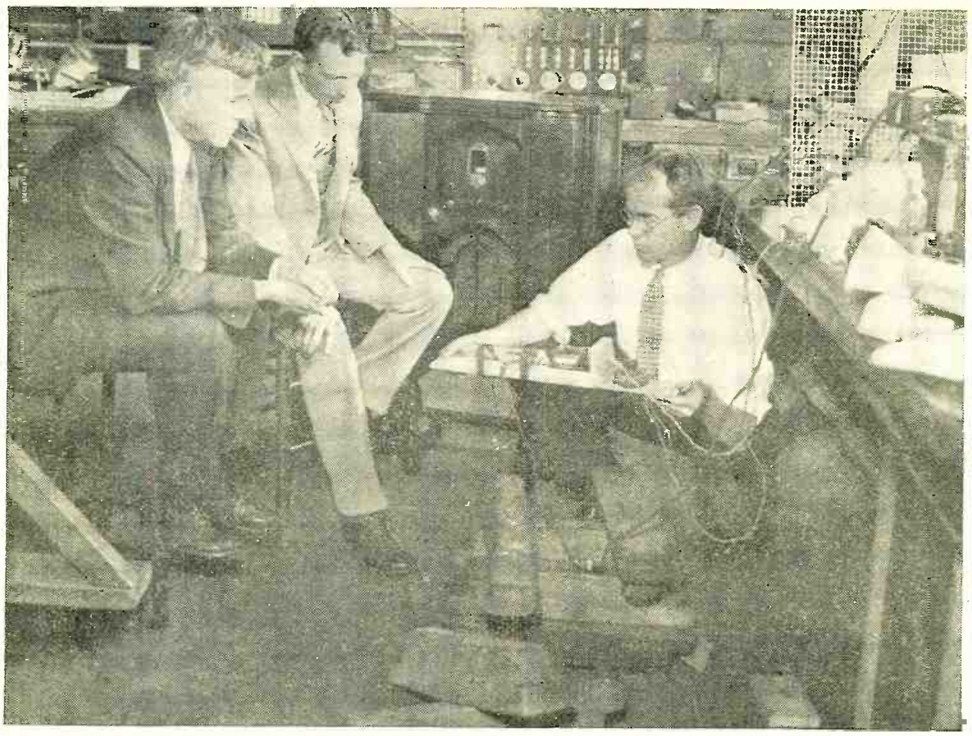
The end came abruptly at midnight. A singer stopped halfway through a verse and there came muffled shouts, hoarse voices and the shuffling of many feet as everyone made for the exits together. Then there was silence. The set was absolutely dead. I went to bed.

The next day, after a sleepless night, I went to see my friend Johnson. He was the man who, years ago, I knew had something to do with "Uncle Henry's" programs. He was greatly interested in my news.

"Uncle Henry!" he said, surprised. "Are you sure?"

"There isn't possibly another voice like his in the world," I replied.

"I hope not," he agreed. "Singing on the radio, eh? He is a remarkable chap. I could tell you some tales about him that you wouldn't believe. The last I heard of him he was off to Australia. In a bit of a hurry—between ourselves—some trouble with the authorities. I'll (*Continued on page* 566)



EQUIPMENT FOR MEASURING COSMIC RADIATION
Figure 3. The Geiger counter used in the experiments of General Electric physicists

SOME NEW USES FOR VACUUM TUBES IN THE ELECTRONIC ARTS

By Irving J. Saxl, Ph.D.

Part One

THE art of electrical measurement, through the application of vacuum-tube technique and allied electronic devices, is one of growing importance in the scientific world. Measurement of all kinds of electrical currents, no matter how minute, has spread through all the sciences, not only in pure researches, but now, more seriously, into everyday applications in medicine, biology, physics, as well as many other physical fields.

Today X-rays are being used as valuable factors in diagnosis as well as a purely therapeutic agent. In this latter use, the treatment of skin diseases, malignant cell growth, the question of X-ray dosage is extremely important. The medical profession has found that some of the older methods for determining dosage were not always reliable. We will discuss, therefore, a few of the electronic developments growing out of the use of vacuum tubes for measuring radiation and determining rates of various atomic processes.

For this purpose, let us start with X-rays. These are electric waves similar to light and radio waves, but of a much shorter wavelength. In looking at an X-ray photograph, we notice that only a part of the rays is transmitted through the object. Another part is absorbed, and it is just this fact—that parts of the rays are absorbed—which makes possible the outline of shadows of those objects which are opaque to the X-ray. It is one of the laws of physics that any energy absorbed does not disappear as such, but may be transformed into other forms of energy. In our case, where we deal with X-rays—extremely short wavelength—intra-atomic energies are released, molecules heretofore neutral being split up into electrically active parts. These new building stones of the molecule are therefore electrically charged—they are said to be "ionized." And the degree of ionization is proportionate to the intensity of the X-rays. It is a logical step, therefore, to determine the effect of the X-rays by the amount of ionization they give.

The therapeutic effect of absorbed X-rays is comparable to any other therapeutic agent—there is a tolerable dosage which *helps* the patient and there is a too-generous dosage which *destroys more than the diseased tissue that is harming the patient!*

Determining the Dosage of X-rays

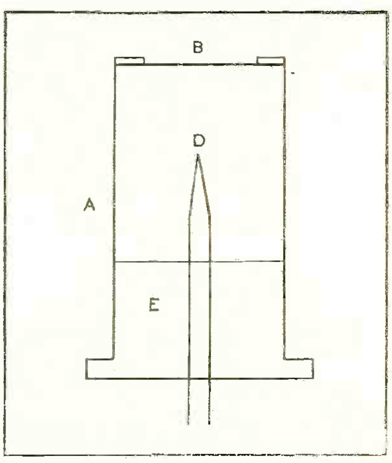
It is most important for the medical science, therefore, to find the exact dosage that helps the sufferer and to avoid over-dosage, which has its extremely dangerous effects.

Various attempts have been made to determine the dosage of X-rays. The decomposition of chemicals, their discoloration and many other methods have been used with varying success.

In investigating X-rays with the methods of the radio sciences, two ways can be taken. One is to determine the exact amount of radiation within a given interval. It is possible, for example, to measure the liberated ions (the ionization currents) in a given volume of air. But what we have to deal with are the minutest currents of electricity known today.

These currents, although of fundamental importance for the health and happiness of humanity, are much too small to be measured by any ordinary means known before the principles of the vacuum tube became well understood. The continuous record of individual electrical charges as necessary, for instance, in electron-counters, was made possible only

FIGURE 4. ELECTRONIC COUNTING CHAMBER



through the development of the advanced radio sciences.

One method for measuring ionization currents is to measure them over a limited time period and to multiply this over the total time interval. Various methods for determining the effects of X-rays within a given time have been developed, the simplest consisting of electrometers, usually of the quartz filament type, which are discharged under the influence of X-rays.

One of the latest instruments for measuring not only ionization currents, but even the impulses of single and separate ionization particles, as, for instance, alpha or H-rays, has been developed by Dr. L. F. Curtiss.*

Apparatus of this type is today of continually growing scientific interest. These smaller currents, often the indication of changes in matter, occur in many instances. For instance, it is just this type of smallest ionization current which is measured for investigating cosmic radiation. Feeble impulses, whether they may be considered as the birth "cries of matter" or as the indication of an old "disintegrating" system, come down to our earth in such a form of energy that the only means we have today for measuring them experimentally is to determine the amount of ionization they produce under various conditions.

It is extremely important that the feeble impulses entering the apparatus are amplified without distortion. It will be readily understood that in experiments where single changes of ionized materials are concerned, the smallest change in the resistance of any medium connected with the input will greatly effect the output, and it was therefore of particular importance when the input amplifier tube was developed, in which charges due to variation in the resistance could be minimized.

In the Curtiss tube (see Figure 1), used in the first amplification stage, high insulation has been achieved by carrying out the grid and the plate leads at opposite ends of the tube. In this type of construction the filament is in the center, between the grid and plate. The grid does not surround the filament as in the regular triode.

Figure 2 shows a wiring diagram of the Curtiss amplifier. The first tube is the special electrometer tube described before. The second, third and fourth tubes are screen-grid tubes of the –24 type. The fifth tube is an output tube of the –47 type.

Attempts have recently been made by engineers of the General Electric Co. to apply devices of this general type in an endeavor to learn more about this mysterious and most penetrating of all known radiation—cosmic rays. It is hoped that by studying these rays in this manner, some practical

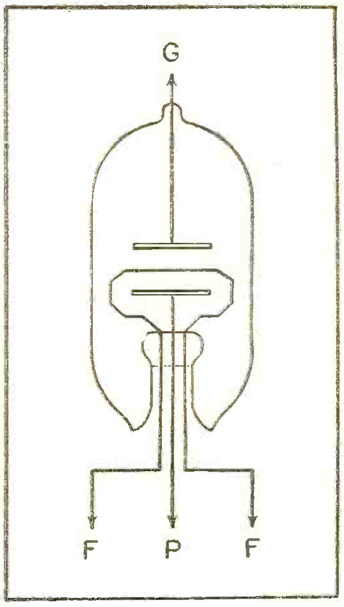


FIGURE 1. CURTISS INPUT TUBE

application can be found for their unique properties. In the present investigations, which are being made by Mr. Chester W. Rice, the Geiger-Muller type of counter is used as a detector.† This counter, which can measure ionization currents produced under various influences, also that of beta rays, consists physically of the following: as shown in Figure 4, A is a metal tubing, approximating one inch in diameter. One end of it is closed by a cover, B; on the other end a hard rubber cover, E, is attached, through which a wire, D, is carried within the tubing. The tubing, A, is connected to the positive side of a high-potential battery, while the wire, D, is connected to the electrometer.

It depends upon the materials used for chamber A and the opening B, respectively, whether this counter is particularly designed for the measurement of alpha or beta particles, X-rays, cosmic rays, etc. The technical design, the shielding of the apparatus, for instance, by lead, follows the purpose for which the counter is to be used. Further data for this are given by Kovarik and Kolhörster.‡

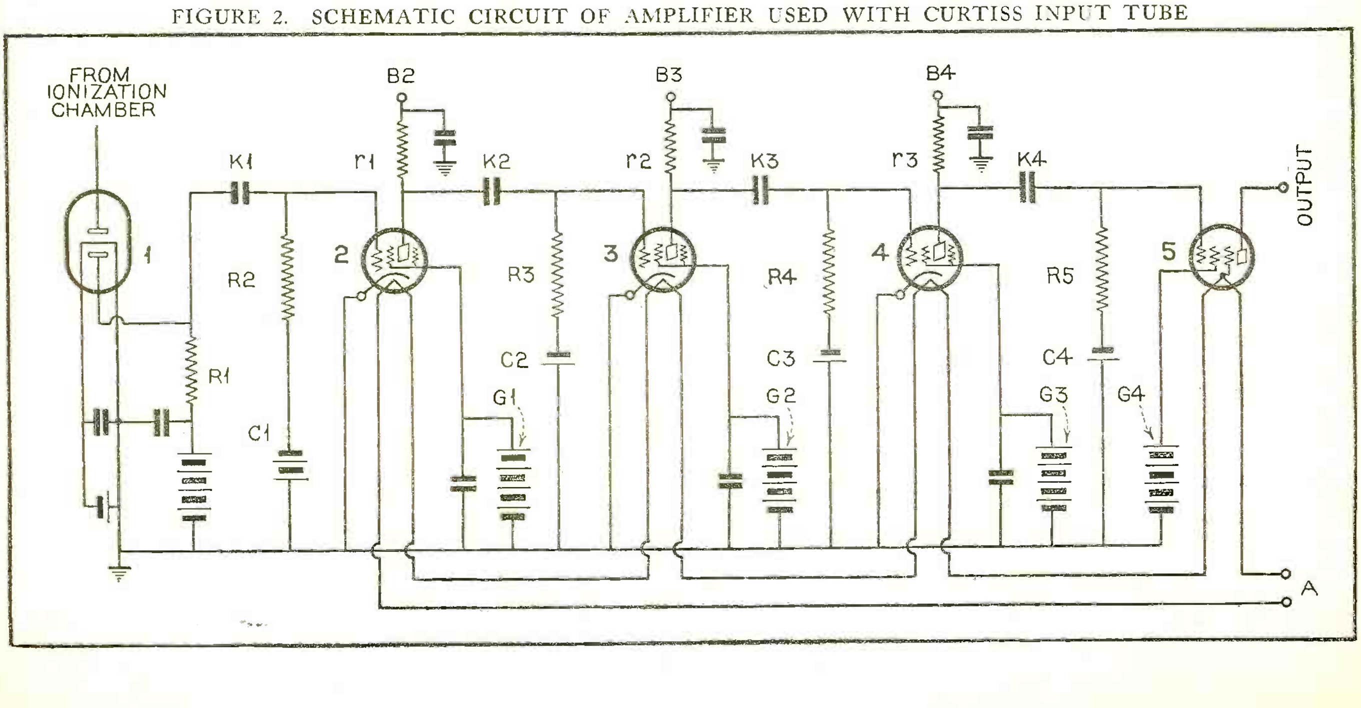
In the investigations mentioned above, the counter tube consists of a small nickel cylinder with a fine tungsten wire stretched along the axis, all enclosed in a glass tubing at reduced gas pressure.

As the rays pass into the space between the wire and cylinder, they initiate corona discharges, and the resulting separate electrical impulses are fed into an amplifier and then to the loudspeaker so that they can be plainly heard as distinct clicks. In series with the speaker is a small relay which is also actuated by the impulses, making possible an accurate count of the bombardment. With this small detector cylinder, which is about two inches long and three-quarters of an inch in diameter, the cosmic ray count is reported to be approximately eight per minute.

To make relatively certain that only cosmic rays are received, the detector is *shielded by a lead housing four inches thick.* This is sufficient to keep out the effects of all known radio-active materials. The lead bars used for the shield in the experiment can be seen at the bottom of Figure 3.

"An interesting result which has been obtained from our study of Geiger-Muller counters is that the count is not directly proportional to the intensity of radiation falling on the counter," Mr. Rice explained. At least, this appears to be true in the case of the gamma ray radiation obtained from radium after pasisng through three-quarters of an inch of lead. If the same result applies to cosmic rays, it means that data obtained by the use of (*Continued on page* 572)

FIGURE 2. SCHEMATIC CIRCUIT OF AMPLIFIER USED WITH CURTISS INPUT TUBE



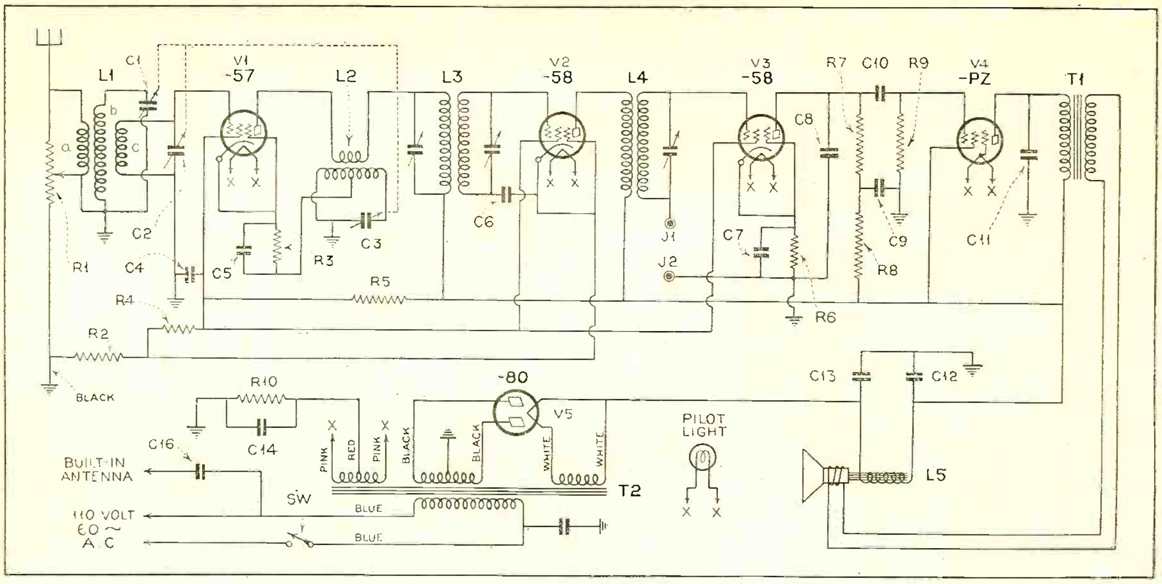


FIGURE 1. THE SCHEMATIC WIRING DIAGRAM

How to Build

THE JUNIOR DX'ER

This five-tube midget superheterodyne is easily constructed following the directions given in this article. As a home receiver its performance is thoroughly satisfying and it holds a surprise in store for the DX fan

By Hubert L. Short*

IN a five-tube (including rectifier) midget superheterodyne one does not ordinarily expect a marked degree of sensitivity, and even if the sensitivity is there, one hardly hopes for sufficient selectivity to permit any real DX work while local stations are on the air. The receiver described here, however, has definitely proven its ability to bring in innumerable distant stations on the broadcast band right through the heart of the evening while local stations are going full swing.

The Junior DX'er was submitted to the RADIO NEWS Laboratory for test, and although the laboratory location is an extremely poor one for out-of-town reception, the receiver proved capable of bringing in stations up to 200 miles distant in the middle of the afternoon and with satisfactory loudspeaker volume. Subsequent tests in the evening in another location produced signals on practically every degree of the dial, the resulting log covering substantially every section of the United States.

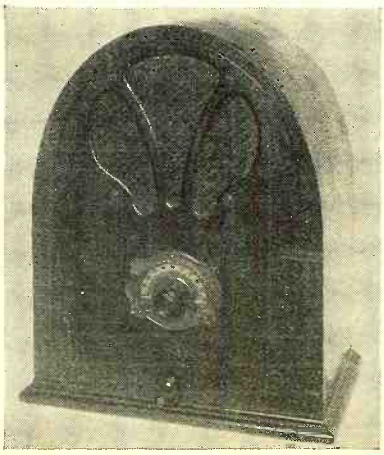
The rather surprising sensitivity of the receiver is accounted for by the care exercised in its design and in the use of the newest types of pentodes throughout. An unusual feature that very largely accounts for the excellent selectivity is the dual-tuned preselector circuit employed.

This emphasis on the sensitivity and selectivity of this little receiver should not be taken as indicating that these are the only features it offers. The power detection, with the power pentode resistance-coupled to this detector, operate to provide most pleasing tone quality which is adequately maintained by the dynamic speaker employed. On the whole, the receiver is such that its performance should satisfy experienced radio fans, yet it is one which will present no constructional difficulties to the merest novice—a fact which will be confirmed by a glance at the wiring diagram and the photographs. Last, but by no means least, the entire kit, including parts, chassis, tubes, speaker and cabinet, cost well under $25.00.

The circuit of the receiver has been designed for high efficiency, economy of parts and tubes, and maximum simplicity. One of the new −57 pentodes is used as a combined first detector and oscillator. In this arrangement, the control grid is connected in the usual manner to a tuned circuit, with a preselector (band-pass selector), L1, ahead of it to provide the necessary selectivity. The primary of the oscillator coil, L2, is in series in the plate circuit, so that the tuned secondary of this coil is magnetically coupled to the plate circuit. This tuned oscillator circuit determines the frequency of the generated oscillations, these being 175 kc. higher than the frequency of the incoming signal. The tuned primary circuit of the first i.f. transformer, L3, is also in series in the plate circuit.

THE FINISHED RECEIVER

As shown here, the chassis and speaker are mounted in a midget cabinet available for the purpose. The cabinet dimensions are 15 inches high by 12 inches wide by 7½ inches deep



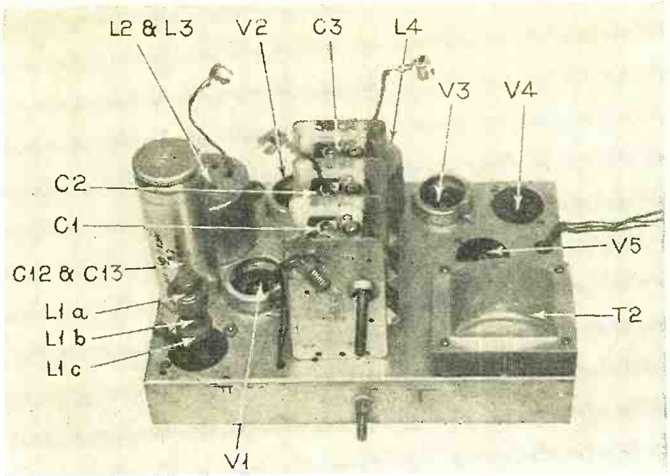
Single-dial control is accomplished through the use of a three-gang, .000365 mfd. (each section) variable condenser. Two sections of this condenser are in the circuits of the signal-frequency band selector. The remaining section tunes the oscillator circuit.

The volume-control potentiometer, R1, performs the dual function of increasing the control grid bias on V2 and grounding the antenna—that is, when reducing volume—and vice versa. This ingenious type of volume control is smooth and even.

The i.f. transformers, L3 and L4, are peaked at 175 kc. The single i.f. stage uses a type −58 variable-mu pentode which effectively reduces cross-modulation

*Chief Engineer, Wholesale Radio Service.

and modulation distortion. A –57 type pentode tube is used as the second detector. Power detection is employed. This tube is resistively coupled to the output pentode (type –47), thus insuring tone fidelity. A 50,000-ohm resistor in the cathode circuit provides the proper detector bias. Phonograph jacks are provided at J1 and J2. These are ordinarily shorted by a small piece of bus-bar wire which is removed when the audio portion of the receiver is to be used in conjunction with a phonograph pick-up.



THE CHASSIS

This is the way the chassis appears upon completion. Tubes and shields have been removed to more clearly show the layout of the various parts

A single power transformer, T2, furnishes the high voltage for the rectifier tube plates, the 5-volt rectifier filament voltage and also a filament voltage of 2.5 volts for the four pentodes. Due to the fact that the two –57 tubes and the –58 tube are of the cathode type, whereas the –47 tube is of the direct-heater type, it is possible to use a single filament winding to supply all four tubes. In other words, the negative bias voltage on the –47 tube does not affect the other three cathode heater tubes.

The 1800-ohm speaker field, L5, takes the place of an audio choke. Combined with the two electrolytic condensers C12 and C13, it acts as an adequate filter system. The output transformer T1, with 7000-ohm impedance primary to match the –47 tube, is an integral part of the dynamic speaker. The "on-off" switch, SW, is controlled by the same knob as the volume-control potentiometer, R1.

The complete receiver is housed in a shaded two-tone cabinet, finished in American walnut. An illumined full-vision dial is used. The cabinet houses not only the receiver, but also a high-quality midget dynamic speaker which gives lifelike, full-rounded tones. In addition, there is provision for using the a.c. line as the antenna instead of outdoor or indoor aerial.

Constructional Directions

First, mount the five sockets and the special preselector mounting socket, as shown in the top view illustration. In mounting sockets V1, V2 and V3, fasten shield bases at the same time. Next mount the three-gang condenser about ¾ inch back from the edge of the chassis. The power transformer is mounted as shown at T2.

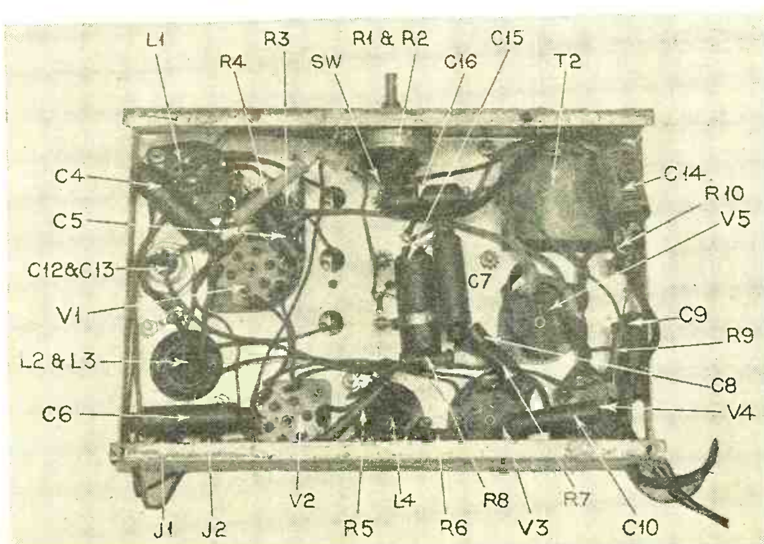
The dual electrolytic condenser is mounted in an inverted position. Then the combination oscillator, the first i.f. transformer and the second i.f. transformer are fastened in place. Finally the preselector is mounted.

The combined volume control and switch is mounted at the front chassis wall. The twin jacks are mounted at the rear of the chassis.

The chassis is now turned upside down and condenser C15 is fastened to the bottom by means of a small strap. All other parts on the underside of the chassis are soldered in place during the process of wiring, in most cases being soldered to the terminal of the particular tube socket with which they function.

THE WIRING VIEW

This view will afford considerable information which will be helpful in assembling and wiring this Junior DXer



Starting with the wiring, the filament circuits of the four pentodes are wired in first. These are all in parallel across the two heavy pink wires of the power supply transformer. The pilot light is wired in at this time to the same filament line. This light is fastened to the top of the three-gang condenser. The filament of the rectifier tube may be wired in next, to the two heavy white wires of the power transformer. The rectifier plates are then connected to the two thin black wires coming out of the transformer on the same side as the heavy pink wires.

Leaving the power supply circuit for the time being, the preselector is now wired in. The top coil is the primary and this is wired to the antenna and volume control at one end and to the ground at the other. The coil close to this is the first tuned secondary. This is wired to condenser C1. The coil at the bottom, separated by ¾ inch from the others, is the second tuned circuit. This is wired to condenser section C2.

The grid circuits are wired next, then plate circuits, then cathodes, negative returns and by-pass condensers. In wiring in the combined oscillator and first i.f. coil, the following color code is to be followed: Yellow goes from the center-tap to R3. Red is the wire from the bottom of the i.f. primary to B plus. Black goes to ground. Blue goes to the stator of C3. Green goes from the end of L2 to the plate of V1. The green wire at the top goes from the top of the i.f. secondary to the grid of V2. The other connection is already made within the case.

The wiring of L4 is equally simple. Yellow connects from the secondary to J1. Blue from the primary to the plate of V2. Red from the primary to B plus. Black goes to ground. The green wire coming out of the top goes from the secondary to the grid of V3.

The speaker leads are wired in as shown. Only three wires go from the chassis to the speaker. The two electrolytic condensers C12 and C13 shunt either side of the speaker field. Finally, the primary of the power transformer is wired in series with the switch on the volume control. Condensers C15 and C16 are wired in at this time. This completes the wiring.

In testing and adjusting the set, the first step is to peak the intermediate-frequency transformers to 175 kc. The first i.f. transformer has two tuned circuits, whereas the second transformer only has a tuned secondary. An oscillator may be used, although it is possible to make this adjustment on a broadcast signal.

The next step is to balance the three equalizing condensers on the three-gang tuning condenser. This adjustment should be made first on a station at the lower end of the dial and then on one at the upper end.

To use the receiver with the "built-in" antenna, connect the brown spotted wire to the blue antenna wire. (*Cont'd on page* 567)

A Few Hints On

R. F. AMPLIFIERS

FOR AMATEUR TRANSMITTERS

The author, owner and operator of the well-known amateur station, W2BRB, outlines some useful methods for setting the r.f. oscillator and amplifier circuits into efficient and stable working order

By Edward M. Glaser

ANY modern transmitter contains at least one stage of r.f. amplification—the power amplifier—following some type of master oscillator, either crystal or self-controlled. The better transmitters (especially in phone work, where it is very advisable) use a buffer amplifier between the oscillator and power amplifier to prevent frequency variation due to a varying load on the oscillator. The buffer stage also permits the oscillator to be run at a light load, which is a particular advantage when using crystal control, as the temperature rise of the crystal with its consequent frequency drift will be reduced. Where high power is used, an additional stage may be necessary to bring the r.f. voltage up to a proper level for exciting the power stage. These are all straight r.f. amplifiers which are called upon to amplify not only r.f. voltage but also r.f. power. Unlike audio (Class A) amplifiers, the r.f. (Class B) amplifier grid draws current and, therefore, takes power to excite it.

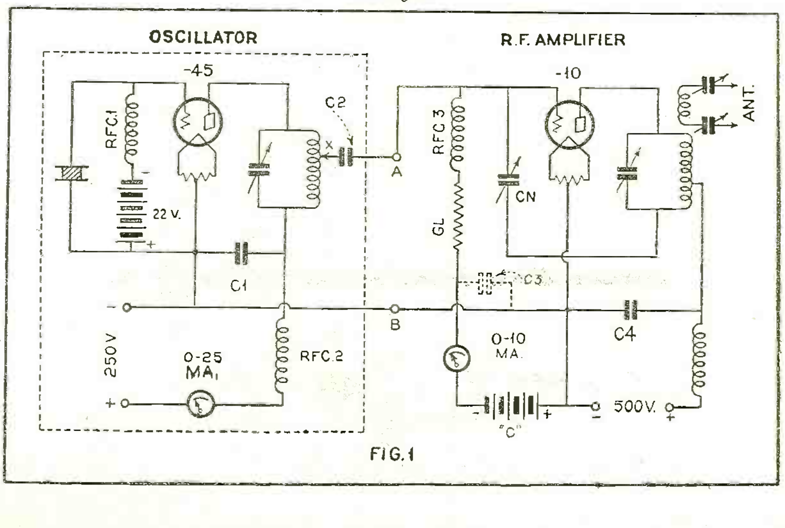
Straight r.f. amplification of one frequency in transmitters has a great deal in common with r.f. amplification in receivers. Each stage must be neutralized unless screen-grid tubes are used, and even then it is sometimes desirable to neutralize the control grid-plate capacity to improve stability. When improperly neutralized or not carefully designed, the amplifier stages are inclined to oscillate, exactly as in receivers. This must be carefully guarded against, for when an amplifier oscillates it is usually on some frequency other than that of the master oscillator—and it is a very serious offense for a transmitter to be off its assigned frequency. The first part of this article will be devoted to straight amplifiers which operate on the same frequency as the stage feeding them. A later part of this article will be given over to amplifiers which amplify at some harmonic of the stage which feeds them (frequency multipliers).

Tubes used as radio-frequency amplifiers are usually operated as Class B stages. This type of amplifier operates with a high grid bias such that, when there is no excitation, the plate current is practically zero. The reason for using Class B amplifiers in place of the more familiar Class A or audio amplifiers is that the efficiency of a Class A amplifier is only around 15%, while 80 to 85% efficiency is obtainable from a Class B stage.

For efficient operation with normal output, it is imperative that the amplifier be given sufficient excitation from the preceding stage. Screen-grid and pentode tubes require somewhat less r.f. power to operate them than do the more familiar triodes and are, therefore, to be preferred. For the present we will consider the operation of r.f. amplifiers from the theoretical viewpoint, to become familiar with some of the working

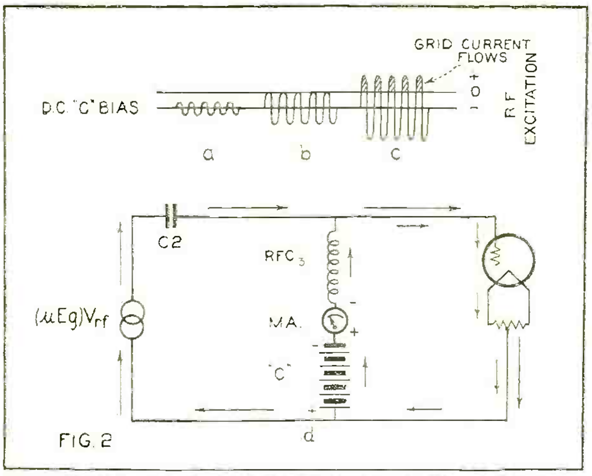
OSCILLATOR AND AMPLIFIER CIRCUITS

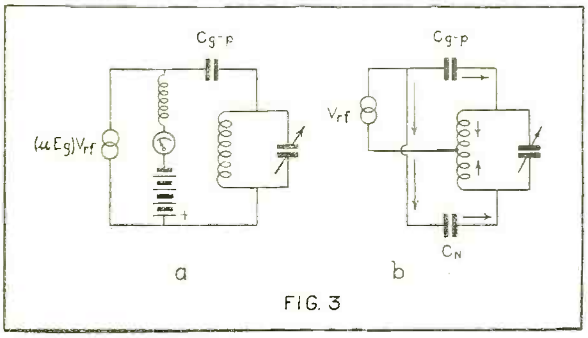
Figure 1. Schematic wiring diagram of the oscillator shown within the dotted line shield at left and the r.f. amplifier and output circuit shown at right



tools of the engineer and experimenter and to be "all set" to find out the whys and the wherefores of the practical arrangements that follow. For the beginner or the non-technical amateur or experimenter, read the following discussion through carefully.

Let us first consult Figure 1, where, for the purpose of discussion, we will consider the simple transmitter consisting of a type -45 crystal oscillator feeding a type -10 power amplifier—a very reasonable low-power arrangement. The r.f. output from the oscillator is fed through the coupling condenser, C2, via the feeders A and B to the input circuit of our amplifier. This constitutes a shunt-feed arrangement where the choke, RFC3, has practically the entire r.f. input voltage across it. This choke, therefore, must be a good one, or some of the precious input voltage will be shunted into the "C" battery circuit, which, besides being a loss, may cause a great deal of trouble by being coupled into other circuits, especially where the same source of grid bias is used for other tubes as well. As a precaution, we could add a mica by-pass condenser (C3) to offer a low-impedance path to filament to any radio-frequency currents getting through the choke, thereby keeping it from the source of "C" supply. If, on adding this condenser, a change in plate or grid current resulted, it would prove that RFC3 was *not* an effective choke. If, on the other hand, no change of any kind was noticed, the chances are that the choke is O.K. Unforeseen troubles, such as this type of feedback, often make it difficult—and sometimes make it impossible—to neutralize the amplifier. This is fortunate, for a disease with clear symptoms is the easiest to diagnose—and cure! But let us continue our story about the grid or input circuit of the amplifier. Note, in Figure 1, the grid milliammeter which is connected in series with the "C" battery.





EXAMPLES OF OPERATION

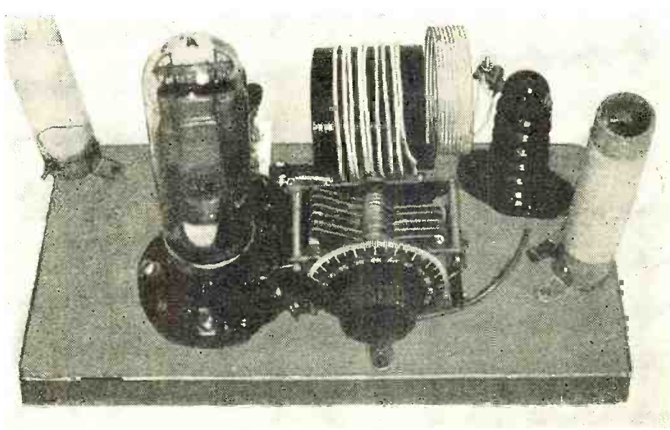
Figure 2. This illustrates the flow of grid current that occurs when the r.f. grid excitation exceeds the C bias. Figure 3 shows at (a) how the tank circuit is coupled to the oscillator and at (b) the neutralizing condenser and split-coil balancing circuit

Use of the Grid Milliammeter

This meter is a valuable indicator, for when the amplifier and the oscillator are turned on, the meter will indicate relative values of exciting voltage. In other words, it will act as an r.f. voltmeter and will be very useful in neutralizing the amplifier and in getting optimum output from the oscillator. The unidirectional current that operates this d.c. milliammeter comes from the r.f. exciting voltage which is rectified by the grid of the amplifier. In other words, the meter reads "rectified r.f. current." This is one of the most important points that must be grasped if one is to really understand the operation of r.f. amplifiers. In view of this, let us pause a moment to consider the various parts of Figure 2. As we are considering Class B amplifiers just now, no plate current is flowing (and, of course, no grid current) when there is no excitation. Let us turn on the oscillator and couple the amplifier very loosely. This will give us a very small exciting voltage which (a) is supposed to represent. A little plate current will now flow, but there will be no grid current, because we still have ample grid bias. (In order that appreciable grid current may flow, the grid must go positive—that is, the r.f. input voltage must exceed the "C" bias.) The curve (b) pictures the condition where the input voltage peaks are just equal to the bias voltage. This is the point at which grid current just begins to flow. With still closer coupling, we get the condition shown at (c), where the exciting voltage exceeds the "C" bias, and grid current flows during a small part of the cycle (shown shaded. Plate current flows during the entire half cycle). Now the grid, in drawing current from the exciting voltage, raises itself (from a d.c. standpoint) above the "C" bias potential so that, during that part of the cycle where the grid is positive with respect to the filament center-tap, pulses of current are sent into the "C" bias circuit. In other words, the grid actually charges the bias battery and the grid milliammeter reads the rate of charge! Maybe it will be more obvious if we picture it in another way, shown at (d). Let V_{rf} be our exciting voltage (it does not have to be a sine wave) which we will fed through the coupling condenser, C2, into our amplifier. When the "top side" of our r.f. generator is positive—as is shown—the grid will draw current if the peak voltage exceeds the grid bias. This current is pictured by the large arrows. None of this r.f. will be shunted into the "C" bias circuit, because the choke, RFC3, presents an infinite impedance to it. If any did get through the choke, the d.c. meter would not indicate it. Now, during that part of the cycle when the grid potential is higher than the "C" bias, a charging current will flow into the "C" battery as already stated. This current, which is represented by the small arrows, is that which the milliammeter records and is what we will refer to as the "grid current."

THE AMPLIFIER USED BY THE AUTHOR

This is an example of the type of r.f. amplifier circuits suitable for amateur work



It is now easy to see that, if we insert a resistance in the "C" circuit, there will be a voltage drop across it equal to RI (the resistance, in ohms, times the current, in amperes, through it). Such a resistor is called a "grid leak" and is included in Figure 1—marked GL. In installations where the "C" voltage is limited, it is economical and sensible to use a grid leak to help supply the bias. It is impossible, however, to get true Class B operation, with its consequent high efficiency, with a grid leak alone. Some "C" voltage must be supplied externally. When using a grid leak, however, the plate current will not drop to zero when the excitation is removed, because the resistor cannot contribute any bias when there is no current flowing through it! The question now comes up—how are we going to know when we

(*Continued on page* 565)

Design Principles of

Long-Distance Receivers

for the Broadcast Band

In DX receiver design there are certain important considerations dictated by common sense, but frequently overlooked. Some of these are discussed in detail in this article and one to follow next month. The author also gives some interesting facts concerning DX on the broadcast band, based on his own experience

By C. H. Long

Part One

IT was the fascination of hearing from a distance that was largely responsible for the almost magic growth of radio broadcasting in the years following the World War. To be sure, the distances were usually only a few hundred miles, but that was enough to grip the imagination. And one who could by dint of ingenuity or better equipment receive voices and music from greater distances than his neighbor was highly elated. There was an undeniable thrill in spanning distances few others could achieve. And what a thrill was his who was successful in hearing other countries—Canada, Mexico and so forth! But the greatest thrill of all was reserved for those very few who were successful in hearing other continents, lands so far away that it took months to receive an answer by mail. Then came short waves, with their remarkably high signal strengths from distant stations, and long distances were covered with even the simplest receiving equipment. But short waves are subject to rapid and destructive fading and other annoyances that take most of the enjoyment out of listening to weak signals in many instances.

Contrary to present general opinion, one need not confine his long-range DX listening to short waves, since, if he has a fair location and suitable equipment, *moderately consistent reception of overseas stations is possible on the broadcast waves.* In that case, the thrill of reception is ever so much greater—indeed, is quite as great as it was before the advent of short-wave broadcasting, and in addition one can more fully enjoy the programs for their own excellence. To illustrate, the author enjoys listening to VK2ME and VK3ME, whose signals come in with great strength here and little fading, but he listens to them only at such times as the Australian broadcast wave stations cannot be heard, as the latter's programs are much more interesting and the satisfaction of hearing them much greater. For the benefit of those who may be skeptical, it may be remarked in passing that the writer has received this season, most of them many times, 23 Australian, 10 Japanese, 1 Chinese and 4 New Zealand broadcast wave stations, a total of 38 stations, all distant 6000 miles or more, and, naturally, scores of distant stations nearer at hand, such as Hawaiian, Canadian, Mexican, Cuban and distant American stations. Others can do as well if they have suitable equipment and a fair location. Regarding the quality of reception, the stronger stations, such, for example, as 4QG, 2BL and 2YA (all of Australia), are received well enough under average good conditions, which may occur 15 to 20 times a month during cool weather, to permit enjoyment of their orchestras, plays, speeches and so forth. Some extracts from their letters of verification will answer the question as to how the smaller stations are received.

The following is an extract from 4BC's (Brisbane, Australia) letter of February 19th, 1932: *"We have to congratulate you most heartily on your most excellent reception of January 7th last, when you sent us a correct report of a period extending over an hour of the 4BC transmission of January 7th. . . . You will be surprised to know that at that moment our transmitting power was only 180 aerial watts."* And the following is an extract from 4TO's (Sydney, Australia) letter of February 22nd, 1932: *"I can only say how delighted we were to receive your letter, and it speaks volumes for the efficiency of your truly wonderful receiver. Allow me to congratulate you. As a matter of fact, the actual power of 4TO is only 150 watts in the aerial at the moment, modulated 80 to 100%."*

It is the aim of this article to lay down the principles applying to receiving apparatus, the application of which will yield the success so hard to attain (but so gratifying when attained) in ultra-long-distance reception on the broadcast waves. In addition, it will point out and discuss the principles governing the satisfactory reception of all feeble signals and in general applying to all wavelengths. These principles of reception, while pointing the way to success with the ultimate in DX, also obviously point the way to better results with all DX.

Location

First of all, let us consider the matter of location. A good location is undeniably a valuable asset. Naturally, the better the location, the better are the results that can be obtained. It is generally agreed that the best location is near the seacoast, particularly that coast nearest the country from which it is desired to receive. A location adjacent to some large body of water, such as one of the Great Lakes, offers the next best choice. Comparatively few are fortunate enough, however, to be so favorably located. Accordingly, the author wishes to stress the point that success can be attained in tuning in the Australian, New Zealand and other distant stations on the broadcast band even in any fair inland location, providing suitable equipment is used, as he has listened with success to these stations from several such locations far inland, never having been fortunate enough to have a better.

It must be remarked, however, that a very poor location will not yield the desired results in distance reception. Hence, where the radio enthusiast can exercise any choice, however limited, in the matter of location, the following hints may be helpful: Since the value of a location can seldom be fully determined without actual testing, a test should be made if possible. It may for convenience be made at midday on distant American stations from different directions. However, there are certain general principles by which one may be guided previous to or even in lieu of testing, where such is impractical.

The locality should be as free of natural static as possible. But one need not give up if his locality is not the best, as the author has secured satisfactory results as far south as central Texas, where the static is quite troublesome, having verified reception in a single season from 22 broadcast wave stations 6000 miles or more distant, and having received over 50 programs of one-half-hour duration or longer from a single station 2BL, Sydney, Australia.

It is highly important that the location be nearly free of man-made electrical interference during the periods when reception is desired; hence it should be as far removed as possible from high-voltage power lines, electrical motors and so forth. The preferred localities are, in the order named: country, outskirts of small town, suburbs of city. The author's results in Texas were obtained from the middle of the residence section of a town of about 2000, there being no high-power lines in the immediate vicinity. However, the step-down transformer for the house lines in the neighborhood was located about 175 feet away. If the co-operation of the local light company can be secured, existing interference can usually be traced to its source and considerably reduced upon application of the proper remedy.

A location on a hill is usually a little better than one in a depression. Finally, the location should be as free as possible of all absorbers such as trees, steel buildings, towers, and the like.

Strong Signal to First Tube

It is of fundamental importance when weak signals are being received that the greatest possible signal strength be applied to the grid of the first tube in the receiver, *regardless* of the number of tubes employed or the sensitivity of the set. This is a point that needs to be stressed, for it is frequently overlooked in one way or another. Unless the signal applied to the first tube has an output value definitely above that tube's noise level, it will not be heard, irrespective of succeeding amplification, which will serve only to amplify the first tube's and other noises. It must be remembered, too, that it is the operating noise level of the tube that must be considered, rather than its static level. The tube when receiving nothing may be nearly quiet, but it becomes noisy as soon as a signal is applied. Though the noise increases as the signal increases, fortunately it does not rise in direct proportion to the signal but roughly as its square root for small values. Hence, the stronger the signal applied to the first tube, the less troublesome becomes the tube's noise factor.

"Success can be obtained in tuning in the Australian, New Zealand and other distant stations on the broadcast band in any fair location, providing suitable equipment is used"

To obtain the strongest possible signal on the grid of the first tube, the following principles should be observed: First of all, the antenna and ground should be of the highest practical efficiency in order to insure good energy pick-up. The aerial-ground circuit should be of low resistance and should be tuned to the signal to be received. The latter may be accomplished by direct tuning with a coil and condenser, or more simply with a variometer, in this circuit. Or induced (impedance) tuning may be effected by coupling (generally inductive) of this circuit to the first tuning circuit in the receiver. It is to be remembered that the coupling *must* increase with increase in wavelength if the latter method is used. Either method is about equally efficient, with the former having perhaps a shade the advantage. In order to achieve convenience of tuning, it has become customary in the present-day receiver to dodge the issue of tuning the aerial-ground circuit, or meet it at some one point only of the tuning scale. As a result, receivers of this type have noise levels quite out of proportion to their sensitivities on most of the scale. The home experimenter can design his circuits to obviate this difficulty by providing for an additional sub-control. The commercial set can often be altered to overcome this difficulty without adding much to the inconvenience of tuning, but this work should be undertaken only by one with the necessary knowledge and experience.

The grid circuit of the first tube should be accurately tuned to the desired signal (or be part of a circuit tuned to the signal) and should be of the lowest possible resistance. The lower the resistance, the greater is the response to the signal. The signal response is also increased by keeping the inductance as high as practical with reference to the capacity of the circuit.

The coupling between the first tube's grid circuit and the aerial-ground circuit should be such as to secure the maximum practical transfer of energy. Hence, pre-selector circuits are undesirable at this point. Such circuits are quite satisfactory for the reception of all but weak signals, but, due to their inherent losses, diminish the energy applied to the grid of the first tube, and so are altogether unsuited to weak reception. It follows, therefore, that the receiver circuit tuning inductively the aerial-ground circuit should also be the grid circuit of the first tube. Should a variometer be used to tune the aerial-ground circuit (preferably in conjunction with a fixed series condenser), the voltage developed across it may, if desired, be applied directly to the first tube's grid; or this circuit may be coupled inductively (it must also be efficiently) to the grid circuit, which is tuned as usual with coil and condenser. If the antenna is quite long, the latter is the preferred method.

All tubes are not equally desirable for use as a first tube. In particular, the screen-grid tube has a slightly higher noise level than the three-element tube in proportion to the amplification secured. The three-element tubes best suited to this important position have been found by the author to be the -01A, the -12A and the -30. Some other battery triodes also give good results. A.C. tubes of all types are less desirable owing to their higher noise levels. On short waves, the three-element tube does not give sufficient amplification, and, therefore, the four and five-element tubes may with propriety be used; indeed, in this instance their use is recommended.

The first tube should be operated at as low a plate voltage as is consistent with good amplification, for the noise increases much more rapidly than the amplification when high plate voltages are used. Each type of tube and, indeed, each individual tube (individual variation not great, however), has a certain best operating point which may be found by experiment.

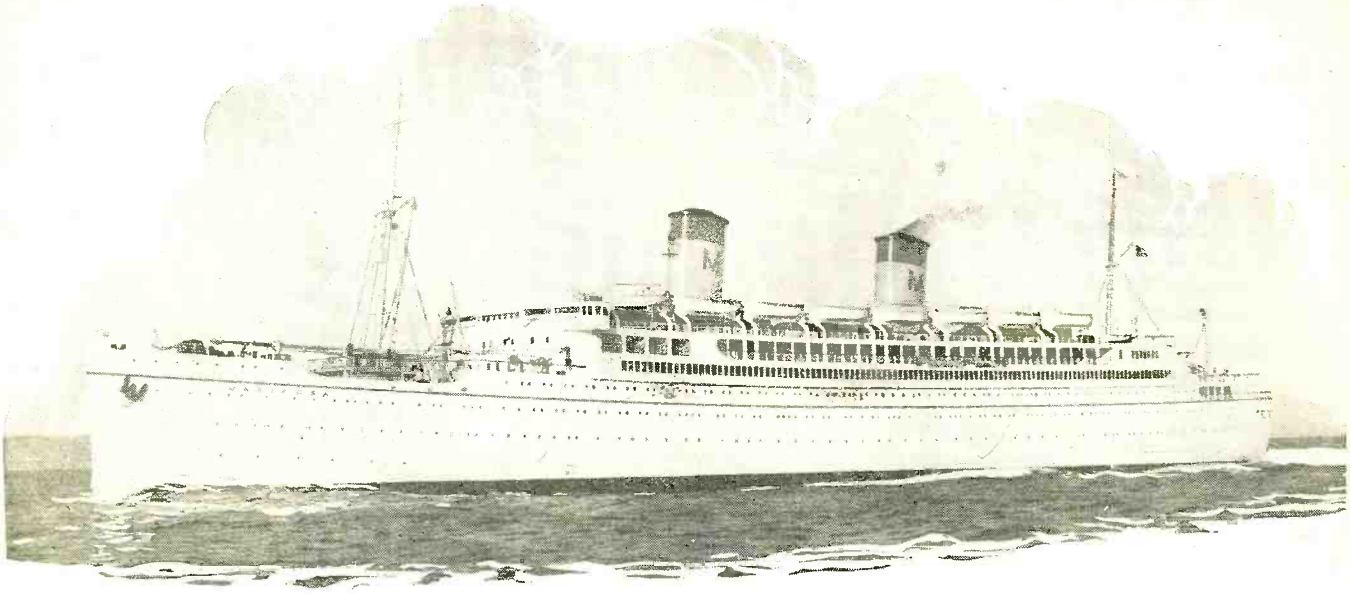
Aerial and Ground

It is clear from the preceding remarks regarding the application of the strongest possible signal to the grid of the first tube that the better the aerial and ground are, the better will be the results with feeble signals, due to the increased signal pick-up. The aerial should not be less than 20 feet in height (clear) and should preferably be 35 feet or even higher. An inverted "L" type single wire antenna has been found quite satisfactory, though a cage or multi-wire antenna is a slight improvement. A single-wire antenna of the "L" type should be at least 100 feet long on the flat top and can profitably be as long as 150 feet. The author is at present using such an aerial, 130 feet long, exclusive of lead-in (30 feet), and 35 feet high, for both broadcast and short waves. However, for very best results on short waves, a different antenna should be employed for each band. This type of aerial is slightly directive and should point away from the direction from which best reception is desired. For example, if it is desired to receive from the north, the aerial should be north and south, and the lead-in should be taken from the north end. However, if space is limited, proper height and length should not be sacrificed for direction, as the directive effect is ordinarily not great. The antenna should be so erected that it is in the clear and as far as possible from trees, metal roofs, buildings and all other obstructions, and should be well insulated and reasonably tightly stretched. The lead-in should be short and direct, clearing by a generous margin all walls, roofs and so forth, and should be part of the antenna itself or be securely soldered thereto with rosin solder. The author has not found buried aerials satisfactory for distance reception. It is advisable to use for the antenna the heaviest practical copper wire, stranded preferred, that has been enameled or otherwise treated to prevent corrosion. Two or three ordinary aerial wires twisted together offer a slight advantage over a single wire.

In order to keep the resistance of the aerial-ground circuit low, it is necessary to have a good ground as well as a good aerial. The ground should offer a short and direct connection to moist earth. Water piping offers a fair ground, but not the best. A *leaky* radiator, buried so that only the cap is exposed and kept filled with water, makes a good ground. The general principles to be observed are that the metal buried should be a good conductor, have as large a surface as possible, and be buried deep enough to make contact with moist earth.

The Receiver

In order to realize the full efficiency of a good aerial and ground and obtain really good results with the weak signals collected, it is absolutely necessary to employ a good receiver, and the better the receiver, the better the results will be. There is so much difference in receivers that, using the same antenna and ground, one receiver may receive a signal and render understandable all or most of (*Continued on page 565*)



LATEST DEVELOPMENTS IN EQUIPMENT FOR

MARINE RADIO

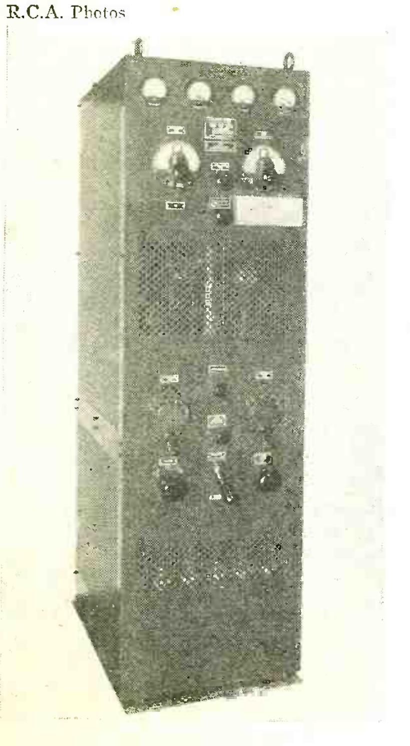
By Arthur K. Ransom

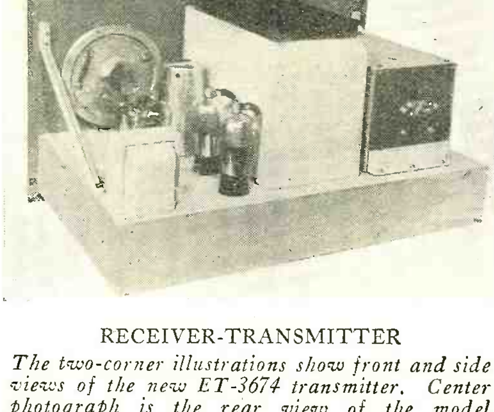
SAFETY and comfort for all aboard her were the all-important factors upon which the new *S.S. Mariposa's* owners and builders predicated their plans and decisions, and these ideals, coupled with the realization that the ship's scheduled itinerary requires her radio apparatus to span great distances and promptly dispatch ship's and passengers' messages over these distances (which may be anything up to 10,000 miles), these considerations were responsible for the selection of newest types of radio equipment to keep the *Mariposa* at all times in touch with the rest of the world.

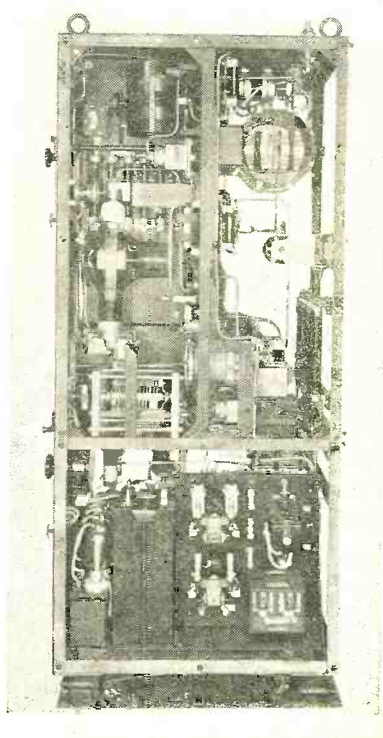
The steamer's new transmitter, type ET 3674, is a complete self-contained unit designed primarily for shipboard installation. Its small physical dimensions make it suitable for yachts where space is at a premium while its effective range of operation commend it to all users. Signalling is accomplished by keying (no voice modulation being provided) and communication may be carried on at either high or intermediate frequencies. Continuous waves or interrupted continuous waves are immediately available at the choice of the operator, the change being affected by a switch on the panel. Frequency is continuously variable within the band limits of 375 to 500 kilocycles and 5500 to 17,150 kilocycles. Nine tubes are used in the set, six of them (UX-866) being in the rectifier circuits, two others (U-860) as master and audio oscillators and the remaining one (UV-861) as power amplifier, which is a screen-grid tube and delivers 500 watts to the antenna system.

In shipboard installations many factors combine to make difficult the maintenance of output frequencies. By no means the least significant of these is the rolling of the ship itself, which heretofore has rendered operation at the higher frequencies almost impossible at times. In the ET-3674, operating frequencies are maintained by the master oscillator, which, however, is not coupled directly into the antenna circuit, but feeds its output to the control grid of the screen-grid, power-amplifier tube. By thus isolating the

R.C.A. Photos



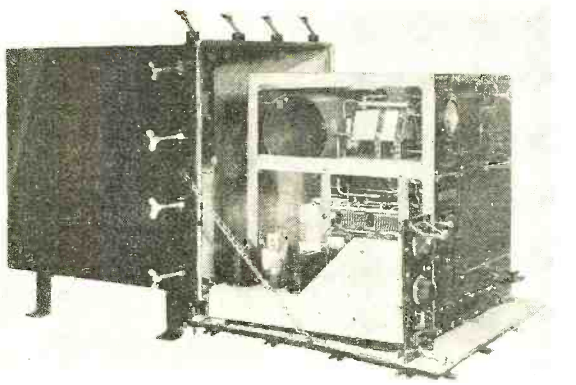




RECEIVER-TRANSMITTER

The two-corner illustrations show front and side views of the new ET-3674 transmitter. Center photograph is the rear view of the model AR-8500 receiver with the center coils, shown with the handle on top, in place two circuits, variation in the characteristics of the antenna leaves the frequency practically unaffected. Two complete and separate tuning systems are provided, one for high-frequency operation and the other for intermediate. The tubes and power supply are common to both circuits and are connected to either at the operator's control by means of a band-change switch located on the set panel.

The intermediate-frequency circuit is a series-fed Hartley, consisting of variometer and fixed tank-circuit condenser. The entire band is covered in one range on the tuning dial. Its power amplifier is a parallel-fed, radio-frequency type, excited from a tapped point on the master-oscillator tuning variometer, and the tuned tank circuit comprises a variometer, tank-circuit condenser and means for capacitatively coupling the antenna thereto. Both master-oscillator and power-amplifier variometers are gang tuned on a single control, while antenna tuning is accomplished by means of a tapped variometer. The coupling between power-amplifier tank and antenna circuits is done by an adjustable capacity.



LIFE-BOAT RADIO
View of the combined transmitter-receiver units removed from water-proof case

A Colpitts circuit, consisting of a variable inductance of the rotating-coil type and fixed condensers, is used as the master oscillator for the high-frequency band. The oscillator tuning control for this range is graduated in 1000 easily read divisions, permitting of the extremely fine adjustment necessary at the higher frequencies, and backlash is completely absent from the vernier gear train. The high-frequency power amplifier is of series-fed, radio-frequency type, receiving grid excitation from the capacitor leg of the master-oscillator tank circuit. Tuning of this circuit is by means of a rotating-coil variable inductance similar to that employed for the master oscillator. For frequencies below 10,000 kilocycles, a fixed tank-circuit condenser is used, but for the higher frequencies the inherent capacity of the power-amplifier tube itself is sufficient.

Operators, Attention!

IN line with the present policy of making this magazine helpful and useful to commercial radio operators, as well as the whole radio fraternity of landsmen, this article is the first of a series to be run describing the latest developments in commercial radio equipment. The Editors would like to hear from operators as to their reactions to this type of feature.

The antenna is voltage fed through a loading inductance and a variable coupling condenser. These adjustments, like all others necessary to the rapid operation of the set, are made by appropriate controls on the front of the panel.

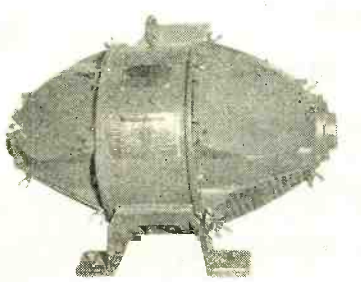
For interrupted continuous-wave signalling an audio oscillator or "howler," consisting of a UV-860 tube with an audio-frequency transformer and a tank-circuit condenser, is used. A 700-cycle note is produced and modulates the output wave.

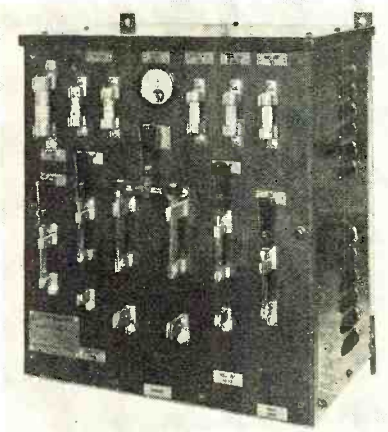
Power is supplied from a two-bearing rotary converter of ball-bearing type, operating from the ship's d.c. lines and delivering 60-cycle a.c. at 70 volts to the transformer primaries. All filaments are heated from separate secondary windings of one transformer. Plate potential is furnished by another transformer with a tapped primary for low, medium and full power. The secondary output of this transformer is passed through a three-phase, full-wave rectifier unit employing six mercury-vapor (866) tubes and delivering 3000 volts at 500 ma. to the plates of the tubes. By mounting the complete rectifier unit in the base of the set as an integral part of it, no high-voltage leads of any sort are to be found outside the set. All wiring not actually within the set is of a voltage no higher than the ship's mains. This is a positive advantage and removes many problems imposed by the use of high-voltage direct-current generators. Another advantage of this arrangement is that line voltage fluctuations, as great as plus or minus ten percent, do not interfere with satisfactory operation.

The transmitter is built up within a copper-plated angle-iron frame, sides, top and back being enclosed with perforated copper-plated sheet iron. The aluminum front panel is handsomely finished in black crystalline. Master oscillator, power amplifier and antenna circuits are located in separate compartments, shielded from each other. Tube access doors are in the front panel, and by means of an interlocking switch the high-voltage circuit is broken when a door is opened. The rectifier unit, together with time relays, contactors and the terminal board for external connections, occupy approximately the lower third of the frame. Just above them are the components of the high-frequency circuit; next, the tubes; and at top, the intermediate-frequency tuning assembly. The entire set is mounted on four semi-elliptical, automobile type springs at the base, and to prevent side sway, is secured to the deckhead with spiral springs and turnbuckles. If desired, a separate antenna may be used for each frequency band, but entirely satisfactory results are obtained when using the intermediate antenna for both bands. For break-in operation, a relay is provided in the intermediate-band circuit and a remotely operated "send-receive" switch for the low wavelengths, but aboard the *Mariposa* neither of these is in use, as a separate antenna for the receiver has been erected, permitting break-in reception at all times.

Remarkable results have been obtained with this equipment, and consistent, day-after-day communication at 5000 miles has been recorded to date.

As a fitting companion piece of equipment for the (*Continued on page* 566)



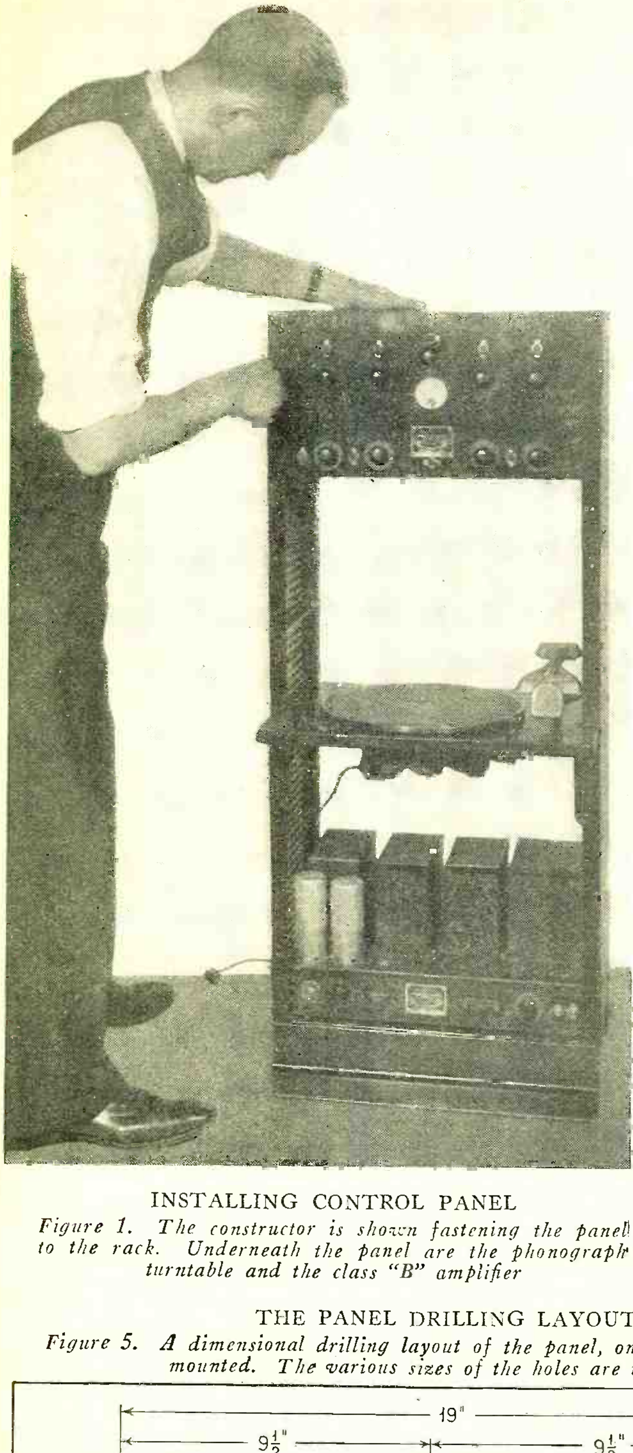


AUXILIARY EQUIPMENT
Control panel for the life-boat radio set, showing charging switches. Left: Rotary converter for the ET-3674 transmitter. Right: Storage battery rotary converter for life-boat equipment

How to Build A RACK *and* PANEL PUBLIC ADDRESS SYSTEM

***By* William C. Dorf**

Part Two



INSTALLING CONTROL PANEL

Figure 1. The constructor is shown fastening the panel to the rack. Underneath the panel are the phonograph turntable and the class "B" amplifier

THIS is the second of a series of three articles describing the construction and assembly of a rack-and-panel sound-reproducing system. It was pointed out in the first article, which appeared in the February issue, that a complete public-address system of this type, with a Class B Amplifier, a dual-speed combination phonograph turntable, a pick-up of improved design, a very effective control panel and a seven-tube superheterodyne radio tuner, was sure to find favor with the radio dealer, individual serviceman and the radio experimenter.

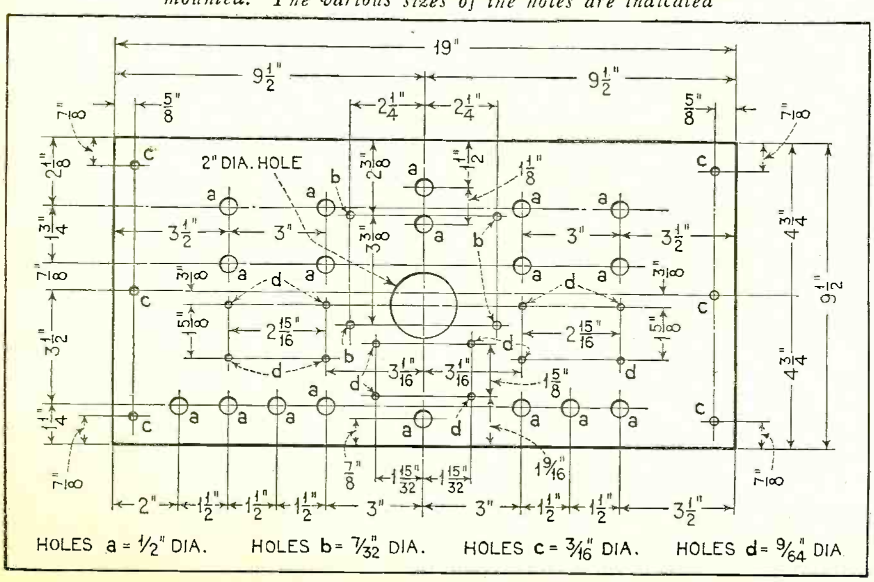
This rack-and-panel public address system has particular interest to the dealer and serviceman for profitable returns by making complete installations in schools, public halls and for sound-truck work. The overall measurements of the rack are only 10 inches deep by 19 inches wide by 45 inches high; therefore it is easily transportable and makes very desirable public-address equipment for renting to public meetings and to the numerous occasions to which it is adapted.

The equipment also has wide appeal to the radio experimenter for his own personal use, as it is especially suitable for the enhancement of large home parties, dances, etc.

The initial article in the February issue gave complete details of the construction and assembly of the rack, installation of the Class B amplifier and the construction of the mounting board for the phonograph motor, turntable and electrical pick-up. The first article, as well as the present and the succeeding article, contain dimensional and schematic wiring diagrams, a parts list, and each illustration on the particular job at hand will show the parts symbol wherever possible.

THE PANEL DRILLING LAYOUT

Figure 5. A dimensional drilling layout of the panel, on which all parts are mounted. The various sizes of the holes are indicated



The six-tube Class B audio amplifier employed in this system is capable of delivering 20 to 26 watts undistorted output power. As explained in the previous article, the constructional details on the amplifier were outlined by Mr. Leon Littman in the December, 1932, issue of RADIO NEWS.

This article will confine itself to the construction, installation and operation of the mixing panel. The wiring is not at all complicated, as the constructor will notice by referring to the wiring diagram in Figure 2. The illustration in Figure 4 shows the input microphone receptacles and twin jacks which make for simple and easy connection to the microphones and the phonograph pick-ups.

Before going into constructional or operating details, it will be appropriate to state here what this control or mixing panel is capable of accomplishing. It centralizes all controls, therefore permitting easy, quick and complete control of any one of the input circuits into the amplifier. It permits matched coupling to the amplifier of one or two phonograph pick-ups, one or two double-button carbon microphones, one to four single-button carbon microphones, or, if desired, one to four condenser type microphones. The mixing panel has been so designed that speech or music can be superimposed over phonograph or radio reproduction. It is equipped with a fader control which permits the fading of the reproduction from pick-up No. 1 into pick-up No. 2, and vice versa. This fading feature permits the change-over from one record to another without interruption.

The panel is equipped with a separate volume control in the output of each microphone circuit, also in the phonograph, pick-up and radio tuner circuits, permitting an absolute independent control of volume for any circuit in operation. The panel is so designed that maximum gain is possible from any one of the circuits and with the complete control and switching arrangement, losses are minimized and the impedance is kept constant in all circuits.

From the foregoing information it is apparent that an operator, with this public-address system equipped with this mixing panel, has at his fingertips the means of controlling individually or simultaneously the reproduction from microphone, pick-up or radio tuner.

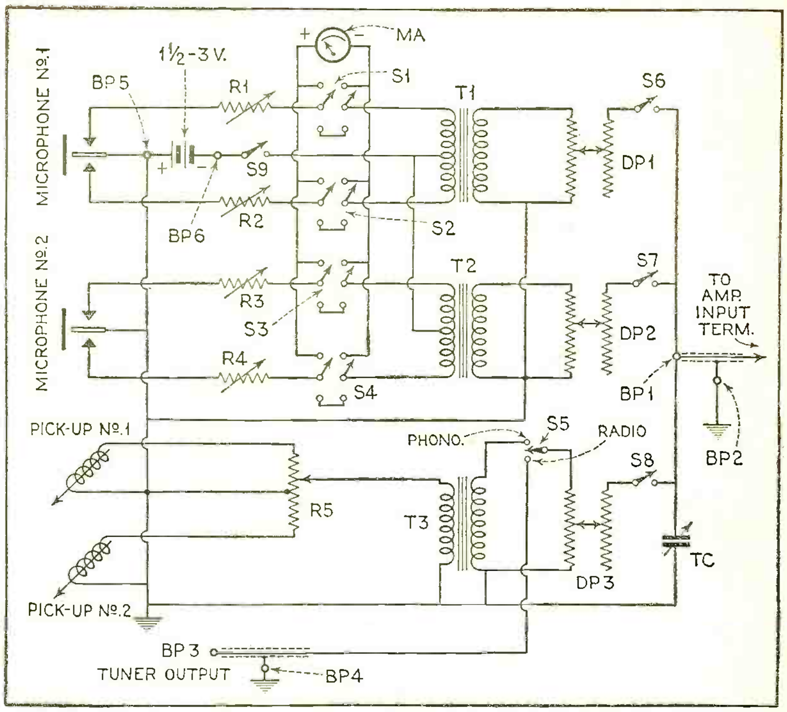


FIGURE 2. THE SCHEMATIC CIRCUIT

Construction and Operation

In reference to the physical construction of the panel, the reader can refer to the drilling layout, the schematic wiring diagram and to the illustrations which are shown with the corresponding symbols of the parts as contained in the parts list.

The wiring diagram, Figure 2, shows individual rheostats R1, R2, R3 and R4 and switches S1, S2, S3 and S4 as connected into each button circuit of microphones Nos. 1 and 2. With the switching arrangement the Weston 0-25 milliammeter can be connected into each individual circuit and by adjusting the resistance for the button under test it is possible to obtain equal current and correct sensitivity adjustment for each side of the microphone, thereby insuring correct input signal to the amplifier.

The output signal from the microphones work into the transformers T1 and T2, which are the Coast to Coast type 6164 transformer, designed for double-button carbon type microphones having 200 ohms impedance each side. For those constructors who have a double-button carbon type microphone of 100 ohms per button there is available the transformer type 6164A. The output of the transformers work into modified "T" pad type, constant impedance controls, DP1 and DP2.

Following these two resistances are the switches S6 and S7, which are incorporated to cut in or out the channel as desired, which prevents losses and keeps constant the impedance of the channel under operation. The same type control, DP3 and switching arrangement, S8, is employed in the output circuit of the phonograph pick-up and radio tuner.

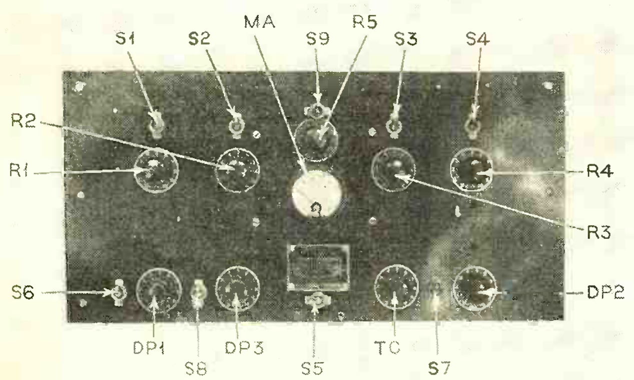
The fader control is the resistance R5, and it will be noted that one side of each phonograph pick-up is connected to the center-tap on this special four-terminal potentiometer. The operation of this instrument can best be perceived by noting, as the arm is brought to this center-tap, there will be a direct short across the transformer T3, therefore zero signal. As the arm is advanced across the resistance of either pick-up No. 1 or No. 2, there will be an increasing amount of signal passed to the input transformer T3. If the pick-up used has a high impedance from 1000 ohms up, the fader resistance R5 should have a value of 50,000 ohms. If the pick-up is of low impedance, 500 ohms or less, the fader resistance should be 10,000 ohms. The switch S5 is employed to connect the radio tuner or pick-up to the amplifier as desired.

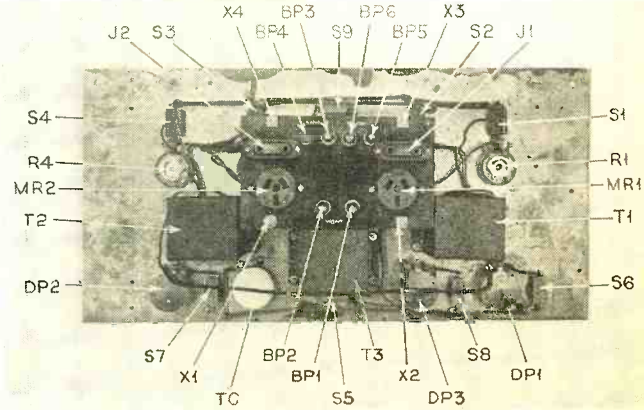
The phonograph pick-up transformer T3, shown in the parts list as type No. 6161A, is standard equipment for connection to a phonograph pick-up having an impedance of 200 ohms. For pick-ups with 500 and 3000-ohm impedances there are available the transformers types No. 6161B and C respectively. The multiple condenser tone control, TC, is connected across the output of the phonograph pick-up, radio tuner and microphone channels.

The proper placement of parts can be determined by referring to Figures 3 and 4. The illustration, Figure 3, shows the four microphones sensitivity controls, R1 to R4, the four meter switches, S1 to S4, and also (*Continued on page* 571)

FRONT AND REAR VIEWS OF MIXING PANEL

Figures 3 and 4. The illustration at the left shows all the controls. The layout of the parts and construction of the terminal board are clearly visible in the illustration on the right

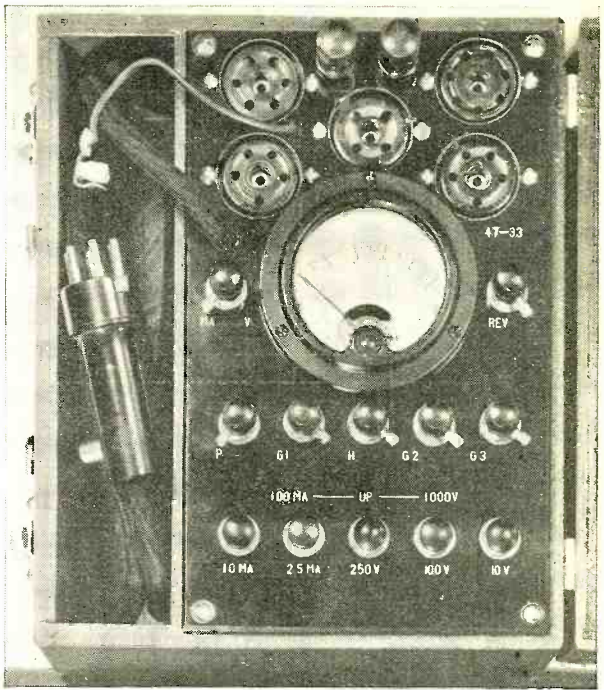




Improving The Direct Current Set Tester

This simple, compact and effective set tester was originally described in the July issue, 1932. The present article suggests changes needed to provide for testing receivers using the newest tubes

By Bernard J. Montyn



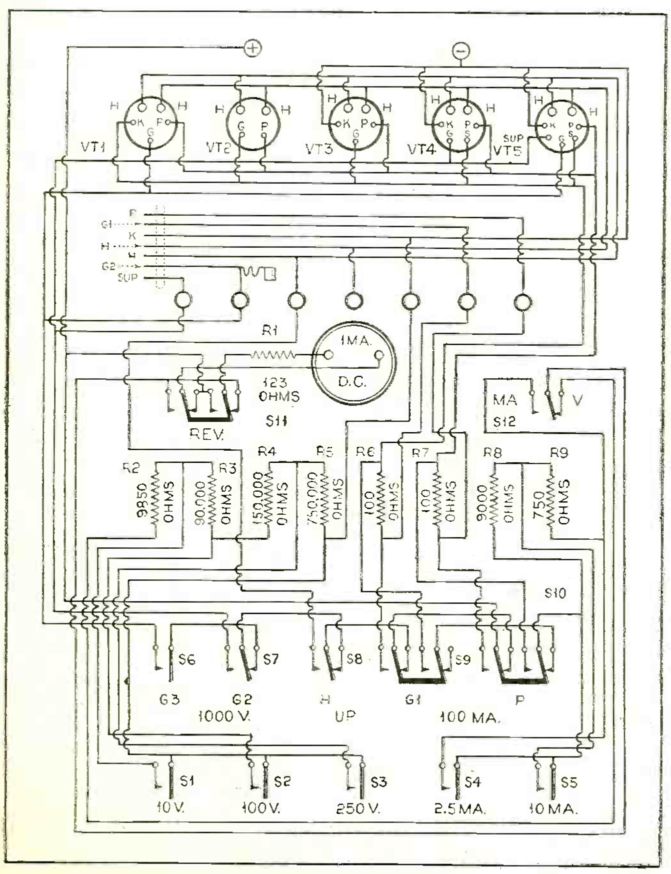
THE LATEST MODEL
The revamped tester with a new panel, two new sockets and one additional switch. All of the parts used in the original model may be used in this new one, except the cable and plug. At a moderate cost the old instrument can be easily brought up to the minute

THE deluge of new tubes has made obsolete most of the testing equipment employed by the serviceman. Therefore we are presenting below the d.c. set tester described in the July, 1932, issue of RADIO NEWS with changes to permit tests of the new tubes.

The difference between this tester and its predecessor is in the addition of two sockets—one for 6-prong and one for 7-prong tubes. There is also one more switch, and the cable with analyzer plug is now designed for a 6-prong analyzer plug, taking adapters on the receiver end for tubes with a different prong arrangement.

The tester will measure all voltages and currents of tubes and can also be used as a continuity tester, an ohmmeter (with the addition of a 9-volt battery) and as a voltmeter for external measurements. Only d.c. measurements can be made.

THE SCHEMATIC CIRCUIT
The complete circuit is shown here, including connections for the new sockets, switch and cable



It will be seen that all the readings are made by turning the proper switches for the individual elements. Switch S9 (marked G1 on panel) serves to measure current or voltage in the screen circuit of a screen-grid tube or an r.f. pentode. S7 (G2) connects to the control grid and S6 to the suppressor grids. In special tubes, like the –46, the –89, etc., one must keep in mind how the tube is connected when operating the tester. Any serviceman familiar with the latest tubes and circuits should have no difficulty in either operation or construction.

Thus, to measure screen voltage of a –58 tube, S12 is set for "volts" and S9 to the left. Then, if screen current is to be measured, S12 needs only to be changed to "ma." The range of the meter is normally 1000 volts and of the ammeter 100 ma. The lower ranges are obtained by pressing the proper button.

When a pentode of the type –47 or –33 is tested it should be inserted in socket VT1 and the six-to-five prong adapter with the control-grid clip should be used at the analyzer plug (the clip goes on the stud of the plug).

The switches S6, S7, S8, S9 and S10 have been so arranged that no damage will be caused when two of them are set at a time, or if they are set wrong in any way. This was explained more fully in the original article (RADIO NEWS for July, 1932).

When the tester is used as an ohmmeter, an external battery should be used. A resistance scale was printed in the July issue, for the use of this tester with a battery of 9 volts.

A pamphlet has been made available by the Shallcross Mfg. Co. describing the tester. This includes a drilling template for the panel and a table of tubes giving information on each type, just how the switches have to be set for every test, etc.

List of Parts

M—Weston Model 301 d.c. meter, 0-1 ma.
R1—Shallcross resistor, type No. 170, 123 ohms
R2—Shallcross resistor, type 6-T, 9850 ohms
R3—Shallcross resistor, type 6-T, 90,000 ohms
R4—Shallcross resistor, type 6-T, 150,000 ohms
R5—Shallcross resistor, type 6-T, 750,000 ohms
R6, R7—Shallcross resistor, type 6-T, 100 ohms
R8—Shallcross resistor, type 6-T, 9000 ohms

(*Continued on page* 573)

Radio Call Book Section

Conducted by S. Gordon Taylor *and* John M. Borst

Broadcast Stations of the World

Principal European Stations

By Call, Location, Frequency and Power

AUSTRIA

Call	*Location*	*K.C.*	*K.W.*
—	Vienna, experimental	238	—
—	Vienna (Rosenhuegel)	581	15
—	Klagenfurt	662	.5
—	Graz	851	.7
—	Innsbrueck	1058	.5
—	Linz	1220	.5
—	Salzburg	1373	.5

BELGIUM

ON4RB	Brussels No. 1	590	15
—	Brussels No. 2	887	15
ON4RW	Liege	1236	.4
ON4CE	Chatelineau	1391	3

BULGARIA

—	Sofia (Rodno Radio)	941	1

CZECHO-SLOVAKIA

OKP	Prague	614	120
OKB	Brno	878	36
OKK	Kosice	1022	2.5
OKR	Bratislava	1076	14
—	Moravska-Ostrava	1137	11

DANZIG

PTB	Danzig	662	.5

DENMARK

—	Kalundborg	260	7.5
—	Copenhagen	1067	1

ESTONIA

—	Tartu	1071	.5
—	Tallin	1004	11

FINLAND

—	Lahti	167	40
—	Tampere	536	1
—	Helsinski	815	10
—	Viipuri (Viborg)	1031	10
—	Pietarsaari (Jacobstad)	1220	.25
—	Turko (Abo)	1220	.6
—	Pori (Bjoerneborg)	1355	.5

FRANCE

Call	*Location*	*K.C.*	*K.W*
—	Paris	174	75
—	Paris (Eiffel Tower)	207.5	13
—	Grenoble	530	2
YN	Lyons (La Doua)	644	1.5
FPTT	Paris	671	.7
—	Toulouse	779	8
F8GC	Paris (Radio LL)	810	1.2
SPTT	Strasbourg	869	11.5
—	Paris (Poste Parisien)	914	60
—	Marseilles	950	1.6
—	Paris (Radio Vitus)	959	2
—	Bordeaux (Lafayette)	986	13
—	Limoges	1022	.7
—	Lyons	1043	.7
—	Montpellier	1049	.8
—	Rennes	1103	1.3
—	Lille	1130	1.3
MRD	Toulouse	1175	.7
—	Juan-les-Pins (Nice)	1205	.8
—	Beziers	1250	1.5
—	Bordeaux (Sud-Ouest)	1265	3
—	Nimes	1265	1
—	Fécamp (Radio Normandie)	1331	10

GERMANY

—	Koenigswusterhausen	183.5	60
—	Freiburg-im-Breisgau	527	.25
—	Hanover	530	.25
—	Augsburg	536	.25
—	Kaiserslautern	536	1.5
—	Munich	563	1.5
—	Langenberg	635	60
—	Berlin	715	1.5
—	Frankfurt-a-M.	770	1.5
—	Hamburg	806	1.5
—	Stuttgart (Muehlacker)	832	60
—	Breslau	923	60
—	Dresden	941	.25
—	Berlin	1058	.5
—	Magdeburg	1058	.5
—	Stettin	1058	.5
—	Heilsberg	1085	60
—	Bremen	1112	.25
—	Leipzig	1157	2
—	Gleiwitz	1184	5
—	Kassel	1220	.25
—	Nuernberg	239	2
—	Kiel	1292	.25
—	Flensburg	1319	.5
—	Koenigsberg	1382	.5

HUNGARY

HAL	Budapest No. 1	545	18.5
HAC	Budapest No. 2 (Csepel)	1428	3

ICELAND

TFA	Reykjavik	250	21

IRISH FREE STATE

2RN	Dublin	725	1.2
6CK	Cork	1337	1

ITALY

IPA	Palermo	572	3
IFI	Florence	599	20

Call List Information Service

EACH MONTH there will be found featured in the Radio Call Book Section at least two pages of information on stations, their calls, frequencies, wavelengths, etc. The present installment is the first of a series of broadcast stations of the world and includes those countries in Europe as well as a number of adjacent parts of Asia. This information has been collected from a large number of sources in each of the countries covered and set down here for benefit of our readers. It includes most of the stations within these areas that will give any possibility of DX reception.

There is also in this installment an addenda to a previously run list of police radio stations in the United States, as well as a list of fire radio stations.

The series to date started with the September, 1932, issue with a list of broadcast stations in the United States listed by frequency.

The next installment in October, 1932, gave the same list of U. S. broadcasting stations alphabetically by call letters.

The December, 1932, issue contained the first installment of the short-wave station list by wavelength and frequency, including also the broadcasting stations in North America exclusive of the U. S. alphabetically by call letters.

The January, 1933, issue continued the short-wave station list by wavelength and frequency.

The February, 1933, number contained the conclusion of the short-wave station list as an addenda of changes and additions to the list of broadcasting stations in North America outside the United States. This issue also included a list of municipal police radio stations in the United States and a list of television stations of the United States.

Future installments will contain much needed list information that it is hoped will be of service to broadcast and short-wave listeners.

Call	Location	K.C.	K.W.
1ROX	Rome	680	50
11BZ	Bolzano	815	1
IMI	Milan	905	7
1NA	Naples	941	1.5
1GE	Genoa	959	10
1TO	Turin	1096	7
11BA	Bari	1112	20
11TR	Trieste	1211	10

LATVIA

Call	Location	K.C.	K.W.
YLZ	Riga	572	15

LITHUANIA

Call	Location	K.C.	K.W.
RYK	Kovno	155	7

LUXEMBURG

Call	Location	K.C.	K.W.
LOAA	Luxemburg	1344	10

NETHERLANDS

Call	Location	K.C.	K.W.
PFBI	Amsterdam (Hilversum)	160	20
PH9	Amsterdam (Huizen)	160	6.4
PCF	Scheveningen	280	2
PFBI	Amsterdam (Hilversum)	1013	20
PH9	Amsterdam (Huizen)	1013	6.4
——	Bloemendaal	1220	.25
——	The Hague	1000	.35

NORWAY

Call	Location	K.C.	K.W.
——	Oslo	277	60
LKH	Hamar	536	.7
LKT	Trondheim	608	1.2
LKD	Bodoe	662	.5
LKP	Porsgrund	662	.7
LKM	Tromsoe	662	.1
LKA	Aalesund	671	.35
LKN	Notodden	671	.08
LKR	Rjukan	671	.15
LKF	Frederikstad	816	.7
LKB	Bergen	824	1
LKS	Stavanger	1247	.5
LKK	Christiansand	1274	.5

POLAND

Call	Location	K.C.	K.W.
——	Warsaw No. 1	212.5	120
—	Wilna	530	16
—	Katowice	734	16
——	Lwow	788	16
——	Poznan	896	1.9
——	Krakow	959	1.5
——	Lodz (experimental)	1283	2

PORTUGAL

Call	Location	K.C.	K.W.
——	Parede	696	1.5
CT1AA	Lisbon	1063	2

RUMANIA

Call	Location	K.C.	K.W.
——	Bucharest	761	12

SPAIN

Call	Location	K.C.	K.W.
EAJ22	Salamanca	662	1
EAJ8	San Sebastian	662	.6
EAJ7	Madrid (Union Radio)	707	2
EAJ2	Madrid (Radio Espana)	707	2
EAJ5	Seville	815	1.5
EAJ1	Barcelona	860	8
EAJ19	Oviedo	1121	.7
——	Valencia	1124	20
EAJ18	Almeria	1193	1
EAJ15	Barcelona (Ass. Nacional)	1193	1
——	Cartagena	1220	.4

SWEDEN

Call	Location	K.C.	K.W.
SBG	Motala	222.5	30
SBE	Boden	244	.6
SBF	Oestersund	389	.6
SBD	Sundsvall	554	10
SCT	Upsala	662	.15
SCN	Malmberget	689	.25
——	Stockholm	689	50
SBB	Goteborg	932	10
SCC	Falun	977	.5
SBH	Horby	1166	10
SCQ	Trollhattan	1193	.25
SCU	Varberg	1220	.3
SCI	Kalmar	1211	.2
SCB	Eskelstuna	1220	.2
SCL	Kiruna	1220	.25
SCP	Saffle	1220	.4
SCV	Orebro	1265	.2
SCO	Norrkoping	1310	.25
SBC	Malmo	1301	1.25
SCQ	Halsingborg	1301	.2
SCS	Umea	1301	.2
SCR	Uddevalla	1310	.05
SCF	Hudiksvall	1328	.15
SCK	Karlstad	1382	.25
——	Halmstad	1391	.2
SCA	Boras	1450	.15
SCW	Ornskoldsvik	1460	.2
——	Gavle	1470	.2
SCK	Kristineham	1480	.25
SCH	Jonkoping	1490	.25
SCJ	Karlskrona	1530	2

SWITZERLAND

Call	Location	K.C.	K.W.
——	Geneva	395	1.5
——	Lausanne	442	.6
——	Beromünster	653	60
——	Sottens	743	25
——	Berne	1220	.5
——	Basle	1229	.5

TURKEY

Call	Location	K.C.	K.W.
——	Ankara	195	7
——	Istanbul	250	5

UNITED KINGDOM

Call	Location	K.C.	K.W.
G5XX	Daventry	193	30
——	Manchester (North Regional)	625	50
——	Midland Regional	752	25
——	Scottish Regional (Nr. Falkirk)	707	50
G2LO	London Regional (Brookman's Park)	843	50
G5WA	Cardiff	968	1
——	Manchester (North National)	995	50
G2BM	Bournemouth	1040	1
G5PY	Plymouth	1040	.12
——	Scottish National (Nr. Falkirk)	1040	50
G5SX	Swansea	1040	.12
——	London National	1147	50
G2BE	Belfast	1238	1
G2BD	Aberdeen	1400	1
G5NO	Newcastle	1420	1

Police and Marine Fire Radio Stations

(Addenda to List in February Issue)

State Police Radio Stations

2506 kc.—115.32 meters
KGPV Des Moines, Iowa
1570 kc.—191.08 meters
WRDS East Lansing, Mich.
WMP Framingham, Mass.
KGPV Shreveport, La.
257 kc.—1167.3 meters
WBR Butler, Pa.
WJL Greensburg, Pa.
WBA Harrisburg, Pa.
WMB West Reading, Pa.
WDX Wyoming, Pa.

Marine Fire Radio Stations

1596 kc.187.97 meters
WRDU Brooklyn, N. Y.
WCF New York, N. Y.
WKDT Detroit, Mich.
1558 kc.— 92.55 meters
WEY Boston, Mass.
KGPD San Francisco, Calif.
KIDA Seattle, Wash.

U. S. S. R.

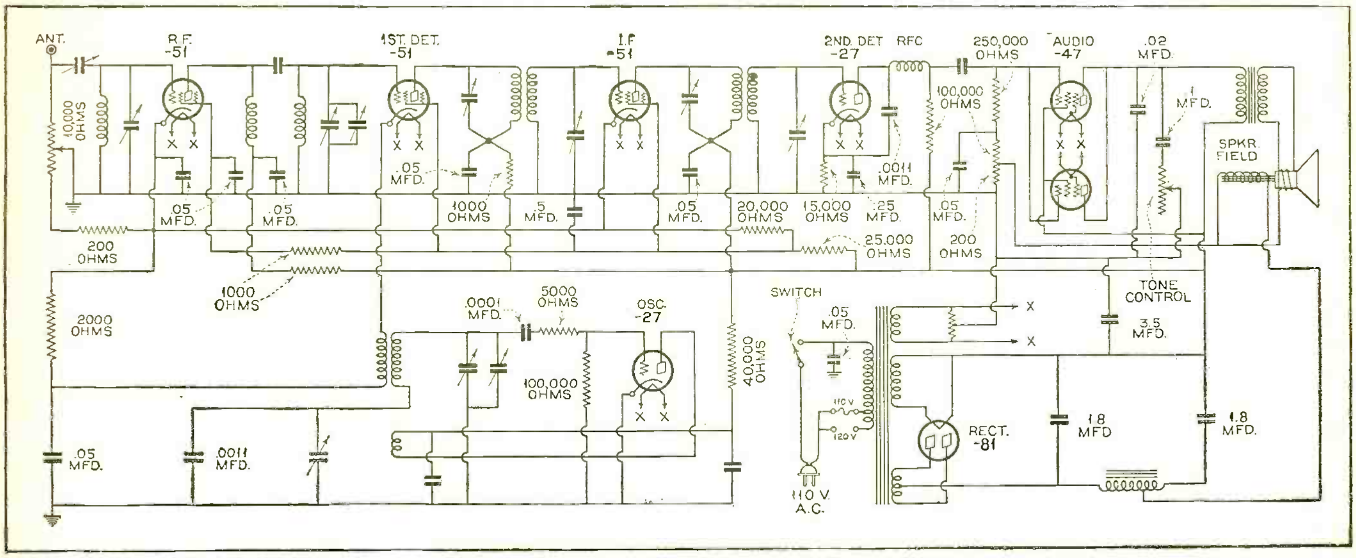
Call	Location	K.C.	K.W.
RW14	Irkutsk	188	10
RW1	Moscow	203	100
RW49	Moscow	230	100
RW6	Novosibirsk	230	4
RW8	Baku	238	10
RW43	Baku	238	1.2
RW11	Tashkent	256	25
RA33	Novorosiisk	268	4
RW58	Moscow	269	40
——	Rostov-on-Don	271	4
RV58	Imeni Pop	273	8
RW7	Tiflis	280	10
RW9	Kiev	290	36
RW3	Leningrad	300	20
RW53	Leningrad (Kolpinsk)	300	100
RW60	Alma Alta	310	10
RW4	Kharkov	320	16
RV49	Stchelkovo	320	——
RW19	Achabad	334	4
RA41	Vologda	338	1.2
RV21	Erivan	343	4
RW18	Samarkand	343	2
RW12	Rostov-on-Don	354	4
RW5	Sverdlovsk	364	36
RW9	Kiev	368	10
RW26	Stalino	370	1.2
RA9	Sebastopol	375	.25
RW25	Voronezh	386	3
RV24	Nizhni-Novgorod	394	4
RW2	Moscow	417	20
RW47	Tashkent	421	2
RW10	Minsk	429	4
RW35	Astrakhan	435	1
RW22	Oufa	444	2
RW45	Orenburg	462	1
RW29	Petrozavodsk	469	1.2
RW44	Omsk	472	1.2
RW30	Dniepropetrovsk	511	4
RA34	Koursk	521	1
RW16	Samara	522	1.2
RW24	Smolensk	531	2
RV53	Sverdlovsk	541	——
RW17	Kazan	551	1
RW41	Veliki Oustug	560	1.2
RV50	Armavir	587	1
——	Nizhni-Novgorod	599	1.8
RA51	Ulyanovsk	600	.02
RW31	Ivanovo Vosnesensk	604	1.2
——	Moscow	604	1.2
RW32	Stavropol	608	1.2
RW40	Gomel	621	1.2
RW52	Simferopol	630	4
——	Sebastopol	630	1.2
RW23	Groznyi	636	1.2
RW28	Vladivostok	636	.3
RW56	Penza	640	1.2
RW48	Tomsk	645	1.2
RW33	Krasnodar	650	1
RW13	Odessa	668	4
RW46	Petropavlovsk	687	1.2
RA44	Tver	690	1.2
RW20	Kharkov	704	4
——	Moscow	707	100
RA32	Saratov	714	.2
RW55	Pokrovsk	730	1
RW51	Nalchik	748	1.2
RA8	Bogorodsk	750	.7
RW36	Arkhangelsk	770	10
RW37	Moscow	793	1
RW39	Moscow	793	.3
RW27	Makhatch Kala	796	1
RV26	Artemovsk	811	1.2
RV43	Nikolaev	820	——
RW57	Tiraspol	838	4
RV36	Leningrad	856	1.2
RW24	Piatigorsk	865	1.2
——	Khabarovsk	1053	.5

YUGOSLAVIA

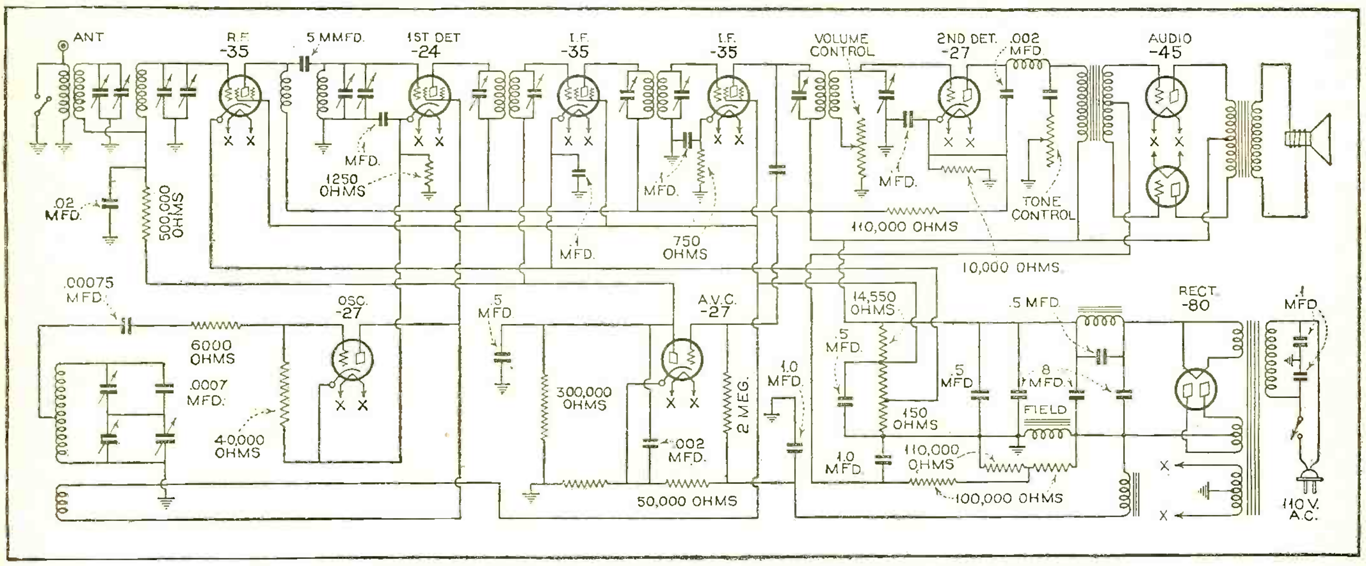
Call	Location	K.C.	K.W.
——	Ljubljana	522	2.5
——	Belgrade	697	2.8
——	Zagreb	977	.75

THE END

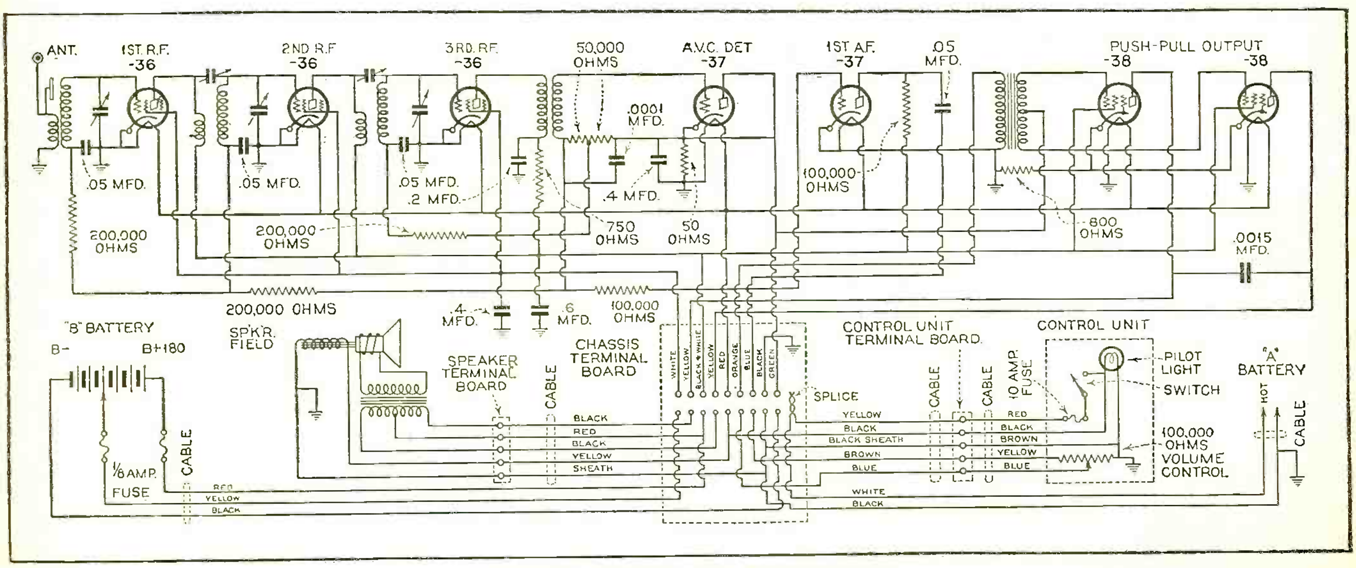
Service Data for Servicemen



BOSCH, MODEL 20 SUPERHETERODYNE

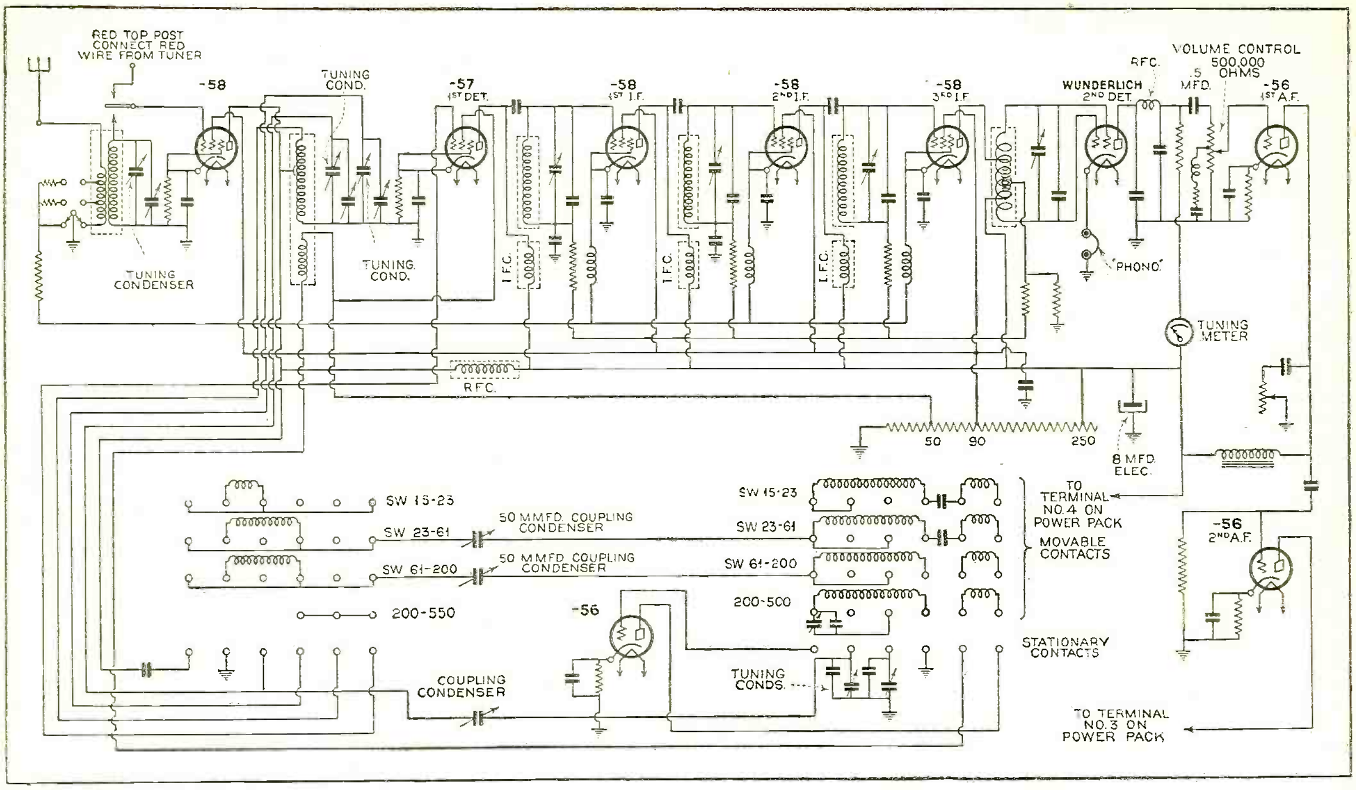


GENERAL MOTORS SUPERHETERODYNE, MODELS 252 TO 258 INCLUSIVE



MAJESTIC, MODEL 110 AUTO RADIO

Compiled from J. F. Rider's Perpetual Trouble Shooter's Manual



SCHEMATIC CIRCUIT DIAGRAM

Figure 1. This circuit is of the main chassis. The circuit of the power unit, which includes the push-pull output stage and complete power supply, is shown on the opposite page

Improvements in All-Wave

De Luxe "Super" Design

By **S. Gordon Taylor** *and* **John M. Borst**

IN the August, 1932, issue a description of the then new Scott all-wave De Luxe receiver began. In these articles were included a description of the receiver and reports on reception tests conducted by the RADIO NEWS Laboratory at various locations in and around New York City.

The present article is concerned with numerous improvements recently incorporated in this receiver. Also, farther on are given the results obtained in operating tests made by the authors. The improvements are so numerous that it can almost be considered a new receiver. Not only have modern operating refinements such as automatic volume control and a tuning meter been included, but the already fine electrical characteristics of the circuit have been greatly improved.

Before going into the details of the alterations made, it is interesting to know the conditions under which the tests of this improved model were made by the RADIO NEWS Laboratory. During October one of the authors happened to be in Chicago on business. Among other calls, one was made at the Scott Laboratories. During this visit a demonstration of this improved receiver was heard. At the time it was felt that the changes were such as to be of considerable interest to RADIO NEWS readers, and arrangements were made to ship one of the receivers to the RADIO NEWS Laboratory to permit further tests to be carried on.

During the discussion of the receiver, one of the points stressed by the manufacturer was their absolute uniformity. To prove this point, Mr. Scott suggested that the visitor go down to the shipping room and there select at random one of the receivers awaiting shipment, then accompany this receiver to the Scott Laboratory, where a complete set of curves could be run and the receiver then shipped to the RADIO NEWS Laboratory for operating tests. This was done, all in the visitor's presence, and the resulting curves are included in this article. Certainly the laboratory measurements backed up the claims for uniformity, as the curves were almost identical with the "laboratory standard" curves for this model. The electrical fidelity curve was slightly better than the standard in that the drop was slightly less marked at the high-frequency end. The sensitivity curve showed an average of a few hundredths of a microvolt less than the standard.

It might be mentioned, in passing, that the sensitivity shown by the curve in Figure 3 is greater than can be used even in a location where noise is at a minimum. Such sensitivity only results in a higher noise level between stations, and word has been received that the sensitivity has purposely been decreased since these curves were run, still leaving a considerably greater degree of sensitivity than can be used to advantage even under the most ideal conditions. This decrease in sensitivity has been accomplished by increasing the value of the resistor providing minimum bias for the three i.f. tubes.

The two most obvious improvements over the earlier model are the inclusion

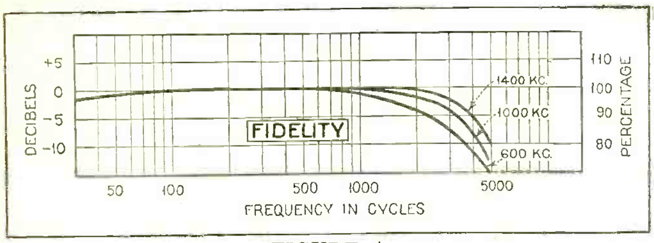


FIGURE 5

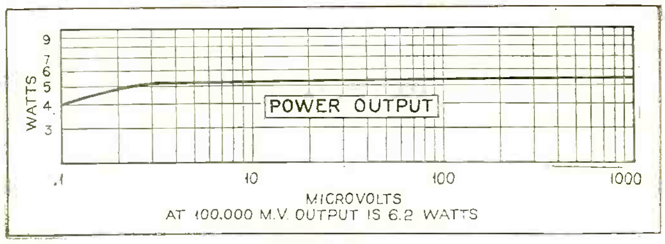


FIGURE 6

of the highly effective automatic volume-control system and a unique tuning-meter arrangement. As indicated in Figure 6, a close approximation to the full rated power output of the receiver is obtainable with an input of only .1 microvolt. From inputs about .3 microvolt and upward, the full power output is obtained.

The tuning meter is an improvement which offers a decided operating advantage. Its method of application in this receiver is of particular interest. The meter itself is not visible but is completely concealed behind the front panel. Only the image of its needle is visible. This image is projected on the calibrated tuning scale and is therefore always directly in the field of vision while tuning the receiver, making it unnecessary to move the eyes back and forth from the tuning scale to the tuning meter while operating the receiver. This tuning meter is included in the plate circuit of the second detector and gives a direct indication of the r.f. signal strength. It does not fluctuate with modulation nor is it in any way affected by the adjustment of the manual volume control. It has a wide range of deflection with a readily evident movement even on extremely weak signal inputs.

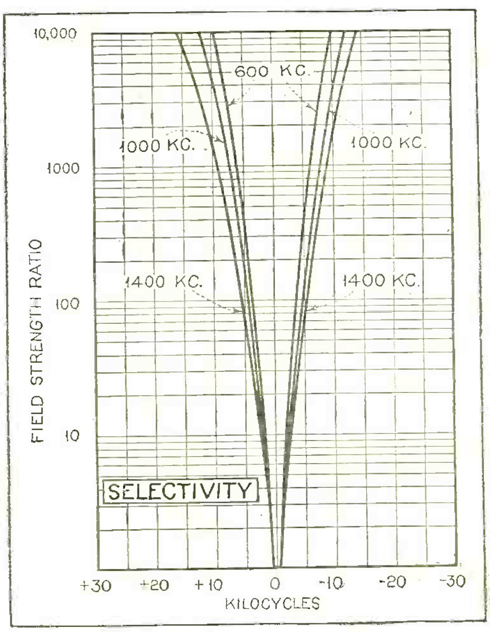
The improved electrical characteristics of the receiver are accounted for primarily in the use of the latest types of tubes in all but the power output stage, where push-pull -45's are still employed, and the power supply, which employs an -80 type rectifier. The other nine tubes are three type -56, one type -57, four type -58 and a Wunderlich tube for the second detector and automatic volume control. The positions in which these tubes are used are shown in the circuit diagram, Figure 1.

Starting at the input, the other improvements and refinements which have been made will be taken up.

The first is the provision for use of a tuned transmission type antenna lead for short-wave reception. The manufacturer has found such an antenna system to offer considerable advantage over the ordinary "L" type antenna for the short waves. The effect of tuning the antenna is to greatly increase signal strength on weak short-wave stations, while the use of a parallel lead-in tends to confine signal pick-up to the antenna wire proper, thus reducing certain types of interference. A complete antenna with two-wire parallel lead is shipped with every receiver, and also an antenna tuning unit. This unit consists of an antenna-coupling transformer, tapped for the different wave-bands, a variable condenser and an inductance switch, all mounted on a metal plate. Binding posts are included for connecting the two lead-in wires, and two wire terminals provide the connections to the short-wave input of the receiver. A regular untuned antenna of the "L" type is recommended for broadcast reception, and the transfer from this to the short-wave antenna system is accomplished automatically by means of the switch shown in the grid circuit of the r.f. tube (Figure 1) which is a part of the main band-selector switch.

The use of the special short-wave antenna and tuning unit is not essential and is provided for those who desire to obtain maximum results on the short-wave bands. By connecting a wire between the short-wave and broadcast antenna binding posts at the rear of the chassis, short waves can be received on the ordinary broadcast antenna in the same manner as the broadcast stations.

FIGURE 4



Each receiver is carefully balanced and all balancing adjustments locked before leaving the manufacturer's laboratory. The chassis is then sealed to prevent tampering with these adjustments. The permanency of adjustment is guaranteed for a period of years, providing the chassis seals remain unbroken. The fact that such a highly refined and efficient receiver can be guaranteed to maintain these characteristics over a period of years certainly represents an achievement on the part of the design engineers.

Coming to the a.f. amplifier, the improved receiver includes two features not included in the original. The first of these is in the provision of manual static control. The De Luxe receiver offers a considerably wider range of audio-frequency response than does the average receiver, particularly in the extension of the high-frequency end of the response curve. Such a good curve offers decided advantage so far as the naturalness of reproduction of speech and music are (*Continued on page* 574)

FIGURE 2

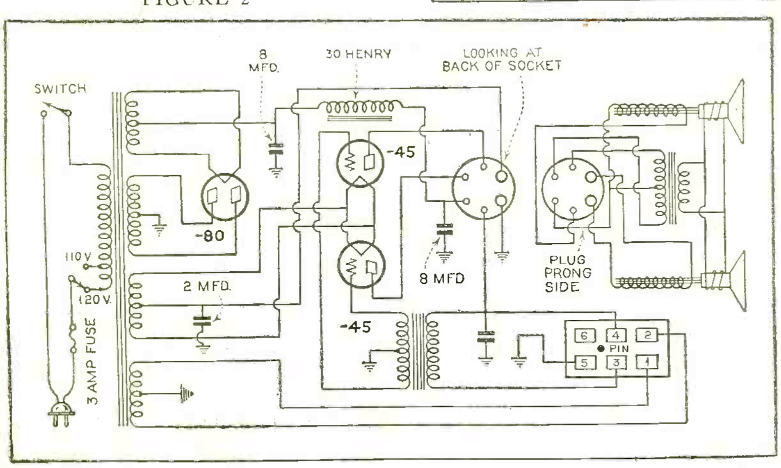
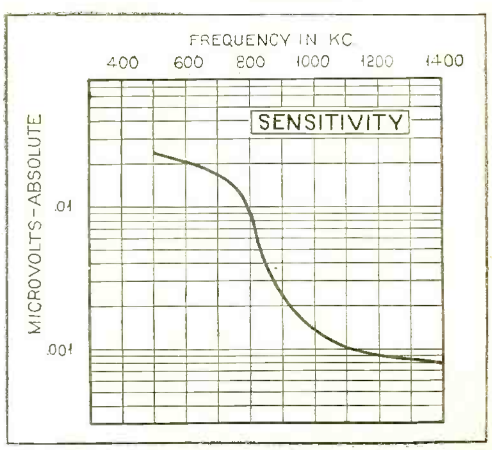


FIGURE 3



An Achievement In Low-Cost All-Wave SUPER DESIGN

Figure 1. The receiver is shown with the matched dual speakers, set up, ready for operation

Sixteen of the newest type tubes—and every tube serving a vital purpose—tells the story of the latest improved model of a receiver designed to meet the economic conditions of today

Part One

By S. Gordon Taylor and William C. Dorf

THE introduction to the market of a sixteen-tube, all-wave receiver which includes practically all of the most modern refinements yet sells for well under $50.00 has aroused a good deal of interest and curiosity on the part of readers, as evidenced by the large number of inquiries which have been coming in to RADIO NEWS concerning it. It scarcely seemed possible that such refinements as automatic volume control, a system for eliminating "between-station" noise, single-dial control, a tuning range from 15 to 550 meters without plug-in coils, a 20-watt Class B output stage, dual power supplies and dual speakers, can all be featured in a receiver selling for this price. Yet all of these features are included in the receiver to be described here and discussed in this article.

In order to obtain some first-hand information, one of these new Midwest receivers was obtained and tests started to determine just what it could do. In the preliminary tests to date it has shown up surprisingly well. These tests are being continued and will be completed in time to report full results in the April issue. In the meantime, the present article will provide the highlights of results obtained in the preliminary tests and also a technical description of the receiver.

First of all, it should be borne in mind that in some respects the radio market is analogous to the automobile market. The fact that a receiver sells at a moderate price does not necessarily disqualify it for consideration of one who desires a really good set. In the automobile field, for instance, we cannot all own Cadillacs or Lincolns; yet with our "Flivvers" and "Chevvies" we manage to get where we want to go, in adequate time and reasonable comfort. We may not be sitting on $12.00-per-yard upholstery and be inclosed in a body with a 12-coat lacquer finish, yet we can have many of the latest mechanical improvements, even though in a somewhat less expensive form than they appear in the more expensive makes of cars. In radio, a low price is not necessarily more significant than in the automobile field. Also, the merchandising methods of the manufacturer have to be taken into consideration. The Midwest receiver, for instance, is sold direct by the manufacturer to the consumer, eliminating the profits of middlemen. The price is therefore equivalent to approximately twice the figure in terms of list prices of other receivers which are marketed through the usual wholesale and retail channels. Few present-day commercial receivers list as high as $80.00 to $100.00 for the chassis alone, and it therefore becomes at once apparent how the receiver under discussion can be a highly satisfactory one, yet sell direct to the consumer at such a low price.

During the preliminary tests in New York City any number of distant stations were tuned in with ease, including KFI, Los Angeles. At normal room volume the program from KFI was in every way satisfactory. The Amos and Andy program broadcast from this station at 11:00 p.m., E.S.T. (8:00 p.m., Pacific Time), was thoroughly enjoyable. Earlier in the evening KOA, Denver, was heard, including its call letter announcement. Several Mexican stations were brought in easily, as were also Texas and New Orleans. Considering the short duration of the test, the foregoing tells a good story of sensitivity, especially as this was all accomplished in an apartment house in the city, using a 20-foot indoor aerial, the length recommended by the manufacturer when the receiver is operated in a location close to high-power broadcast stations.

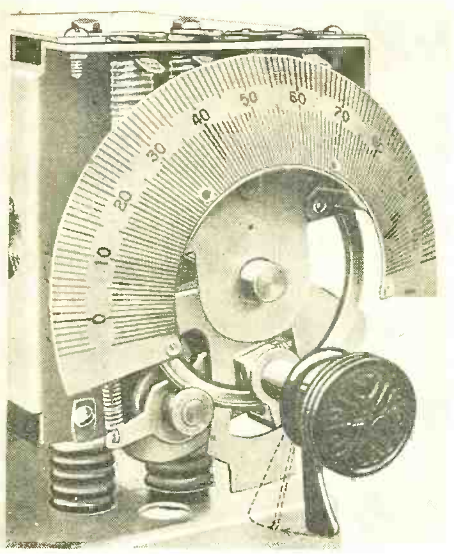
During a short-wave test of about two hours in the middle of the afternoon, Rome, Paris and Germany were brought in with good volume. Rome, especially, provided more than ample volume to fill a two-story home with the program. In this test a 100-foot outdoor antenna was employed.

The tests to be described next month will be far more comprehensive and will be reported in detail.

A feature of major importance in this Midwest receiver is the "statomit" circuit, which automatically suppresses all in-between station noises. The small center knob mounted directly underneath the main tuning dial knob is the "statomit" control. As this knob is turned to the left, the annoying crackling, frying and sizzling noises between station channels are automatically reduced. For ordinary home use, the control may be set at a point where the receiver is absolutely quiet when tuned to local stations, and it will then be possible to tune these local stations in without hearing a sound on any other part of the dial. With the control all the way to the right, the "statomit" action is eliminated so that the faintest signal can be heard at any part of the dial.

The receiver employs 16 tubes in all, which include the new –50 series type tubes, such as the –55, –56, –57 and the –58 types. The audio amplifier is of the Class B type, utilizing the new –42 type tube in the driver stage and two –46 type tubes in the push-push output stage. It is equipped with dual, matched electrodynamic speakers, one 8 inches in diameter for the higher range of audible frequencies, the other 10 inches in diameter, especially designed for lower frequency reproduction.

The receiver features a wave-band selector switching arrangement which includes four colored lights to indicate just which band the receiver is operating on. The complete operation of this colored-light wave-band selector switching arrangement will be discussed in the later paragraphs. Other important features are automatic volume control, a two-speed gear-shift vernier tuning arrangement, complete shielding with double shielding for some of the tube circuits to eliminate undesired radiation and signal pick-up. Still other features include full floating ganged variable tuning condensers, as illustrated in Figure 2, and there are two separate power supplies.



DUAL RATIO DIAL

Figure 2. The gang tuning condensers are installed on live rubber mountings to prevent vibration, thereby improving the acoustic qualities of the set. This illustration also shows the gear shift for operating the dual speed tuning arrangement. Two of the color lights for the wave band selector are to be seen at the top just in back of the tuning dial

A new safety development incorporated in the set is the thermal fuse connected across the input circuits of both power packs. This is actually a combination fuse and thermal cutout, and it is designed to blow instantly on short circuits, but to blow on overloads only if the overload is continued long enough to actually endanger the apparatus.

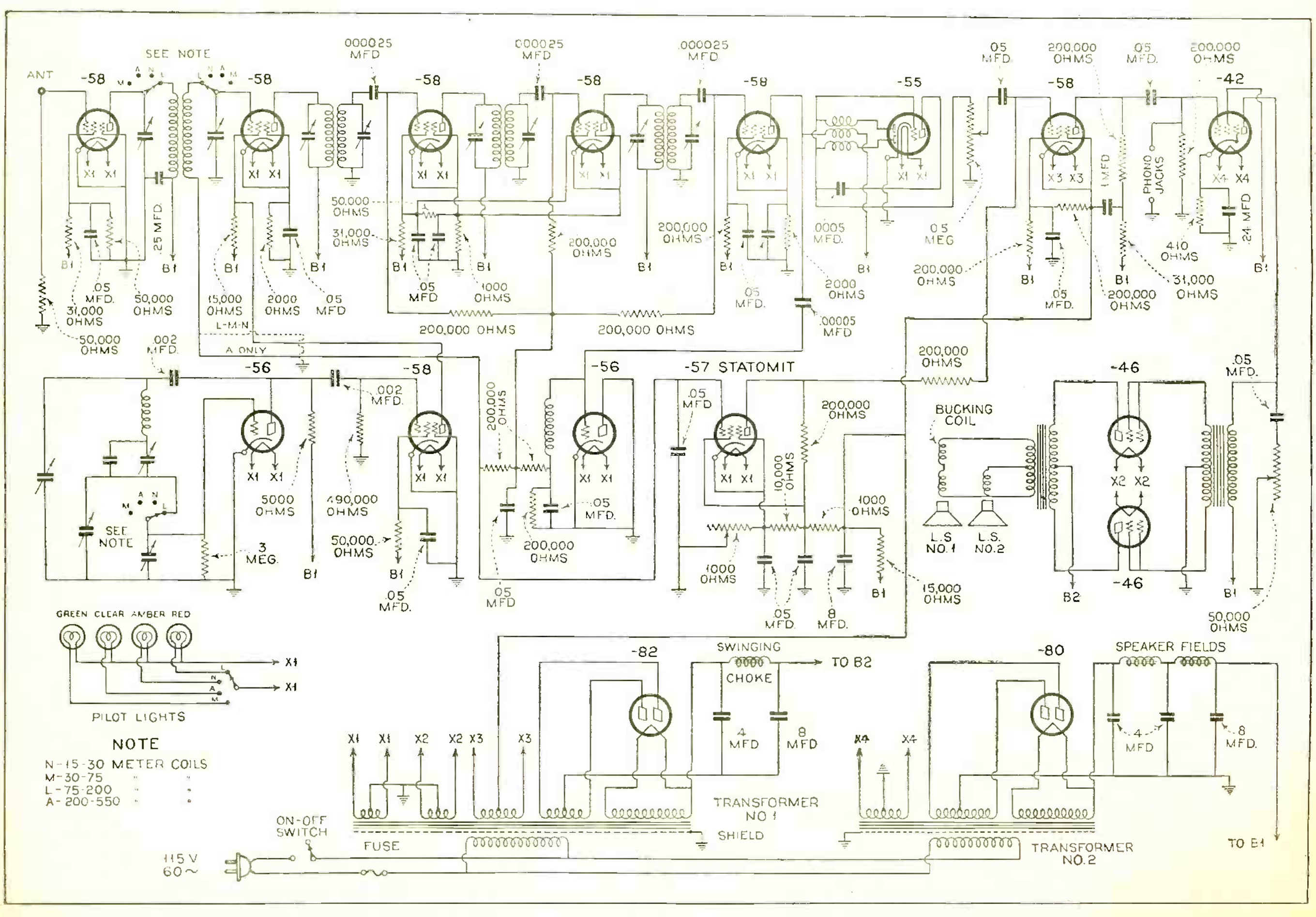
The first detector, using a –58 type tube, receives only radio-frequency signal voltages on its control grid. The signal and oscillator voltages are mixed in the plate circuit to produce the required intermediate-frequency voltages.

The radio-frequency voltages fed to the grid of this tube are doubly filtered in the dual-tuned r.f. coupling transformer. This radio-frequency preselector coupling is completely isolated from antenna losses and capacities by means of a variable-mu r.f. tube of the –58 type. It is critically coupled to transfer a maximum of energy with no side-band cutting.

The oscillator circuit with a –56 tube is of the single-coil type. The feed-back is accomplished by connecting the coil between the plate circuit and the grid circuit and is controlled automatically by the capacity of the variable condenser at the same time that this condenser tunes the coil. The purpose of this design is to maintain the output of the oscillator uniform throughout each wave-band.

This oscillator tube with its associated tuning circuit is completely isolated from the rest of the set and particularly from the radio-frequency preselector by means of an untuned amplifier stage through which energy is taken into the first detector. This prevents interlocking of the oscillator with the preselector and permits a much greater amount of energy to be transferred into the first detector without overloading the (*Continued on page 568*)

FIGURE 3. THE SCHEMATIC DIAGRAM



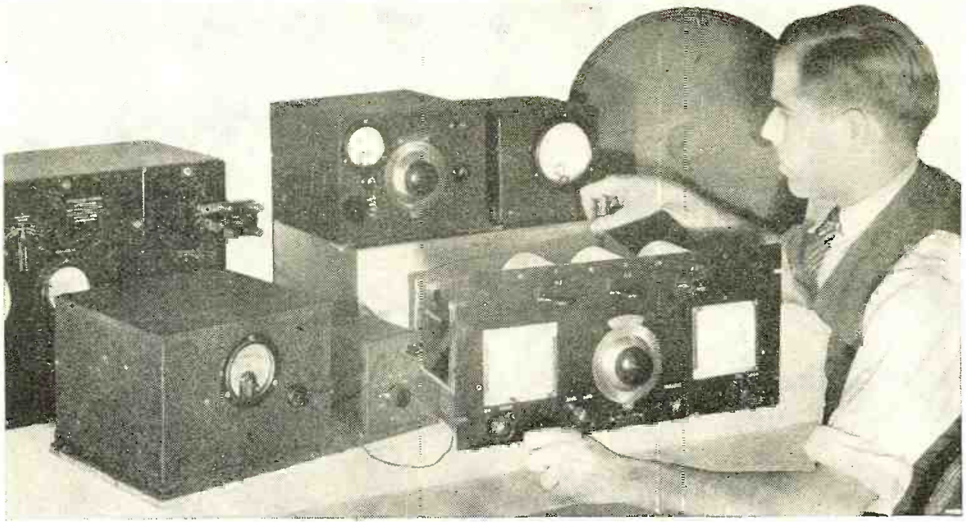


FIGURE 7. MAKING FINAL LABORATORY CHECK

DESIGNING AND TESTING A COMMERCIAL Short-Wave "Super"

By James Millen*

THE production methods of the machine age have had to capitulate to the hand craftsmanship of older times in the construction and test of short-wave receivers designed to meet the exacting demands of commercial reception. It is not sufficient that a small percentage of the total output of receivers be capable of consistent transoceanic reception. Rather it is essential that the performance of the finest model be duplicated in every receiver in the series, over a long period of usefulness. Reliability of this order exacts a high degree of mechanical and electrical perfection attainable only by the application of strictly laboratory procedure to each and every receiver.

Considerations of reliability, to which no concession can be made, are further complicated by the characteristics of the higher frequencies and their circuits. Commercial receivers must be designed for beat-note as well as modulated-carrier reception. At the higher end of the spectrum, a frequency variation so slight as 0.001 percent may make all the difference between intelligibility and chaotic babel in code reception. Slight variations in inductance and capacity, negligible in even a high-grade broadcast receiver, will cause relatively great frequency shifts on the short waves, seriously affecting the performance and reliability of the commercial receiver. Engineering finesse of the highest order, accompanied with laboratory adjustments, is essential to the production of a single-control, short-wave receiver without manual compensation. Dielectric losses, inappreciable on the conventional set, assume proportions which make a receiver inoperable on waves below 50 meters unless special insulating material is employed. The possible use of the commercial receiver for rebroadcast purposes adds still further to the problems with which the designer must contend. The automatic volume control must be unusually effective in combatting the excessive carrier fluctuation of transoceanic stations. The high amplifications employed in rebroadcasting predicates a low noise-to-signal ratio, imposing added labors in the design of a humless power supply, and suggesting the use of a minimum number of high-gain tubes and circuits.

Consideration of how these qualifications are met in the National Type AGS receiver emphasizes many short-wave design points of basic importance and general interest to the engineer and experimenter. Numerous features of the receiver itself were described in RADIO NEWS for January, 1933. Further reference to the circuit diagram, Figure 1 (improved version accompanying this article), will illustrate several of the fundamental points of design.

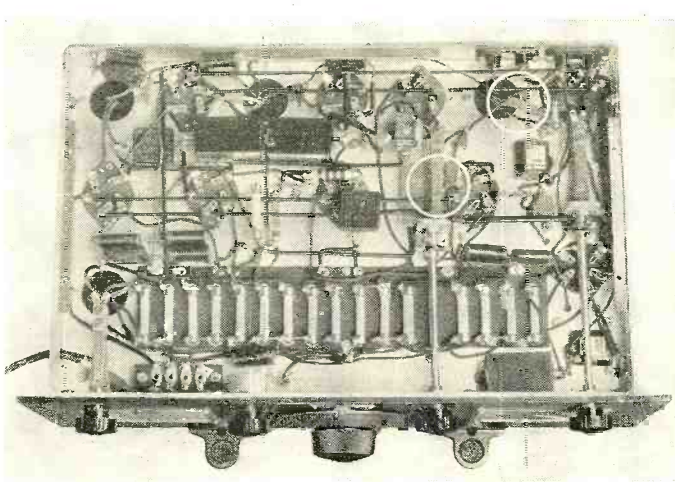
A stage of tuned-radio-frequency amplification precedes the first detector, providing pre-amplification and the rejection of "image" signal frequencies. A single tuned amplifying circuit is sufficient for this purpose, due to the high intermediate frequency of 500 kilocycles. The oscillator is mixed in the grid circuit of the first detector by transfer via the untuned primary in the plate circuit of the pre-amplifier. The first detector functions both as a mixing tube and as an r.f. amplifier at the intermediate frequency, thus providing, all told, three stages of highly effective i.f. amplification.

The oscillator is coupled to the load circuit by means of electronic coupling, a system which contributes much of the receiver's inherent stability. This method of coupling is so named because the interaction of the two circuits is directly dependent on the electron flow in the oscillator tube, rather than upon inductive or capacitative effects.

In Figure 1, both the screen-grid and plate of the oscillator tube function as anodes, with the screen grid, control grid and cathode

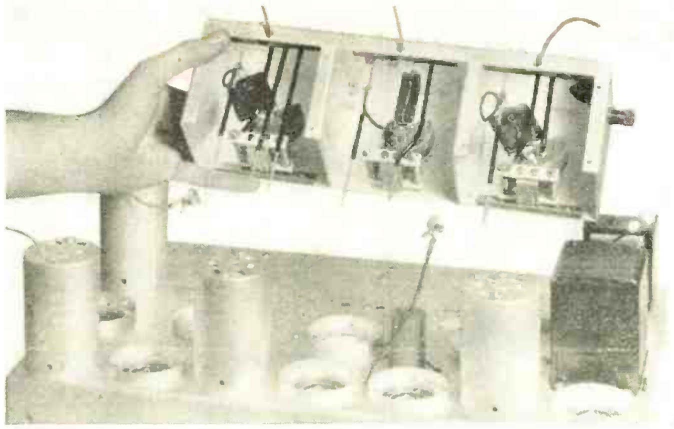
VIEW FROM BELOW

Figure 5. This construction facilitates part replacement. Note the shield details indicated by circles



* The National Company.

acting as the elements of a simple triode oscillator. Oscillations cause a pulsating flow of plate current which is used to set up an oscillating current in the load circuit (the plate circuit of the pre-amplifier) altogether independent of the primary oscillatory circuit. Thus there is no inductive or capacitative interaction between the oscillator frequency-determining circuit and the rest of the receiver. The frequency of the oscillator is also independent of any reasonable fluctuations in plate or heater voltages, caused by line variations, due to the fact that such changes set up counteractive effects between the two anodes in the oscillating tube.

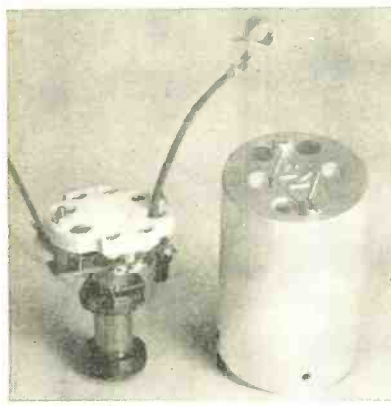


A STEP IN ASSEMBLY

Figure 2. The slide wires by which inductance of individual circuits can be adjusted are shown above

The windings of the intermediate-frequency transformers are of Litz—a wire that has demonstrated radio-frequency superiority over solid wire at the intermediate frequency of 500,000 cycles. The c.w. oscillator is set to beat with the i.f. at a highly stable frequency close to 500 kc., insuring a steady beatnote.

A convenient switch controls the output of the second detector, switching from earphones to the input of the pentode power-amplifier for loudspeaker operation. The power amplifying tube is of the new type –89, a three-purpose, three-grid tube operated as a Class A pentode. In this circuit, its high power sensitivity characteristic, utilized to fullest advantage by a Magnavox permanent-magnet dynamic speaker, provides high-quality audio output of several watts power.



I.F. COIL UNIT

Figure 3. Coils are Litz wound to reduce losses at 500 kc.

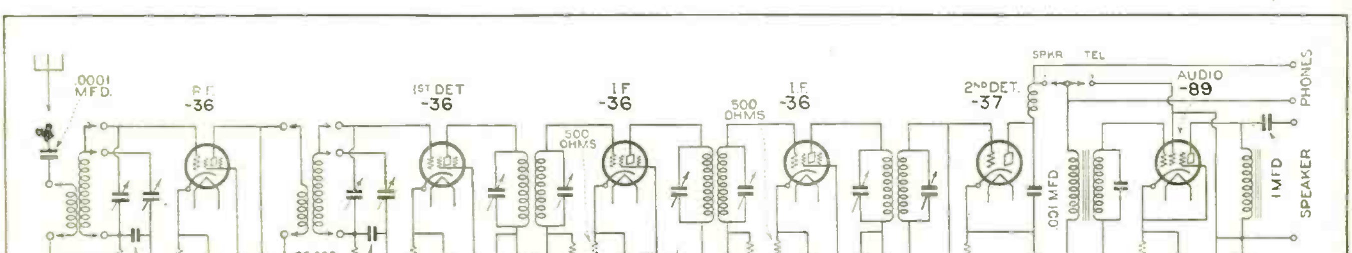
The hand-made character of this receiver is evident in the painstaking care with which each step in assembly is effected. Simple mechanical and electrical tests accompany the various stages of construction to insure rigidity, permanence of wiring and adequate bonding of shielded joints. This latter precaution results in the elimination of "creeping" r.f. resistance and contributes its mite in raising the signal-to-noise ratio. The receiver, in the course of assembly, is shown in Figure 2.

The first step in electrical adjustment is the alignment of the intermediate-frequency amplifier at 500 kc. This is effected in the conventional manner, with an oscillator, by the variation of primary and secondary capacitors. The construction of the i.f. units is shown in Figure 3. Following alignment, the intermediate-frequency amplifier is checked for gain, a laboratory test of definite importance which shows up such subtle faults as "power-factor" loss in the adjusting condensers and "maverick" wires in the Litz windings.

The second detector is logically next in line and is subjected to a series of tests which determine its overload capacity and reaction to signals of different degrees of modulation, following which the audio circuits receive routine inspection.

The volume-control circuit, which combines both manual and automatic actions, is the next recipient of laboratory vigilance. While the automatic volume-control tube functions in a conventional manner, receiving its input from the i.f. amplifier and varying the bias to the radio-frequency tubes through plate IR drop, the actual circuit and combination with the manual action are highly desirable innovations. The grid of the tube is operated at chassis potential, the cathode at 3 volts positive, the screen-grid at 16 volts and the plate at 30 volts. The manual adjustment operates by varying the cathode-grid bias of the a.v.c. tube, affecting the amplifying tubes through a relay action. The practically imperceptible (*Continued on page* 564)

FIGURE 1. THE CIRCUIT DIAGRAM OF THE TYPE AGS, COMMERCIAL RECEIVER



Mathematics in Radio

Calculus and Its Application in Radio

By J. E. Smith*

Part Twenty

IN order to prove a very important and fundamental relation in the application of calculus to radio circuits, let us investigate the simple series circuit of Figure 1. The current through this circuit is:

(1) $$i = \frac{e}{r_o + r}$$

The power delivered to the output resistance r is:

(2) $$p_2 = i^2 r$$

Now, from (1):

(3) $$i^2 = \frac{e^2}{(r_o + r)^2}$$

and substituting this value of i^2 in (2) we have:

(4) $$p_2 = \frac{e^2 r}{(r_o + r)^2}$$

In the above equation, let $e = 1$ and $r_o = 10$ ohms. Tabulating the results of p_2 for various values of r, we have:

When $r = 0$, the corresponding value of $p_2 = 0$

"	1	"	$\frac{1}{122} = .008$
"	5	"	$\frac{5}{225} = .022$
"	10	"	$\frac{10}{400} = .025$
"	12	"	$\frac{12}{484} = .0248$
"	15	"	$\frac{15}{625} = .024$
"	20	"	$\frac{20}{1600} = .013$

Plotting these values graphically as shown in Figure 2, we find that the maximum power occurs when the output resistance r is equal to 10 ohms. But this was also the value for the resistance r_o, so it can be concluded that the maximum power in an output resistance in a circuit similar to Figure 1 is obtained when the output resistance is equal to the internal resistances of the other parts of the circuit r_o.

In this simple case it was rather easy to plot the values of the variables and note the condition of maximum power. But there are many equations which are rather involved and where this method would be rather inconvenient. Let us investigate the possible use of calculus for solving this type of problem. It will be necessary at this time to point out a few additional and simple theorems of the fundamental calculus. Let us refer to the curve of Figure 3, which is similar to the one shown in the previous figure. The direction of such a curve at any point can be defined to be the same as the direction of the line tangent to the curve at that point. Therefore, a line PT tangent to the curve at point A will have an angle expressed as follows:

$$\tan \theta = \frac{o}{a}$$

We have previously learned that this is represented as the slope and is the value of the derivative at that point. It will be noticed that as the function is increasing, this tangent line will in general be making an acute angle with the axis of x. It will be equal to a positive number, since the $\sin \theta = o$, and $\cos \theta = a$ are in the first quadrant and have positive values: thus:

$$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{o}{a} = \frac{+}{+} = + = \text{slope} = \text{derivative}$$

When the function is decreasing, a tangent line drawn at any point such as C in Figure 3 will be making an obtuse angle "θ" with the axis of x. It will therefore be equal to a negative number; thus:

$$\tan r = \frac{\sin r}{\cos r} = \frac{+}{-} = - = \text{slope} = \text{derivative}$$

From the above analysis, since the derivative is a positive number up to the maximum point of the curve and a negative number beyond this point, it follows that at the maximum point it must be equal to zero.

This very important relation gives us a method of solving the following equation for the appropriate value of r.

(a) $$P_2 = \frac{e^2 r}{(r_o + r)^2}$$

In order that the power p_2 become a maximum, it follows:

(b) $$\frac{dp_2}{dr} = o$$

Solving:

(c) $$\frac{d}{dr}(p_2) = \frac{d}{dr}\left[\frac{e^2 r}{(r_o + r)^2}\right]$$

The solution of equation c appears to be a little complicated, but it is simply an application of the elementary forms of differentiation. Showing the intermediate steps of the solution, we have, first, the derivative of a quotient which is of the form:

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

Solving:

(d)

$$\frac{d}{dr}\left[\frac{e^2 r}{(r_o + r)^2}\right] = \frac{(r_o + r)^2 \frac{d}{dr}(e^2 r) - e^2 r \frac{d}{dr}\left[(r_o + r)^2\right]}{(r_o + r)^4} = o$$

Second, it will be recalled: (*Continued on page* 573)

* President, National Radio Institute.

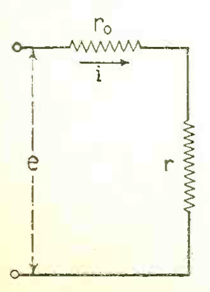


FIG. 1

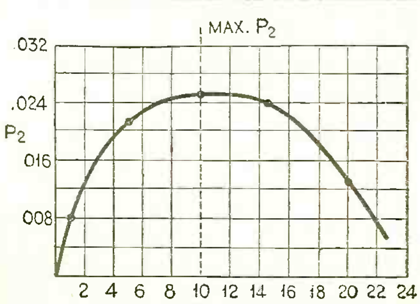
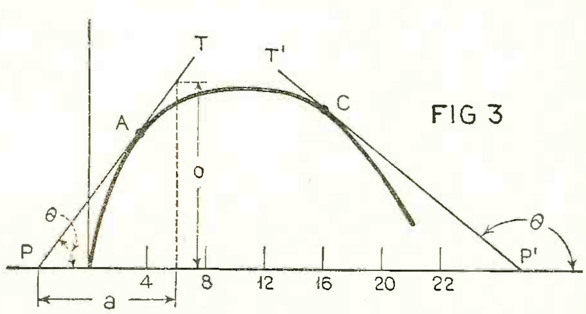
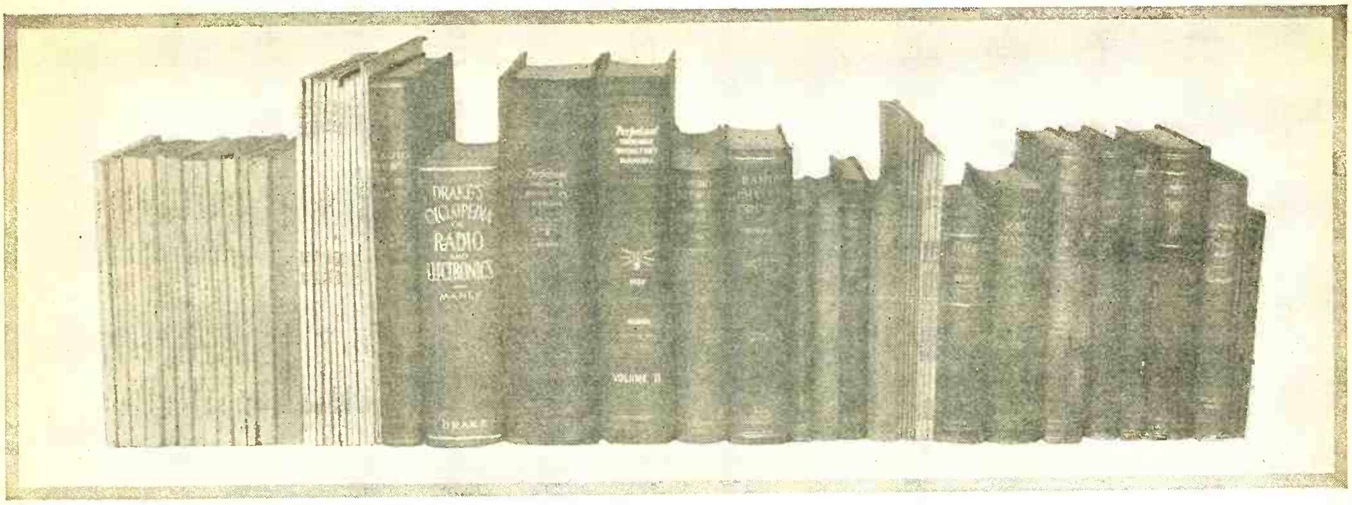


FIG. 2





Technical Review

RADIO SCIENCE ABSTRACTS

Radio engineers, laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by
Joseph Calcaterra

The Wonder Book of Electricity, edited by Harry Golding; Ward, Lock & Co., London. This book is one of a series of "Wonder Books" on different subjects. This is a popular treatise on electricity for "children of all ages." Most chapters of the book have been written by such authorities as Prof. A. M. Low, David Owen, Capt. Eckersley, W. S. Proctor and others. The book begins with a chapter entitled "What Is Electricity," wherein the reader is introduced to the electron theory. Subsequent chapters explain how electricity is developed and distributed. Then one comes to electrical communication. Chapters on broadcasting, television, "wireless wonders," automatic telephony, etc., familiarize the reader with the latest developments in this field. Finally, there are chapters on electrical measurements, and the use of electricity for controlling machinery, in medicine and for refrigeration. There are numerous illustrations of machinery and some of famous experiments. The writing of chapters by specialists assures accuracy of the contents. There is, however, a rather curious error in the chapter on sound pictures. It is said that the cameraman sometimes stands outside the booth when shooting a picture and turns the handle through a hole in the booth. This is, of course, impossible, since the camera must be synchronized with the sound camera which makes turning the crank by hand an impossibility. Special synchronous motors are used for this purpose.

Il Proiezionista di Filmi Sonori (The projection of sound pictures), by E. Costa; Ulrico Hoepli, Milan, 1933. A textbook for projectionists, entirely written in Italian. The larger part of this book is devoted to a treatment of the theory of sound, light, optics, acoustics, vacuum tubes, photo-cells and amplifiers. Description of apparatus and tubes often refers to European types, although some American makes are described, too. The book contains about 430 pages, and for anyone familiar with the Italian language it is well worth studying.

National Radio Institute Advanced Course in Television. Lesson 1TA—Essentials of Television, Part I. Lesson 2TA—Essentials of Television, Part II. Lesson 3TA—Optics. Lesson 4TA—Geometric Optics. Lesson 5TA—Applied Optics. Lesson 6TA—Television Quality Requirements. Lesson 7TA—Synchronization and Framing. Lesson 8TA—Telephotography and Facsimile Transmission. Lesson 9TA—Mechanical Television Systems. Lesson 10TA—Electronic Television Systems. Lesson 11TA—Television Studios and Transmitters. Lesson 12TA—How to Build Radiovisors. Lesson 13TA—How to Build Radiovision Receivers. Lesson 14TA—How to Build Radiovision Receivers, Part 2.

The television course distinguishes itself by an extraordinarily thorough treatment of the fundamentals: scanning, optics, synchronization, etc. For the understanding of new developments in television a good knowledge of the basic principles is essential. Another feature of the course is the abundance of practical information. The student is shown how to make his own phonic wheel, scanners of all types, and the use of television lamps as well as the cathode-ray tube. The last two lessons describe the construction of a complete television receiver. These chapters contain much information on the design of the r.f. tuner and the resistance-coupled amplifier so as to obtain the fidelity required for television.

Review of Articles in the December, 1932, Issue of the Proceedings of the Institute of Radio Engineers

An Investigation of Various Electrode Structures of Cathode-Ray Tubes Suitable for Television Reception, by Allen B. Du Mont. This paper is a summary of the facts learned in an experimental determination of the characteristics required in a cathode-ray tube when used for television as against the use of similar tubes for cathode-ray oscillographs. The construction features found to produce best results for television are discussed.

Applications of the Cathode-Ray Oscillograph, by Ralph R. Batcher. A discussion of the factors which affect the accuracy of results in the application of cathode-ray tubes to oscillographic measurements. Means for minimizing or compensating for the effects of distortion are outlined. A description of several oscillograph tubes and associated apparatus, in which simplicity of operation is a feature, is given.

A Note on an Automatic Field Strength and Static Recorder, by W. W. Mutch. This paper contains a description and circuit of a device for making a continuous record of the energy received from a signal or from static, with data for making modifications whereby peak or average voltage may be recorded. The device is specially suited for making field-strength tests on broadcast stations and for static studies over different periods in various localities.

Some Notes on Demodulation, by Hans Roder. This paper describes a method of finding the detector output if the radio-frequency envelope and the rectification characteristic of the detector are known. The independent character of the radio-frequency envelope and the detector characteristic is brought out in pointing out the range over which the detector output can be controlled at the receiver.

Review of Two Papers from the October, 1932, Journal of the Acoustical Society of America

Acoustics of Large Auditoriums, by Samuel Lifshitz. The effects of size, shape, reverberation time, articulation field and absorbing material on distinctness of speech and music as a result of investigations conducted in large auditoriums are given in this article. The results point out the factors which affect the design, shape and size of auditoriums.

Acoustic Pick-up for Philadelphia Orchestra Broadcasts, by J. P. Maxfield. This paper discusses the various factors of microphone placement with respect to acoustic conditions and the proper "mixing" and volume control required in the control apparatus to produce the maximum artistic effect possible at the receiver.

Review of Contemporary Literature

Generating High Frequencies with Precision, by R. A. Heising. Bell Laboratories Record, December, 1932. This article describes the means perfected to generate high frequencies which can be adjusted in steps of one cycle over a fairly wide range of frequencies.

Transmission Lines for Short-Wave Radio Systems, by C. B. Feldman. Bell Laboratories Record, December, 1932. This paper discusses the various factors which must be considered in the design of transmission lines to avoid transmission losses, interference and the reception of undesired signals, static and noise.

The Existence of More Than One Ionized Layer in the Upper Atmosphere, by Geoffrey Builder. The Wireless Engineer and Experimental Wireless, December, 1932. In this paper the results obtained by the chief wireless methods of investigating the electrical structure of the upper atmosphere are shown to support the hypothesis of the existence of at least two layers of ionization capable of reflecting radio waves.

Interference: Notes on Methods for Elimination of Interference Caused by Non-Radio Devices, by E. T. Glas. The Wireless Engineer and Experimental Wireless, December, 1932. The various types of interference are discussed in this article and the design of suitable filters is explained in detail.

A Signal Generator for the New Receiver Tests, by A. E. Thiessen. General Radio Experimenter, November, 1932. The new method of testing the response of a receiver to a desired signal and the interference created by signals on nearby frequency channels is described. The characteristics of a standard signal generator for the purpose are given.

A Direct-Reading Meter for Power and Impedance Measurements. General Radio Experimenter, November, 1932. This article gives a complete description of an instrument which is designed to give direct readings of power and impedance measurements over a wide range of impedance values, and eliminates the tedious work and time usually required to obtain such measurements in the usual way, using the ordinary methods.

Directive Antennae for Broadcast Stations, by Raymond M. Wilmotte. Electronics, December, 1932. The interesting manner in which WFLA solved the problem of providing high field strength over the territory it desired to serve, without interfering with another station transmitting on the same frequency, by the use of a directive antenna, is explained in this article. The possibilities in the use of such antennas to permit increase in power and economy in operation without causing interference is pointed out in the article.

Reducing Man-made Static, by Glenn H. Browning. Electronics, December, 1932. This paper gives a mathematical discussion of the design factors involved in eliminating man-made interference by means of suitable shielded lead-in and ground wires together with an impedance-matching network to eliminate transition losses resulting from the large capacity introduced by the shielding.

Beat-Frequency Oscillator Control: Determining Proper Plate Shape, by G. F. Lampkin. Electronics, December, 1932. An exposition of the design factors used in working out the proper shape of the plates of a condenser for use in a beat-frequency oscillator.

One More Step in Universal Communication. Radio Engineering, December, 1932. A description of the essential features of a new combination telephone and telegraph transmitter and receiver unit for portable use which weighs only 22 pounds, has a rating of ½ watt and transmits on a 5-meter waveband. The unit is designed especially for army, police, fire department and forestry use.

An All-Purpose 56-MC Station, by Ross A. Hull. QST, December, 1932. A complete description, with wiring diagrams and constructional data on four units—power supply, oscillator, modulator and receiver, interconnected by three cables to form a flexible, highly efficient Class B equipped 5-meter outfit.

How to Calibrate Your Frequency Meter from WWV, by Louis Berkowitz. QST, December, 1932. A description of a simple method by means of which the 5000 kc. transmissions of WWV may be used to calibrate an amateur frequency meter. The advantages of making the calibrations with this transmission are pointed out.

How to Get Copies of Articles Abstracted in This Department

The abstracts of articles featured in this department are intended to serve as a guide to the most interesting and instructive material appearing in contemporary magazines and reports. These publications may be consulted at most of the larger public libraries, or copies may be ordered direct from the publishers of the magazines mentioned.

RADIO NEWS *cannot undertake to supply copies of these articles. They are NOT included in the* RADIO NEWS *Free Technical Booklet Service.*

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THROUGH the courtesy of a group of radio manufacturers, RADIO NEWS now offers to its readers this Technical Booklet Service. By means of this service readers of RADIO NEWS are able to obtain quickly and absolutely free of charge many interesting, instructive and valuable booklets and other literature which formerly required considerable time, effort and postage to collect.

To obtain any of the booklets listed in the following section, simply write the numbers of the books you desire on the coupon appearing at the end of this department. Be sure to print your name and address plainly in pencil, and mail the coupon to the Radio News Technical Booklet Service. Stocks of these booklets are kept on hand and will be sent promptly as long as the supply lasts. Do not send for any material in which you are not actually interested or of which you already have a copy, in order to avoid waste and needless postage expense.

To avoid delay, please use the coupon provided for the purpose and enclose it in an envelope by itself or paste it on the back of a penny postcard. The use of a letter asking for other information delays the filling of your request for booklets and catalogs. If possible, however, please enclose one of your blank business letterheads to establish your connection in the industry.

Review of Technical Booklets Available

1. *1933 Radio Parts and Sets Catalog*. A complete catalog of over 130 pages, issued by the Wholesale Radio Service Co. The catalog contains illustrations, descriptions, specifications, list and net prices of a complete variety of radio parts, tools, replacement items, receiver chassis, complete sets, public-address systems and electrical merchandise required by dealers, servicemen, set builders, amateur and commercial operators, experimenters and engineers.

2. *1933 R.F. Parts Catalog*. An 8-page folder containing complete specifications on the entire line of Hammarlund variable and adjustable condensers, r.f. transformers, sockets, shields and miscellaneous parts for broadcast and short-wave receivers, complete short-wave receivers and transmitting variable condensers.

4. *A 15 to 200-Meter Superheterodyne*. A description of the outstanding features of the Hammarlund-Roberts high-frequency superheterodyne designed especially for commercial operators for laboratory, newspaper, police, airport and steamship use.

5. *A 1933 Volume Control, Fixed and Variable Resistor Catalog*. This 14-page catalog, issued by Electrad, Inc., gives complete data on standard and special replacement volume controls, Truvolt adjustable resistors, vitreous wire-wound fixed resistors, voltage dividers and other resistor specialties, public-address amplifiers (using new tubes). Many revisions and additions to the 1932 line are included.

6. *Line Voltage Control*. Complete characteristics and uses of a real voltage regulator and complete chart showing the correct Amperite recommended by set manufacturers for their receivers. Also tells how to improve your customers' sets and make a profit besides.

8. *Trouble-Shooting in A.C., D.C. and Battery Sets*. This is a sample lesson of the National Radio Institute Course. It contains valuable information on how to overcome hum and noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, etc. It is available only to RADIO NEWS readers who are over 16 years of age and who are residents of the United States or Canada.

9. *Catalog of Fixed, Metallized and Precision Resistors*. This 16-page catalog gives complete specifications of the International Resistance Co. 1933 line of metallized, wire-wound and precision wire-wound resistors, motor radio suppressors, handy servicemen's kits, valuable technical data and list of free bulletins available on the building of servicemen's test equipment.

10. *Information on the Suppression of Motor Radio Noises*. This interesting and useful folder of the International Resistance Co. gives complete information on how to overcome motor-generator, ignition coil, interrupter and spark-plug noises in automobile radio installations.

16. *RMA Standard Resistor Color Code*

Chart. A handy post-card size color-code chart designed by the Lynch Mfg. Co. to simplify the job of identifying the resistance values of resistors used in most of the standard receivers. It also contains a complete list of the most commonly used values of resistors with their corresponding color designations. A complete catalog of Lynch products is included.

25. *Transposition Noise-Reducing Antenna System.* A detailed description, with technical data, on a new antenna system, perfected by the Lynch Mfg. Co., which is effective in eliminating the majority of electrical noise interference on both broadcast and short-wave reception. It is especially suited for application on all-wave receivers which have sometimes given unsatisfactory results because of objectionable interference on the shorter waves. It can be applied to existing installations and offers a big field for profitable jobs for the serviceman. Its use on amateur receivers makes possible more and better QSO's.

29. *Practical Radio Engineering.* A 28-page book which gives a detailed description of the home-study course in practical radio engineering offered by the Capitol Engineering Institute. The course is divided into two main parts. The first part is intended to provide the student with the fundamental knowledge and training required to thoroughly understand the second part which is an advanced course in radio engineering. The course prepares the student for actual radio engineering work in the industry. Stress is laid on the practical application of radio principles.

30. *Shielded "Noise-Reducing" Antenna System for Broadcast Waves.* A complete description of a new Lynch low-cost, impedance-matching system of unique design—including impedance-matching transformers for the antenna and for each receiver—which now makes possible the use of a shielded transmission line of any length, without loss of signal strength. This system is designed for the elimination of "man-made" electrical interference on the broadcast frequencies, and because of its low cost, the ease with which it can be installed and the means it provides for using several receivers on a single aerial, it offers many opportunities for profitable jobs to dealers and servicemen.

31. *The Recording Phonograph.* A descriptive folder on a high-quality instrument in three models, made by the Samson Electric Co., which makes possible faithful recording (on aluminum discs) and reproduction of lectures, musical renditions, radio programs, dictation, etc., for homes, schools, colleges, theatres, hotels, etc. It can also be used as a high-quality phonograph to reproduce standard disc records.

32. *Microphones and Accessories.* Complete descriptions and specifications of a wide variety of high-quality hand, desk and suspension microphones of all types, such as carbon, condenser and dynamic, made by the Samson Electric Co. Specifications of microphone stands and cables are included.

34. *Serviceman's Replacement Volume-Control Chart.* A revised complete list, in alphabetical order, of all old and new receivers showing model number, value of control in ohms and a recommended Electrad control for replacement purposes. Contains specifications for over 2000 different receiver models. A handy chart which should be in every serviceman's kit.

35. *Paper and Electrolytic Condenser Catalog.* A 16-page book giving specifica-

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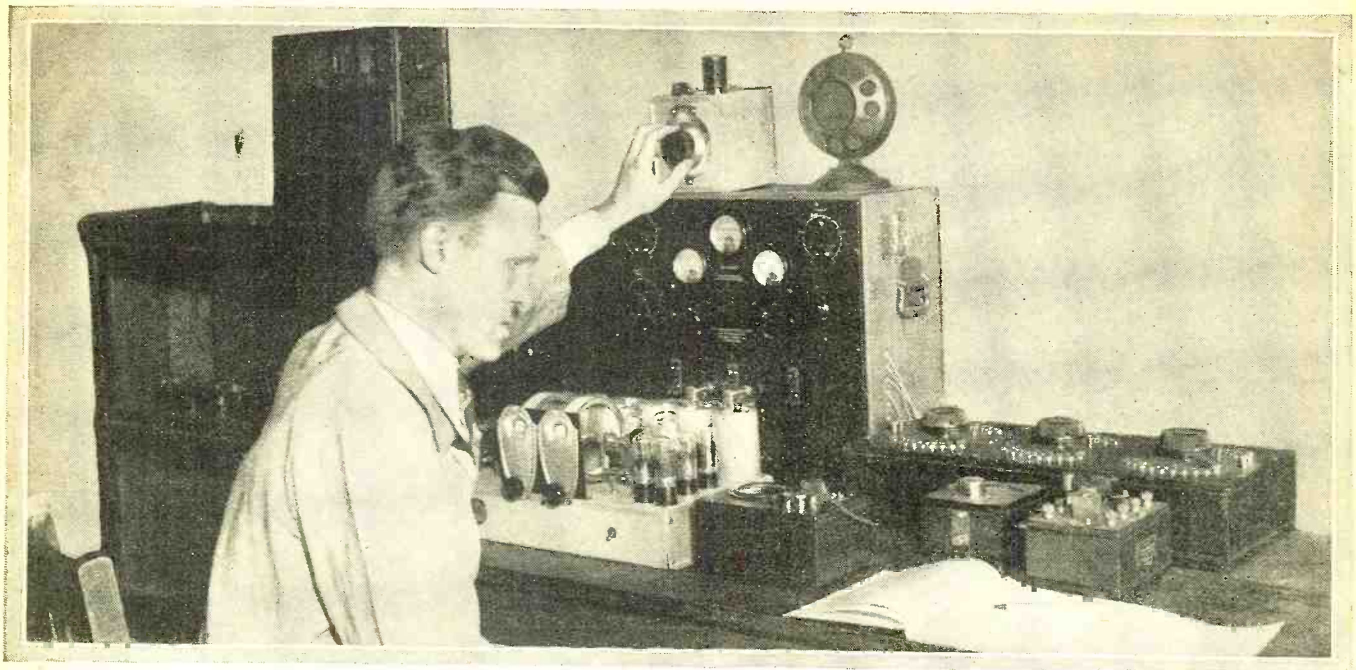


With the Experimenters

Simple Equipment for Measuring Capacity, Using a Dynamic Loudspeaker as a Microphone, Home-made Rotary Switch, How to Operate A.C. Dynamics from a Car Battery, An Antenna Which Reduces Noise

Conducted by
S. Gordon Taylor

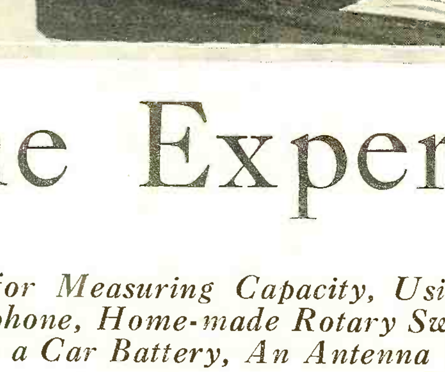
A Simple Capacity Bridge

It is a generally accepted fact that every serviceman's laboratory should contain an ohmmeter, an oscillator, and a set and tube checker. In addition to these instruments, the author has found it very desirable to have some quick, as well as accurate, method of determining unknown capacities.

Very little apparatus will be required to construct an instrument of this latter kind. As can be seen from the illustrations, the apparatus consists essentially of a source of a.c. potential, an indicating instrument, a known standard of comparison, and a variable resistance. It will be well to say a word about this latter item. Any variable resistance having a value of from 1,000 to 100,000 ohms may be used. It is necessary, however, to know the total resistance of the unit and to be able to determine what portions of this total resistance are being used for any given setting of its dial. Refer to figure 1. Suppose the total resistance of the unit is 1,000 ohms and we are using a dial which is calibrated from 0 to 100. Then, every division on the dial represents 10 ohms resistance. If our dial reads, say, 63, we are reasonably sure that we have a resistance of 630 ohms on one side of the slider arm and 1000-630=370 ohms on the other side.

To operate the instrument, connect the apparatus as shown in Figure 2. At the point marked C, we use a known capacity, which should not vary too greatly from the value we believe the unknown to be. In other words, if we believe the unknown condenser to have a capacity of something near 1. mfd. we would use a known capacity at C of perhaps 0.5 mfd., or one perhaps as high as 2.0 mfd. Convenient binding posts may be arranged so that these connections may be easily and simply made.

The oscillator is started and its note will be heard in the headphones. The slider arm of the resistance is then varied until the oscillator note can no longer be discerned. If the slider is moved further in the same direction the note will again become audible. The point we desire to find is the spot of



least volume, at which the bridge is said to be balanced. If a galvanometer is used in place of the headphone, this balance is indicated when the meter deflects in neither direction. We can now calculate the value of the unknown capacity from the following equation:

$$X = \frac{BC}{A} \qquad (1)$$

where X is the unknown capacity, A is the resistance as read from the dial of the variable resistor, B is the total resistance minus the reading of A, and C is the capacity of the standard.

A specific example will perhaps make the procedure more clear. The unknown capacity is connected at the point X, the standard being connected at C. The capacity of the standard is ⅓ mfd. The oscillator is now started and the resistance is varied until the signal is no longer discernable in the headphones. Our resistance dial now reads 31.3—the equivalent of 313 ohms. This is the A of our equation; and for B we have 1000-313=687 ohms. Multiplying 687 by ⅓ (the C of the equation) we get 229. We now divide this 229 by A, and get 0.72 as our answer. This value is the capacity of the unknown condenser.

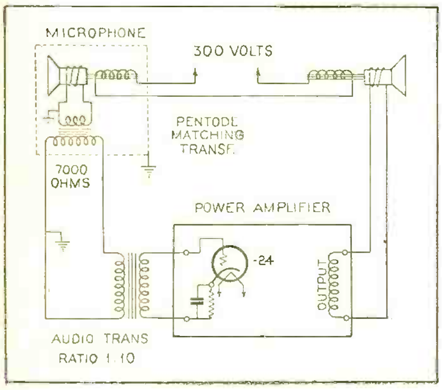
Some readers may lack both the audio oscillator and the galvanometer suggested to build the instrument as described here. In that case it is only necessary to substitute the 110 volt 60 cycle alternating current supply as the source of potential and a headphone as the indicating instrument. When a headphone is used, regardless of the source of potential, care must be taken to find the exact spot at which the volume is weakest, in order that a minimum of error is caused in locating the bridge balance. It is usually more satisfactory to use a small step-down transformer with this later voltage so that only 10 or 12 volts potential is actually connected across the apparatus. This low voltage also eliminates the danger of getting a shock while using the equipment.

The device as described is particularly effective in determining the capacity of variable condensers at different settings. As an example, suppose we have constructed a circuit in which we are using a variable condenser of 0.0005 microfarad capacity with its plates only partly meshed. We desire to substitute a fixed capacity for this variable one in order to make the equipment more compact. We therefore remove the variable condenser from the circuit, taking care not to disturb its adjustment, and measure its capacity in our bridge circuit. We can now substitute a fixed capacity of this amount and get exactly the same results from our circuit as when we were using the variable condenser.

MILBURNE O. SHARPE,
Knoxville, Tenn.

Novel Microphone Stunt

Noticing an article on the dynamic microphone in a recent issue of RADIO NEWS, we thought of trying an ordinary a.c. dynamic speaker as a microphone. The unit used was a Utah Carter 8-inch dynamic speaker with matching transformer for single pentode and 2,500 ohm field. The power amplifier used was composed of a –24 resistance-coupled into a –27 which fed push-pull –47's. The field coils of the output



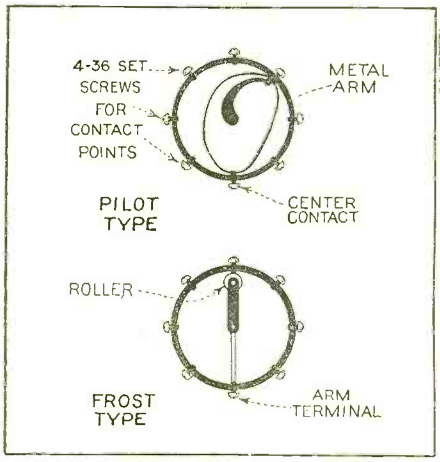
speaker and the dynamic microphone were connected in series. It was found necessary to put a condenser across the field coil of the microphone in order to avoid oscillation between it and the output speaker.

Except for some attenuation of the treble, the results were very satisfactory. The unit was so sensitive that a band playing half a mile away could be heard distinctly. The hum was surprisingly low despite the fact that there was no special provision made for filtration of the current supplied to the microphone field. It was found necessary to experiment with the polarity of the microphone field in order to reduce hum to a minimum. When phones were placed in the circuit no hum was perceptible. Considering the fact that no changes were made to the unit the results were highly commendable.

HOWARD C. WHITE,
RALPH A. MARSH,
Chilliwack, B. C., Canada.

Inexpensive Rotary Switch

The next time you need a rotary switch look in the junk box before you go out and buy one. Dig out an old Pilot Volumgrad or Frost potentiometer with a bakelite shell. Take off the cover and remove the resistance element. At equal distances around the shell, centered between the edges, drill holes for the contact points. The number of contacts and the spacing will depend on what the switch is to be used for. Short 4/36 machine screws are used for contact points. Drill the holes so that the screws will have to be forced in and thus cut their own threads. Be careful that the holes are not too small, as too much pressure will cause the shell to crack. Let the screws project inside just far enough to make good contact with the moving element. The switches can



handle quite a little current. I use one of these switches in the filament circuit of a tube tester and it can handle 2 amps. without any trouble.

HARRY SCHMIDT,
Richmond Hill, N. Y.

Operating A.C. Dynamics from Car Battery

Here's a kink for the mobile public address gang. All 110-volt a.c. speakers employing a step-down transformer and dry-disc rectifier can be used with a 6-volt storage battery. To do this, the supply leads from the field coil to the rectifier are clipped and the field side brought out to terminals for the 6-volt supply.

The rectifier side may be brought out for emergency charging of the battery if desired. The field coil in speakers of this type are wound for 7 volts d.c. at 1.5 amperes, and operate perfectly on 6 volts from a car battery.

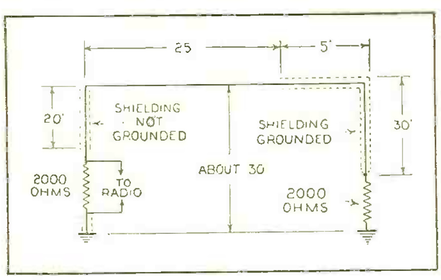
By using a double throw switch the speaker can be switched off the battery to the rectifier for a.c. operation when line current is at hand.

W. T. GOLSON,
Dothan, Ala.

Another Noise-Reducing Antenna

In the October Experimenters Department of RADIO NEWS I saw an article by Mr. Joseph Stokes on DX broadcast band reception with a filtered aerial. My work in this field extends back several years and I am giving herewith the results.

Back in '29 I was working for a department store when I developed an antenna similar to that described by Mr. Stokes.



This system was designed to overcome interference (noise). The fact that the same system also resulted in extraordinary DX reception was to me merely incidental.

The very fine results obtained with a properly designed antenna of this type may be accounted for to some extent by the fact that it is directional, greatly favoring sig-

(*Continued on page* 573)

The Service Bench

Resistors for Voltmeter, Ammeter and Ohmmeter Circuits; Service Kinks—Cleaning Prongs, Drill Holders, Collodion Cement; All in the Day's Work—Replacing Speaker Screens, Auto Antennas, Noisy By-pass Condensers, Servicing Autodyne Circuits

Conducted by
Zeh Bouck

IT is generally appreciated by the serviceman that the various forms of direct-current meters used in radio measurements are fundamentally the same, and vary principally in the values of the resistors used with them and the manner of connection. However, considerable confusion seems to exist in the application of the principle involved—a vital consideration in these days where often one meter must do the work of three or more.

The fundamental unit is a sensitive galvanometer—the more sensitive, the greater the elasticity of ranges. Series resistors are used to increase the voltmeter range, shunt resistors to extend the ammeter range; and either the voltmeter or ammeter, in conjunction with a known voltage source, can be calibrated to read in ohms. The interrelation of voltage, current and resistance—volts, amperes and ohms—is expressed by Ohm's law, and if the principle is understood, any meter, regardless of type or manufacturer, can be converted for current, voltage or resistance measurements within the limits of sensitivity of the instrument.

Ohm's law states that $E = IR$ (1)

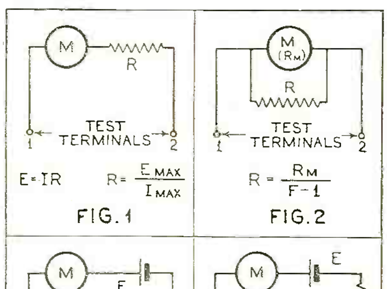
—where E is the potential in volts, I is the current *in amperes* and R is the resistance in ohms. Similarly

$$I = \frac{E}{R} \quad (2) \qquad \text{—and } R = \frac{E}{I} \quad (3)$$

The most convenient fundamental measuring instrument in radio work is the 0 to 1.5 ma., d.c. meter—i.e., a milliammeter reading from 0 to .0015 ampere. It is sufficiently sensitive for all practical work and rugged enough to stand the rigors of servicing. Bear in mind that the use of resistors is to *increase* the range. It is easy enough to convert a meter, originally designed to read up to .0015 ampere, to read as high as 10 amperes; but it would entail the ripping out of built-in shunts to redesign a 10-ampere meter for a 1.5-milliampere range.

Voltage Multipliers

According to equation (1), voltage equals the current in amperes multiplied by the resistance in ohms. Hence, in a circuit such as Figure 1, if we disregard the resistance of the meter and battery or other potential source (which are negligible if a highly sensitive meter is used), the voltage across the test terminals, 1 and 2, will be equal to the current in amperes, indicated by the meter, multiplied by the resistance R. The highest voltage that can be measured will equal the range of the meter times R. In accordance with equation (3), the resistance required for any desired range will be equal to the maximum voltage to be measured divided by the maximum range of the meter.



GIVEN: an 0-1.5 milliampere meter. REQUIRED: voltage range of 150 volts. *Find value of R.*

$$R = \frac{E}{I} = \frac{150}{1.5 \text{ ma.}} = \frac{150}{.0015} = 100{,}000 \text{ ohms}$$

Current Shunts

By connecting a resistor across the meter, part of the total circuit current will be carried by the shunt, lowering the current through the meter, thus making it possible to utilize the meter for higher current readings than those for which it was designed. This circuit is shown in Figure 2, and the formula by which the shunt value is computed is—

$$R = \frac{R_m}{F - 1} \quad (4)$$

—where R is the resistance of the shunt, R_m the resistance of the meter, and F the factor by which the maximum range of the meter is to be multiplied.

GIVEN: an 0-1.5 milliampere meter. REQUIRED: current range of 15 milliamperes. *Find value of R.*

$$R = \frac{R_m}{F-1} = \frac{R_m}{10-1} = \frac{1}{9} R_m$$

In other words, the shunt resistor should have a value one-ninth the resistance of the meter itself. Obviously, the resistance of the meter must be known—a fact that can be ascertained by consulting a catalog, by writing to the manufacturer, or experimentally.

Equation (4) itself indicates a simple method of determining the meter resistance. If a variable shunt resistor is cut in until the current reading is halved, the shunt resistor now equals the resistance of the meter, and can be measured, preferably on a bridge. The meter itself can be measured directly on a bridge, providing the bridge current does not exceed the rating of the meter.

A simple and practical method of current multiplying is to connect a low resistance across the meter and note the fractional drop in current—say from 1 milliampere to .25 milliampere. This fraction will hold for all readings, and in the example just cited, the range of the meter has been multiplied by four.

Ohmmeters

Figure 3 shows the fundamental ohmmeter circuit and equations. GIVEN: $E = 1.5$ volts and $I = .5$ milliamperes. REQUIRED: resistance of R_x.

$$R_x = \frac{E}{I} = \frac{1.5}{.5 \text{ ma.}} = \frac{1.5}{.0005} = 3000 \text{ ohms}$$

When using the circuit of Figure 3, care must be observed that the resistor being tested is sufficiently high so that no more than the maximum current will be passed through the meter. This precaution generally resolves itself into the circuit of Figure 4, where R is a limiting resistor. It is usual to choose R, by means of equation (3) so that the meter will just read maximum current with the test terminals, 1 and 2, shorted. For instance, with a 0-1.5 milliampere meter and a 1.5-volt flashlight cell—

$$R = \frac{E}{I} = \frac{1.5}{1.5 \text{ ma.}} = \frac{1.5}{.0015} = 1000 \text{ ohms}$$

This circuit is easily calibrated by calculation. The needle swings to the left as the resistance R_x, under test, increases. It is usually accurate as low as 50 ohms.

For still lower value resistors, the circuit shown in Figure 5 is recommended. Once again R is the limiting resistor, and a value is chosen so that the meter swings "full scale" when the test terminals, 1 and 2, are *open*. The needle, in this circuit, swings to the right with increasing test resistor values.

This circuit is more difficult to calibrate, due to the fact that the meter resistance must be known. The symbols in the formulas accompanying the diagram are as follows—R_m is the resistance of the meter; I_{max} is the full-scale or "open" test terminal reading in amperes; I_{rm} is the current reading of meter during test. A switch is provided to open the circuit when the meter is not in use.

Circuit 5 is best calibrated against low values of standard resistors. As a matter of fact, all mathematical calculations should be checked this way at three or four points. A few "spot" points on the proper cross-section paper will greatly facilitate calibration. Using d.c. meters, circuits 1, 2 and 3 calibrate in a straight line on ordinary coordinate paper. Circuits 4 and 5 will plot a straight line only on logarithmic paper.

Special scales can be prepared and placed over the milliampere scale for direct reading.

In Conclusion

All equations given here are based on volts, amperes and ohms. Considerations involving megohms, millivolts, milliamperes, or any other subdivisions or multiplications of the fundamental units, should be converted accordingly before computations are undertaken.

The power requirements of the resistors used in these circuits are usually well under

SHOP AND KIT EQUIPMENT

Frank W. Bentley, of Missouri Valley, Iowa, dedicates two ideas to the methodical and efficient serviceman—in other words, to all of us.

"The usual method of cleaning tube prongs, tips, volume controls, etc., is by means of sandpaper or emery-cloth. Neither is particularly suitable for the purpose, being too light, and the fingers cannot get down to many places with the paper or cloth. I employ a much more effective substitute in the shape of small-size nail cards or emery boards, which are readily and cheaply obtainable in neat packets at any counter selling toilet goods. The size of the strips can be gathered from the photograph in Figure 6. They are of stiff, durable cardboard, with fine and rough abrasives on the opposite sides. In the illustration, a common tobacco can has been cut down, which protects several

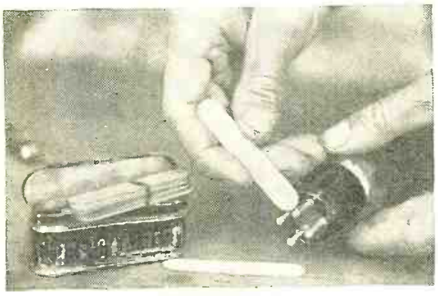


FIGURE 6

dozen when carried in the serviceman's kit.

"Another contribution to general efficiency is suggested in Figure 7, which shows a simple carrier for drills serving several purposes. It is made by pushing out the lead from an adequate length of pencil, by means of a blunt nail. Plugs are whitled for both ends, one plug having an enlarged shank to facilitate removing. Delicate drills are pro-

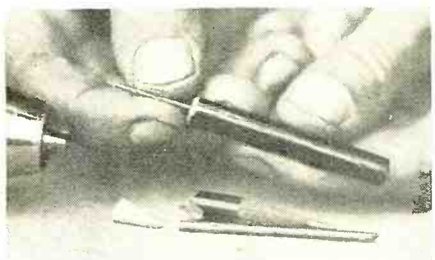


FIGURE 7

tected from breakage and rust—the latter condition being responsible for premature dullness. The drills can be readily found and instantly identified by notches on the pencil case."

Collodion Cement

Several inexpensive collodion cements have been described from time to time in the *Service Bench*. A small bottle of such cement should be in every service kit and will soon justify its presence in "tacking" loose wires on coils, in loudspeaker repairs, etc.

Liquid nail polish—any color—is an excellent cement for this purpose, and the small bottle in which it is sold makes a convenient kit size, with the added feature of providing a brush stopper for application. It is recommended, however, that when the original nail polish supply is exhausted, the bottle be refilled with any of the numerous and much cheaper substitutes.

ALL IN A DAY'S WORK

Charles Felstead of Los Angeles, California, solves a knotty problem for the serviceman as follows:

"The silk cloth that is fastened over the speaker opening and the back of a radio receiver, serving as a dust screen, is often rather difficult to replace after it has been removed in the course of servicing. It is usually in a section of the cabinet that is so close to the receiving set as to prohibit the use of a tack hammer, and it is almost impossible to do a neat job of gluing the silk in place. The easiest solution to this difficulty is to employ very small tacks of the type used to secure window curtains to the

(*Continued on page* 575)

Personal interviews with broadcast artists and executives

BILL MITCHELL PEARL PICKENS

Backstage in

By Samuel

THE hill-billy type of program seems to be gaining in favor with radio audiences. An NBC Tuesday period now features Carson Robison, one of the foremost exponents of the American folk-music termed "hill-billy." The new series, sponsored by Barbasol, also features Robison's Pioneers, consisting of John and Bill Mitchell and Pearl Pickens. The Pioneers play harmonicas, banjos, guitars and harmonize with Robison in his melodies of the backwoods and plains. The group brings to the American airlanes a good reputation built up in England, where it is said to have broken attendance records at smart show places. Carson Robison, a native of Kansas City, is a pioneer radio entertainer and first appeared in the Midwest as the "Kansas City Jay-Bird." Robison has composed over 200 songs. John and Bill Mitchell are natives of Columbia, Tennessee, who have made a lifelong study of mountain music. Off the air, Pearl Pickens is Mrs. Bill Mitchell.

FRANK BLACK, well-known NBC conductor, composer and arranger, has been appointed general music program director of the network, succeeding Erno Rapee. Black's manifold musical activities have earned him an enviable record in the broadcasting world. He is perhaps best known for his vocal arrangements of orchestral compositions. He has specialized in making symphonic arrangements of popular tunes as well as the reverse—simplified arrangements of the classics. Frank Black, a native of Philadelphia, began studying music at the age of six. Four years later, he gave his first recital. He studied organ in Philadelphia and commuted to New York to study piano. After his graduation from Haverford College, Black conducted and played for many noted artists. He became associated with broadcasting when the art was in its infancy. For some years, in addition to his other duties, Black wrote the arrangements for the Revelers Quartet and has acted as its accompanist. Black is accredited with creating lyrical settings to well-known piano and

Our "Uncle

¶ *The real name of David Ross (CBS), the 1932 diction winner, is David Rosenthal. . . . Groucho and Chico Marx continue their humorous antics when "out of character." . . . Despite the much-talked-of unimportance of fan mail, letters to artists are still among the best sponsor baiters. . . . Jack Benny doesn't seem to click as well with his new CBS program with Ted Weems as he did on the NBC with George Olsen. . . . Sponsors are showing more care in preparing commercial announcements. . . . Count Von Luckner rates prolonged applause for excellent commercial bit on "The Five-Star Theatre" series. . . . Johnny Johnstone, NBC publicity executive, has a liking for foreign orchestra recordings and spends his occasional spare moments listening to them in his office. . . . What has happened to the "Miss Radio" contests? . . . Most stage and talkie productions centered around broadcasting plots have been flops. . . . Despite constant criticism from many sources, virtually all of our headlining radio comedians are continuing to use antiquated gags. . . . Although their respective styles of entertaining are miles apart,*

ALFRED J. McCOSKER

FRANK BLACK

RICHARD CROOKS

LAWRENCE TIBBETT

CARSON ROBISON JOHN MITCHELL

Chatty bits of news on what is happening before the microphone

Broadcasting

Kaufman

orchestral works. Among them are Rachmaninoff's "Prelude in C Sharp Minor," which he called "Bells at Eventide," and "Prelude in G Minor," which he designated "Sea Tales." Rachmaninoff accorded his approval to both of these efforts of Black.

Sam"Says

listeners are continuing to get the names of Jack Benny, the humorist, and Jack Denny, the musician, confused. . . . Roxy's Radio City broadcasts would be better if he eliminated some of his intimate cross-chatter with artists when introducing them. . . . Rudy Vallee seems to have obtained a firmer footing than ever in the radio domain. . . . Bing Crosby registers better on the screen than he does on the stage or air. . . . Jack Pearl has the reputation of being one of the most superstitious persons on the air. . . . When Bob Taplinger, CBS press represenative, wants to telephone Morton Downey, he first looks out of the CBS window to see if there's a light in Downey's window up Madison Avenue. . . . Most of the stellar radio spots continue to be assigned to men. It's been a long time since any woman scaled the heights of radio stardom. . . . Unlike most artists who celebrate the launching of new programs, Ray Perkins threw a party at the end of his Barbasol contract. . . . James Wallington and Graham McNamee have soared tremendously in listener popularity since they began acting as straight men for Eddie Cantor and Ed Wynn.

ALFRED J. McCOSKER, managing director of Station WOR, Newark, New Jersey, is the new president of the National Association of Broadcasters. Mr. McCosker, who formerly served as director and treasurer of the broadcasters' organization, is an ex-newspaperman who started his journalistic career as copy boy to Arthur Brisbane. McCosker was employed as a press representative by WOR and six years ago was made managing director of the popular Eastern station. Throughout his association with WOR, McCosker has always endeavored to get persons prominent in the day's news to the station's microphone. McCosker has seen the station grow from a small 500-watt unit to a 5,000-watt transmitter. Now, the staion has been authorized to construct a 50,000-watt outlet. McCosker was born in the Greenwich Village section of New York in 1886. He attended the local schools and St. Francis Xavier College. He is married and has one daughter. President Hoover, in a message of congratulation to McCosker, stated: "It is especially noteworthy that you were chosen from the field of independent broadcasters."

THE return of the "Voice of Firestone" to the air after a brief absence was especially significant by the starring of Lawrence Tibbett and Richard Crooks, respective stellar baritone and tenor of the Metropolitan Opera Company. Tibbett and Crooks are not heard together on the Monday night NBC series, but are presented on alternate groups of broadcasts. The program is presented twice each Monday from New York, once for an Eastern hook-up and once for a Pacific Coast hook-up. Tibbett, last season's Firestone star, returned from Europe shortly before resuming his appear-

(*Continued on page* 569)

MRS. F. D. ROOSEVELT GROUCHO MARX CHICO MARX CHANNON COLLINGE

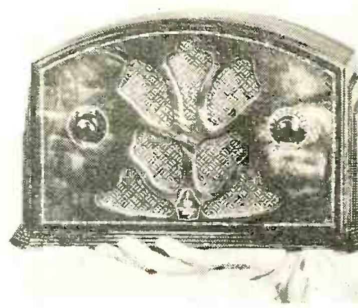
What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

A Portable Universal Set

Description—A compact receiver measuring only 10 inches wide by 6½ inches high by 4½ inches deep, operates from any 110-volt lighting supply of either alternating current (25 to 60-cycles) or direct current. It makes an ideal travelling set for use in

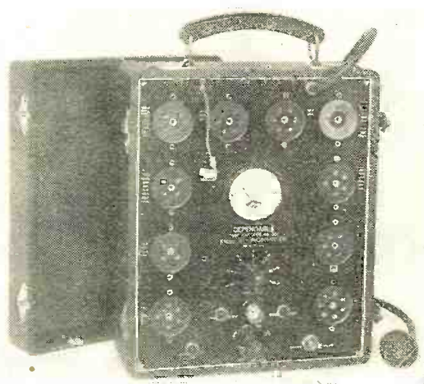


the hotel room, summer camp or aboard steamships. It also has popular appeal as a personal radio for the children's room or guest room. The receiver employs the following type tubes: one -36, one -37, one -38 and one -39. The set is equipped with a 6-inch size speaker. The attractive cabinet is finished in burl walnut veneer and a leather carrying case is available to fit this compact set. It weighs 6 pounds.

Maker—Emerson Radio and Phonograph Corp., 641 Sixth Ave., New York City.

Tube Tester

Description—The model 301 tube checker can test all the old types as well as the new 6 and 7-prong type vacuum tubes. The instrument is designed to test both plates of the 80, -82 and -83 type rectifier tubes. There is a filament control switch so that



the heaters or filaments of the tubes can be supplied 1.5; 2.0; 2.5; 3.3; 5.0; 6.3 and 7.5 volts at each and every one of the ten sockets mounted on the face of the panel. The tester provides grid shift, short and gas tests. The checker is a.c. operated and is enclosed in a leatherette carrying case measuring 5 inches by 9 inches by 11 inches.

Maker— Radio City Products Co., 48 West Broadway, New York City.

Resistor with Fibre Protection Guard

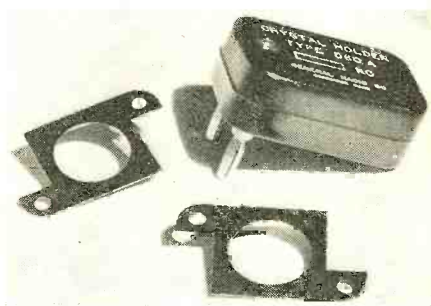
Description—A new feature of the Truvolt resistor is the full-length guard that slips over the resistor and protects the user from accidental contact with hands or tools. The construction design of the resistor permits larger wire to be used, which means longer life and greater heat radiation. The spiral winding of the resistance wire provides bet-

ter electrical contact and the new type of adjustable sliding clips permits accurate voltage adjustments.

Maker—Electrad, Inc., 175 Varick St., New York City.

Crystal Holder

Description—The type 560-A crystal holder will accommodate crystals up to 1⅛ inches in diameter and of thicknesses to 4 millimeters. With each crystal holder there are three fabricated bakelite blank retention plates, so that the user may cut out the blanks to fit crystals of different shapes. The

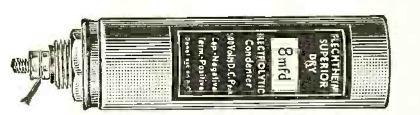


holder is equipped with a flat spring to provide pressure on the top plate. The tension of this spring is adjustable. The electrodes are chromium plated and the case of the holder is manufactured from molded bakelite.

Maker—General Radio Co., 30 State St., Cambridge, Mass.

Dry Electrolytic Condensers

Description—The new line of dry electrolytic type condensers, rated at 500 volts d.c. peak are available in cardboard and round aluminum containers. The illustration shows the inverted JS type which is encased in an aluminum can and is made in capacities of 2, 4, 6 and 8 mfds. This style condenser is fitted with a screw terminal for

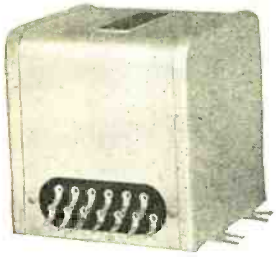


mounting in a ¾ inch hole. Multiple section condensers are supplied in upright mounting cans. There is a double section unit of 8-8 mfd. capacity, a three section unit of 8-8-8 mfds. and a three section condenser of 9-9-18 mfds. This new line of dry electrolytic condensers also includes the new tubular type LT and LTC suitable for by-passing and coupling purposes. The LT type has a rating of 30 volts d.c. peak and is made in capacities of 10 and 25 mfds., the second type LTC rated at 55 volts d.c. peak is available in 10 mfd. capacity.

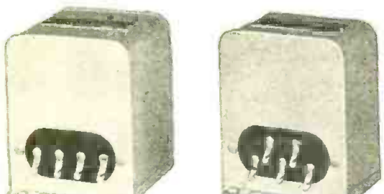
Maker—A. M. Fletchtheim & Co., 136 Liberty St., New York City.

Transformers

Description—A complete line of all purpose audio-frequency amplifier and power transformers especially designed for use in sound reproducing systems and in radio receivers.



The transformer cases have a silver finish which adds to their appearance. The large unit shown above which is the ILC mounting is utilized for such transformers as type No. B-245 PT which is a plate and filament power supply transformer for a tuner and a

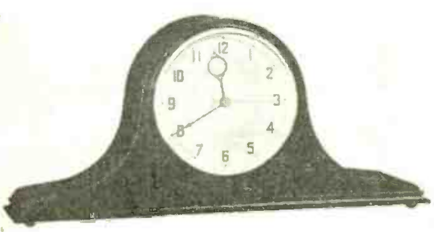


push-pull amplifier with –45 or –47 type tubes. The 2C mounting shown at lower left is used in type No. B-461, a driver input transformer for –46 type tubes in Class B amplification. The mounting on the right is style No. 1C, employed for type No. BLL, a mixing transformer from a universal line to a universal line.

Maker—Kenyon Transformer Co., 122 Cypress Ave., New York City.

A Clock with a World Time Dial

Description—This is a standard clock with a separate dial face, mounted directly over the regular numeral dial face. This separate dial has twelve zone plates on which there are printed the principal countries and cities of the world. The time dial revolves with the hour hand and acts as a carrier for the twelve zone plates. Each zone plate has both a plus and minus zone reading, and to find the time in any zone in the world in comparison to your time, simply follow the



minus zone plates from that which includes your own locality in a clockwise direction until you find the plate with the desired minus zone. The clock numeral nearest this zone plate will represent the time in that zone, thus all calculation is eliminated. To find the plus zones, proceed from the standard time in a counterclockwise direction un-

(*Continued on page* 570)

Latest Radio Patents

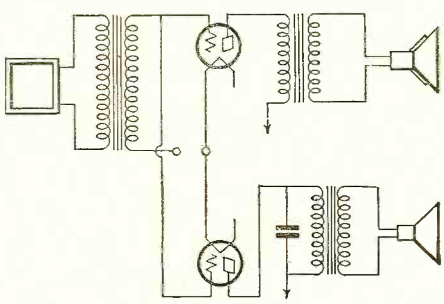
A description of the outstanding patented inventions on radio, television, acoustics and electronics as they are granted by the United States Patent Office. This information will be found a handy radio reference for inventors, engineers, set designers and production men in establishing the dates of record, as well as describing the important radio inventions

By Ben J. Chromy*

1,867,542. SYSTEM OF TELEVISION. JOHN HAYS HAMMOND, JR., Gloucester, Mass. Filed Dec. 6, 1928. Serial No. 324,078. 5 Claims.

1. The method of television which comprises analyzing a scene and recording the impulses produced thereby upon an electromagnetic tape, transmitting said tape to a studio, electromagnetically reproducing said impulses from said tape and transmitting the reproduced impulses, receiving and recording said transmitted impulses, at some later time reproducing said transmitted impulses and retransmitting said reproduced impulses, receiving said retransmitted impulses, recording said last mentioned impulses and at some later period of time reproducing said last mentioned recorded impulses and projecting a beam of light controlled in accordance therewith to re-form the originally analyzed scene.

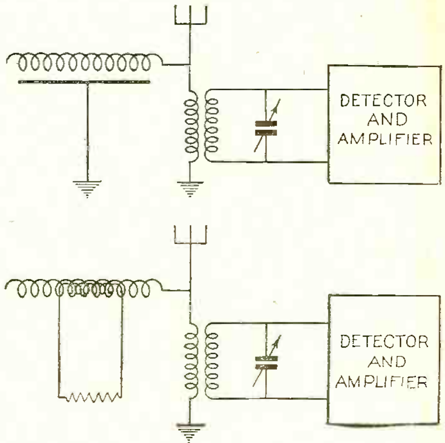
1,867,177. LOUD SPEAKER. HENRY JOSEPH ROUND, Westfield, London, England, assignor to Radio Corporation of America, a Corporation of Delaware. Filed Jan. 3, 1930. Serial No. 418,173, and in Great Britain Jan. 10, 1929. 4 Claims.



1. Sound reproducing apparatus comprising two loudspeakers of the same type and response characteristics, both of said loudspeakers being adapted to normally reproduce sound at both high and low frequencies, means for reducing the high frequency output of one of said loudspeakers only, and stiffening means applied to the diaphragm of the other loudspeaker to increase its output at the higher frequencies.

1,872,246. RADIO SIGNALING. LOUIS COHEN, Washington, D. C. Filed July 23, 1928. Serial No. 294,742. 7 Claims. (Granted under the act of Mar. 3, 1883, as amended Apr. 30, 1928; 370 O. G. 757.)

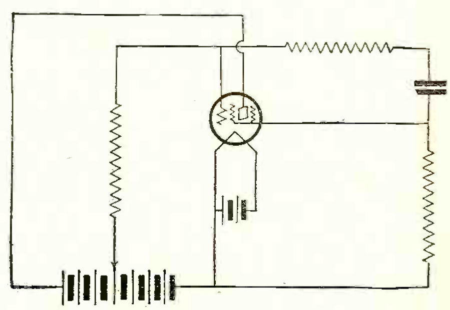
1. In a system for the reception of radio signals comprising an antenna, a coupling coil and ground connection constituting the antenna circuit, a secondary tuned circuit coupled to the said coupling coil, and suitable means for amplification and detection coupled to the said tuned circuit, an adjustable wave conductor connected at the junction point where the antenna is connected to the said coupling coil, said wave conductor being adjustable to absorb the energy of an interfering signal of a particular frequency, the said wave conductor consisting of a solenoidal coil placed in close proximity to a grounded metal plate, the adjustment being



effected by varying the distance separation of the said solenoidal coil from the said grounded metal plate.

1,869,500. RELAXATION CIRCUIT OSCILLATOR. ROBERT M. PAGE, Washington, D. C. Filed Feb. 11, 1930. Serial No. 427,622. 11 Claims.

5. In a relaxation oscillator, an electron tube having cathode, inner grid, outer grid,



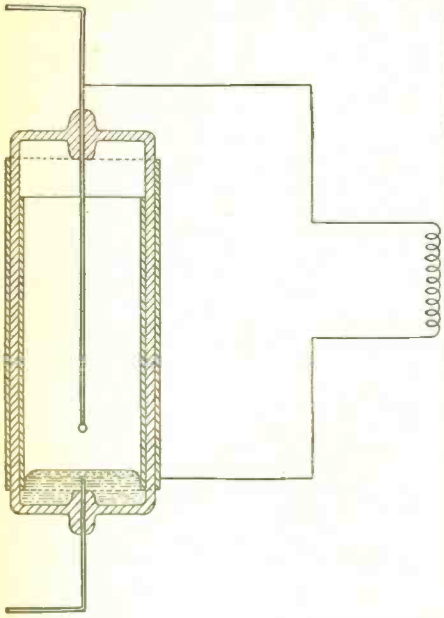
and anode, a resistor connected between said outer grid, and said cathode, a source of potential connected between said cathode and said inner grid, a second source of potential connected between said inner grid and said anode, and a condenser and a second resistor connected in series between said inner grid and said outer grid.

1,861,561. OSCILLATOR. LEROY J. BUTTOLPH, Grantwood, N. J., assignor to General Electric Vapor Lamp Company, Hoboken, N. J., a Corporation of New Jersey. Original application filed Dec. 11, 1926. Serial No. 154,065. Divided and this application filed Dec. 7, 1928. Serial No. 324,567. 1 Claim.

An oscillator comprising a vitreous envelope, leads sealed into said envelope, each

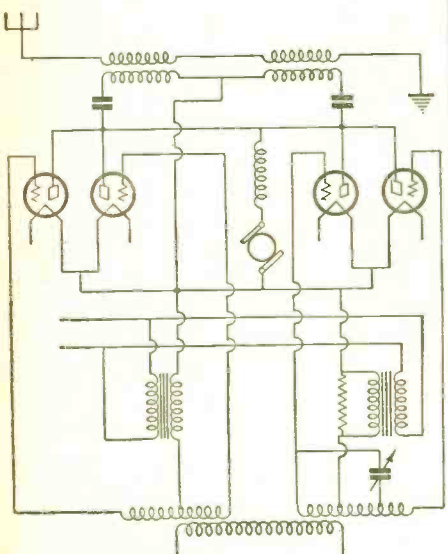
* Patent Attorney, Washington, D. C.

of said leads terminating in an electrode of a spark gap, a spark quenching material in said envelope, an electrostatic condensing surface within said envelope and connected to one of said leads, and an inductance con-



nected between the other of said leads and an electrostatic condensing surface mounted outside said envelope in cooperative relation with the first said surface.

1,868,339. ARRANGEMENT FOR THE ONE SIDED BAND MODULATION OF HIGH FREQUENCY VIBRATIONS. FRIEDRICH TRAUTWEIN, Berlin-Zerlendorf, Germany, assignor to the Firm Dr. Erich F. Huth Ges. m. b. H., Berlin, Germany. Filed Feb. 2, 1925. Serial No. 85,460, and in Germany Feb. 3, 1925. 7 Claims.



1. A system of modulating carrier frequency with suppression of carrier wave and one of the side-bands comprising electron device arrangements, each one connected to suppress the carrier wave, separate input circuits for said arrangements, a common output circuit for said arrangements, means for shifting the phase by 90° at carrier frequency on one of said arrangements, and means for shifting the phase by 90° at modulating frequency on one of said arrangements.

1,871,632. OSCILLATION SYSTEM. FREDERICK E. TERMAN, Stanford Universi-

(Continued on page 562)

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

ONE of the questions asked on the examination for Aeronautical License is, "What is the purpose and method of bonding an airplane?" and one of those bright boys who believes an exam. is passed by looking intelligent ups and answers, "So that if in case of fire or crashing of the 'plane the owners would be reimbursed for the damage."

For the fellows who haven't gone in for Aviation the answer is, "By bonding is meant the interconnection of all metal parts of the 'plane by means of good electrical conductors. This decreases the fire hazard and eliminates certain causes of noises in the aircraft receiver. Bonding is also necessary in order that the metal parts of the plane may collectively constitute a counterpoise of sufficient capacity value to make it a proper substitute for the 'ground' in the antenna circuit."

The big "Brass and Tube" man from Somerville, Mass., who is chief operator of the police radio station WPEH, our old pal Harry Chetham, recently passed the Civil Service exam. with a high mark, getting 100% in experience but is battling with the commission over his physical condition.

Remaining on the beach for any length of time has its dangers (make note, RMCA), as witness the downfall of Freddy L. Ullrich, BU, ex-breeze shooter of the Navy and now with the engineering staff of WNYC. Picking out Thanksgiving Day as the one day to have the knot tied, he writes in, "Am getting a new Skipper on above date and shoving off on the *S.S. Veragua*, United Fruit boat, for the West Indies just so I can laugh at Revielle and at the guy standing a watch in the shack." We'd bet more than a plugged dime that BU will ask the Op to let him put the cans on, eh. What does a letter-carrier do on his day off?

We hear from up Boston-way that Ralph Rice, who for about seven years was on the Boston-Savannah run, is now on the trawler *Quincy*, running out of Boston. A short time ago he had been reported lost on the fishing banks and we're sure happy to hear he is still with us. Twenty-two years ago he was on the old excursion boat *King Philip*, which carried fishing parties out to the Boston Lightship. Another old-timer from Beantown is Philbrook. Bob is now strutting his stuff as relief Op at WPEH.

Alonzo Carroll, one of the life members of the Veteran Wireless Operators Ass'n., is at the Coast Guard Station (radio), Winthrop Highlands, Mass. He has been kept busy, he sez, with the bad gale that blew down the coast recently. He logged an average of four vessels a night in trouble and logged the *S.S. Phemius* (GBWY) with four holds filled with water, funnel gone and "busted up a bit." Also the *Vista* and *Scotio*, who were in distress in Lat. 23, Long. 73.45. Alonzo made four trips on the *U.S.S. Topilla* with cargo and ammunition across the pond during the War and was on the destroyer *O'Brien* at Queenstown. He also has a few SOS's to his credit.

And while we're in the neighborhood of Beantown we mustn't forget Dan DeCoste, Ass't Sup't of the Eastern Division of the Radiomarine Corp'n, who is still at the Boston office, sez he can remember 'way back when he used to exchange "TR's" with HC in the Caribbean in A.D. 1908. And Ray Myers, who did his bit on the *Nautilus* expedition, is now the big reason for broadcast stations WBZ and WBZA, being on frequency as per reports of the Commish.

A 1000-watt transmitter, used by a bootlegging syndicate and being operated by two unlicensed ops, was recently located by Federal agents in an apartment house out Newark, N. J. The unique arrangement used for the transmitting antenna, which did not use any visible wires, was the reason given for this station having been in operation longer than usual. The room had been completely shielded from floor to ceiling and walls, while the antenna was a steel pipe stuck through the roof and connected to the output. It had operated on an extremely short wavelength.

Seen on a church bulletin board the other day: "IF ABSENCE MAKES THE HEART GROW FONDER, THERE SURE MUST BE A LOT OF FOLKS WHO LOVE THIS CHURCH."

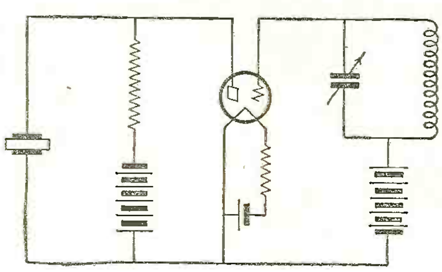
We received a letter the other day from "Li'l Willie" Hardage, GH, who is handing out orders through a chief radioman's rating down in San Juan, P. R. Li'l Willie and I were shipmates on the good ol' pigiron *Marblehead* back in '25. It had been decided to shove off for Panama or thereabouts with only half a load aboard. About the third day out, reports began coming in thick and fast of a terrific storm in the Caribbean district and moving north. That was the storm which blew down the towers of WAX, Florida, made the city of Pensacola, Florida, look like a lake, pushed boats back a mile inland from the waterfront of Galveston and did enough damage to cause insurance company heads to get gray.

The skipper ordered a hard left rudder to escape the storm, but caught the tail end of it a short 300 miles further out. Li'l

Latest Radio Patents

(*Continued from page 561*)

ty, Calif., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed Nov. 19, 1929. Serial No. 408,391. 2 Claims.



1. An oscillation system comprising an electron tube including a cathode, a grid and a plate, an input circuit including said plate and cathode, an output circuit including said grid and cathode, means for charging said anode at a negative potential, means for charging said grid at a positive potential, and a frequency determining vibratile element connected in said input circuit.

Willie and yours truly had the Mid that night because we were about the only ones on the gang who were able to stand up. By this time the ship was doing everything but standing on an even keel. A degree or two more on either starboard or port and she'd have taken in water through the funnels. Books from the shelves were strewn all over the shack deck; mills, which had fallen from the tables, were sliding up and back with the roll of the ship. The oscillator, which was bolted to the bulkhead, ripped completely off. What a sweet night for a murder that was! And that isn't all. For supper we had had a nice dish of greasy pork chops, so, me laddies, you can rest assured that part of the Watch had been stood on the rail.

We hear that: . . . Lt. Robert J. Hartshorn, who was radio officer of the *U.S.S. Shoshone,* transport force, during the War and also used to operate the station at the Somerville (Mass.) State Armory years ago, is still at the Armory and would like to hear from some of his old buddies. . . . Vernon Giles is now at Rockland, Me., and sends his 73's to the gang. . . . Norman Filson, one of the old-timers from "way back when," is in charge of the auto trucks at the Hathaway Bakeries and is living at Waltham, Mass., his old home town about which he would crow. . . . Willie Woodbury, chief Op of WPED, the Arlington police radio station, says his station is getting along fine and his assistants, Al Zwink, Bill Robinson and Patrolmen Scanlon and Riley, are all in top form. Al Zwink is the boy with a Transport Pilot's License and recently flew to Texas and back.

Amongst some of the mail which came in the other day comes one from Dan Mooney, of wartime fame, who is now looking over his estates out in the Atlantic. His address is: P. O. Box 108, Santa Cruz De Teneriffe, Islas De Canarias. That shows you just how far an Op will go to make both ends meet, and also adds new laurels to those already earned by this magazine for circulation and the distances to which it is being carried. The thanks which have come pouring in for various information which was received is only part of the job, and this column wishes it to be known that its aid is always at the beck and call of its readers. So with a cheerio and a bloomin' pip-pip 73s ge. . . . GY.

$2000 Prize Contest

Every radio dealer and serviceman will be interested in the news that a prize contest, entirely within the radio industry, is to be sponsored by the Tobe Deutschmann Corporation of Canton, Massachusetts. This contest, which is open only to bona fide radio servicemen and dealers, will result in the distribution of one hundred valuable prizes, including the latest types of radio interference-locating apparatus, service instruments, condenser kits, radio magazine subscriptions, etc. To the newcomers in the radio industry the name Tobe has not been so closely associated with condensers, but has rather been synonymous with interference elimination.

Believing that the majority of radio servicemen are "fed up" on cheap condensers, sold at prices which do not enable either the distributor or the serviceman to realize a reasonable profit and manufactured with safety tolerances so close that even a slight excess voltage is likely to cause breakdown, this corporation has developed a complete line of service condensers constructed of high-quality materials and incorporating the same operating characteristics which are required in Filterettes.

Full details of the contest may be obtained from the leading radio parts jobbers or by writing to the Contest Director of the Tobe Deutschmann Corporation.

Short-Wave "Super"

(*Continued from page* 547)

inertia characteristic of the a.v.c. circuit is sufficient to iron out microphonic noises associated ordinarily with manual volume adjustment, contributing a refinement that will be particularly appreciated by the code operator. As the manual adjustment also limits the maximum output under a.v.c. operation, such adjustments as may be occasioned by extreme conditions of slow carrier swings will be inaudible in telephonic reception and rebroadcasting.

Following the adjustment of the a.v.c., the radio-frequency circuits are rechecked to ascertain that their maximum sensitivity has not been adversely affected.

Next order is the *bête noire* of the single-control short-wave receiver—ganging. The increased effects of inductive and capacitative variations on high frequencies have all received comment. Inspection of the equation—

$$f = \frac{1}{2\pi\sqrt{LC}}$$

—will indicate that simple condenser compensators across the individual circuits are no real solution to the problem. This holds true even on low broadcast frequencies, and obviously is a fact of still greater significance on short waves. If inductive discrepancies are compensated on any given frequency by trimming condensers, the circuits cannot gang on any other frequency. For true alignment, the inductance and capacity of each circuit, tuning to the same frequency, must be identical at all times. The attainment of this condition in a receiver employing several sets of plug-in coils involves a multitude of individually checked adjustments. The condensers must have identical tuning curves. The circuit distributed capacities must be the same. The inductance of the wiring in each tuned circuit must be checked for a similar equality. The inductance of every coil in a given set must check within tolerances far more rigid than could be ascertained by usual production methods. Finally, the distributed capacity of each coil in a given set must be identical. Rather a job!

The tuning curves of the three condensers are first checked, and corrected if slight discrepances exist. If other than minor adjustments are required, the condensers are discarded. The distributed capacity of each circuit is adjusted to a predetermined minimum by means of padding capacitors, checking against laboratory coils of standard capacitative and inductive values. Using these same coils, the inductance of the wiring is set at a similarly predetermined value, by moving the tap on the inductive slide-wires in each conderser compartment. These wires are shown in Figure 1. The wires are soldered when the correct inductance is obtained.

Equally painstaking procedure is employed in adjusting every coil. The distributed capacities are set at the correct values by small padding condensers within each coil. As the coils are wound on grooved -39 forms, the inductive values of a production run are close to the required inductance—well within the tolerances allowed in high-grade broadcast receivers. Nevertheless, they are checked against a standard, and adjusted to a still finer exactitude by varying the length of the short lead between the grid end of the coil and the prong.

The inductive and capacitative values of the oscillator and signal circuits necessarily differ, but the same degree of precision is required and the same technique of adjustment and check is observed. The result is a single-control receiver in which every circuit is tuned to the correct frequency at every dial setting without the use of trimmers. The tuning curves exhibit "straight" frequency lines, over a 270-degree rotation, and the tuning ranges of the five standard sets of coils are indicated in the graphs of Figure 4.

The audible beat-frequency oscillator is adjusted and checked for pitch and frequency drift. The output is precisely regulated so that the optimum amount of energy is applied to the second detector. Special tests are made to determine the adequacy of the shielding in this circuit, in order to prevent the stray transference of oscillations to the i.f. circuits, where consequent amplification would result in an overloaded second detector.

In shielding the component parts of this receiver, every precaution has been taken to prevent circuit interaction. Photograph Figure 5 illustrates the attention to detail shielding, showing the plate between the manual a.v.c. switch and the radio-frequency socket, as well as the shielded coupling leads between the second detector and the beat-frequency oscillator. In addition to the individual shielding of coils, tubes, etc., the set is overall shielded by the metal cabinet.

The sub-base illustration, Figure 5, shows the accessibility of such parts as might break down in service, and which can be quickly replaced without affecting the precision adjustments of the radio-frequency circuits.

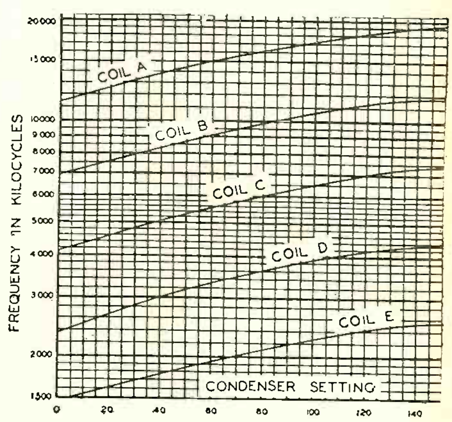


FIGURE 4

The only radio-frequency circuit that may require the attention of the individual operator is that governing the frequency of the audio heterodyne oscillator employed for beat-frequency reception of code signals. This circuit is adjusted at the factory, by means of the tuning capacitor, to beat with the intermediate frequency at a few hundred cycles "off resonance," providing a note which has been shown, psychologically, to be most readily copyable by the average operator. This note, however, can be readily changed to suit the individual ear, or the beat-frequency, at correct tuning, raised to a higher pitch to secure greater selectivity through the asymmetrical action. A beat-note of 500 cycles will result if the audible beat-oscillator is adjusted to 500,500 cycles and the receiver tuned to resonance. A similar note will be produced by an intermediate-frequency signal of 501,000 cycles, which, however, would be appreciably attenuated.

Laboratory technique is carried through consistently to the ultimate test and adjustment. Here the receiver is checked against attenuated local oscillators (Figure 7) and foreign stations, and receives a final minute inspection of switch contacts and all exposed bearings. The result is a receiver as perfect, electrically and mechanically, as present-day engineering knows how to make.

R. F. Amplifiers

(*Continued from page* 531)

have the proper amount of resistance for Class B operation? The answer is simple; and this is a beautiful case in which the man who knows a little theory triumphs over the man "who is just an operator." Class B bias $= \dfrac{E_b}{\mu}$ where E_b is the plate voltage and μ the amplification constant of the tube (which is given in the tube data sheets). This is the total bias. Knowing how much actual voltage we have available, the remainder must be supplied by the grid leak (which is calculated from Ohm's law—$R = \dfrac{E}{I}$ where I is the current given by our grid milliammeter. In a number of tests run at W2BRB with various tubes, the value of the grid current ranged from $^1/_{10}$ to $^1/_{30}$ of the plate current. The actual value of the grid leak is not critical, and it is better to use a little too much resistance than not enough. A good plan might be to use any available resistance, calculate the drop across it and see how it checks with the desired bias. A vacuum-tube voltmeter—many have been described in RADIO NEWS—would come in handy here in measuring bias voltages.

In connection with the foregoing calculation of grid bias, the author has found that, when using tubes as Class B r.f. amplifiers, the given value of μ is too high, so that it is usually necessary to add about 10% to the calculated bias to get complete "cut-off" (μ, the amplification constant, actually varies considerably with different grid and plate voltages and different plate loads).

So far, our discussion has centered on the grid circuit of the amplifier and, more especially, on the grid milliammeter itself. We are now ready to proceed to the next step, which is neutralizing. Here the grid meter plays a very important part.

Neutralizing

When our oscillator is functioning properly and our grid meter shows the presence of r.f. in the amplifier stage, the first logical step is to neutralize the amplifier. Starting with the neutralizing condenser at minimum capacity, we tune the amplifier plate condenser until a dip occurs in the grid current. This indicates that the plate circuit is tuned to the oscillator frequency and, furthermore, that the tank (plate) circuit is drawing power, assuring us that the amplifier is *not* neutralized. As these phenomena are important, we will pause a moment to picture the happenings just referred to.

Figure 3 at (a) shows how the amplifier tank-circuit is coupled to the oscillator through the condenser formed by the tube's grid and plate (C_{g-p}). When the tank is tuned to resonance with the oscillator, it absorbs some energy, which causes a lowering of the grid potential and, therefore, a dip in the grid current. Now if we add a neutralizing condenser and split the plate coil as in (b), we can prevent the plate tank from absorbing any energy by balancing the circuit formed by C_{g-p} and the top half of the plate coil, with the circuit formed by the bottom half of the plate coil and the neutralizing condenser. The arrows picture a current coming from the source of radio frequency, splitting into the two branches just mentioned, and balancing each other so as to cancel in the tank coil. This is the principle of one method of neutralizing. The plate coil need not be tapped in the center. All that is necessary is that the number of turns used, with a given capacity neutralizing condenser, be sufficient to balance the voltage arriving in the plate circuit through the grid-plate capacity. The fewer neutralizing turns used, the larger the neutralizing condenser must be—and the greater loading effect the condenser will have on the oscillator tank circuit, as will be subsequently explained.

Now to go on with the process of neutralizing—we must turn on the amplifier tube so that it can draw a load, and we must disconnect the plate voltage to prevent self-oscillation with its dangerous feed-back. Now we start increasing the neutralizing capacity with one hand while we swing the plate condenser through resonance with the other, stopping every few seconds to readjust the oscillator plate condenser so that the r.f. input will not drop off. We should notice the resonance dip gradually diminishing until, at some point on the neutralizing condenser, there should be no dip at all. This is the point of neutralization. To prove that neutralization is really accomplished, we might further increase the neutralizing capacity whereupon the dip should return when we tune the tank circuit to resonance. It frequently happens that the point of what seems to be neutralization will be maximum capacity of the neutralizing condenser which shows us that we either need a larger condenser or, what is usually more reasonable, *more* neutralizing turns on the plate inductance. Then, again, the point nearest neutralization might be the point of minimum neutralizing capacity, which shows we need *less* neutralizing turns. Since the neutralizing condenser is effectively in parallel with the oscillator tank condenser, it may happen that, as we add neutralizing capacity, we get to a point where the oscillator tank condenser is at minimum capacity and will not tune, causing our r.f. input to drop off. This must be answered by removing a few turns from the oscillator inductance. During this process of neutralization it is well to reduce the "C" bias enough to permit full-scale reading on the grid milliammeter so that it will be easy to see the dip. Many amateurs and experimenters balk at the very word of "neutralizing," which is really foolish, seeing how easily it can be accomplished by the foregoing method. Many of the small, cheap voltmeters have a low resistance and a full-scale reading of 8 to 30 milliamperes, which makes it possible to use them for grid milliammeters. Their resistance will act as a grid leak, contributing to the bias as previously explained.

DX Receiver Design

(*Continued from page* 533)

what is spoken, while another gives nothing whatever or only noise. So strongly do the short-wave signals come in that the average short-wave receiver usually gives some results in long-distance reception, but a better receiver will give better results, bringing in those difficult stations the neighboring listeners do not hear. On the broadcast waves the signals from distant stations do not come in with such strength. Unless the location is exceptionally good, the receiver must be of the very highest efficiency to achieve any large measure of success in the reception of the far-away stations.

The second part of this article will be devoted to outlining those principles of receiver design that make for the utmost in results in distance reception (with present-day apparatus and knowledge). The principles apply in general to receivers for all waves, with particular reference to broadcast receiver design.

Marine Radio

(*Continued from page 535*)

transmitter the new RCA receiver, type AR-8500, is in use in the *Mariposa's* radio room. This is one of the first marine receivers produced employing anything other than the usual three circuits, essentially the same as embodied in the SE-143 and SE-1420 receivers of wartime vintage. The new receiver utilizes tuned-radio-frequency amplification, a regenerative detector and two stages of audio amplification. All tubes are of the high emission, heater type for d.c. operation, requiring eighteen seconds for the filaments to attain proper operating temperature. Type –36 tubes are employed in all positions except as second audio amplifier, which is a type –38 pentode. Nine plug-in coils permit reception over an unbroken range from 16.7 meters to 20,000 meters. A novel feature of these coils is the ejector which permits their easy removal from the friction-grip pin sockets. A four-section variable condenser is used to tune the plug-in coils over the specified frequency ranges. All knobs on the panel have been arranged to rotate in the same direction relative to the effect produced. For example, wavelength, volume and regeneration increase as their respective control knobs are turned in a clockwise direction. Contained with the tuned input coil for the radio-frequency grid circuit is the coupling coil. Design of these units is such that coupling is automatically increased with the wavelength. The radio-frequency plate circuit is tuned and coupled directly to the detector grid, while regeneration is obtained by the conventional tickler method. In the radio-frequency grid circuit a trimmer condenser is employed so that a beat-note may be obtained without impairing the line-up of the tuned circuits. Both stages of audio amplification are resistance coupled. Provision is made so that either high or low-impedance headphones or a loudspeaker may be operated. As the power output of this receiver is extremely high, it is necessary (when operating in congested radio areas) to use a recently developed "limiting phone" which is of 120-ohm d.c. impedance and fitted with fibre stops limiting the travel of the diaphragm and preventing "blasting." Quality of reception with this receiver is comparable with the best broadcast technique.

While the *Mariposa* is not the first liner to equip its lifeboats with radio (two of the Matson liner's motor lifeboats are so equipped) it is the first time that radio apparatus especially intended for lifeboat use has been produced. The equipment was designed by R.C.A. for minimum space requirements and least possible weight. Protection from water and the corrosive action of salt air also presented problems which were complicated by the fact that the antenna dimensions are definitely limited aboard lifeboats and thus work a hardship on intermediate-frequency operation, although being well adapted to short-wave working. In actual tests made from a lifeboat with this equipment a consistent range of 100 miles (daylight) was obtained on the 600-meter wave, while the high-frequency signals were reported at four times that distance. Rating of the transmitter is ten meter amperes at 500 and 5525 kilocycles, depending upon the height and the dynamic characteristics of the antenna. Two UV-210 tubes of 7.5-watt rating are used, and power is supplied by storage batteries to a 350-cycle rotary converter—a two-bearing watertight unit—which, like the radio set itself, may be immersed in salt water for short periods without damage. A full-wave, self-rectified circuit, inductively coupled to the antenna, obtains a 700-cycle note from the two oscillators. Individual tank circuits are provided for both frequency bands and a single control on the panel effects the change. The receiver, however, operates only at the intermediate frequencies. It is a simple regenerative detector with one transformer-coupled audio stage and fixed inductive antenna coupling. Regeneration is controlled through a bypass potentiometer in the plate circuit. No battery circuits are grounded and all filament resistances (including those for the receiver) are mounted in the transmitter compartment so that the B batteries in the receiver cannot be overheated. To limit spare-part requirements, both receiving tubes are also 210's. Furnished with the lifeboat set is a control panel which cares for the trickle charging of batteries from the mother ship and operates the lifeboat's searchlight, Morse light, running and cabin lights in addition to the radio equipment. The six cells of lead-acid battery have a capacity sufficient to operate the radio and all lights for six hours continuously.

In conclusion, it might be remarked that the *Mariposa* enters the Pacific service with radio equipment in every way in keeping with the excellent qualities which have won her so much favorable comment.

Some DX!!

(*Continued from page 525*)

write to my cousin in Sydney. She will probably know where he is. You don't know the name of the station he broadcasts from?"

"No," I said. "And that isn't the half of it. I wrote to a radio magazine, giving particulars of the wavelength and asking them what station it was. They replied that there was no such station."

"Queer," murmured Johnson.

"Queer is not the word. I have mentioned it to several people, but none of them have ever heard it."

"Remarkable. Well, let's get going; I'm bursting to hear the old boy once again."

On arriving at home, promptly at 10 p.m., I tuned in on the unknown station. We were in time to hear the last line of a limerick being recited. Johnson displayed even more interest.

"Smoking concert is about right," he observed, five minutes later. "And no ladies present."

At last the piano struck up the opening bars of "In Cellar Cool," and Johnson leaned forward expectantly.

"That was Uncle Henry, sure enough," he admitted when the song was over. "He never lost his Southern accent and he still manages to keep slightly off the note. I must find out where he is."

And he departed, as surprised and mystified as I was.

That was five months back. Last night Johnson came around again. There seemed to be something on his mind.

"I've heard from my cousin in Australia," he gabbled as soon as we were alone.

"Yes?" I said. "And where——"

Johnson dropped his eyes. "Keep it to yourself," he said awkwardly. "'Uncle Henry' was hung two years ago."

I smashed the set! But I can't help wondering what part the wrong hook-up played in this experience. Had we discovered something fundamentally new? It would never bring in any of the regular stations.

The Junior DX'ER

(*Continued from page 529*)

Connect the black wire to ground if this is available. A ground is not absolutely essential. For maximum distance, however, a good aerial and ground are recommended.

Although the above directions may sound a bit complicated, this set has been thoroughly worked out in advance and even a beginner will experience no trouble in assembling it, wiring it and obtaining excellent results. If there is any difficulty in controlling oscillations, these may be eliminated by shunting condenser C2 with a 500,000 ohm resistor.

As explained above, the power transformer and the various coils are all color-coded, so that only a color blind person could make a mistake in wiring in these parts.

List of Parts

C1, C2, C3—Trutest, 3-gang shielded variable condenser, .000365 mfd. each section, with three equalizing condensers attached.
C4, C6, C7—Cornell "cub" cartridge condenser, .1 mfd., 200 volt
C5—Cornell "cub" cartridge condenser, .002 mfd., 600 volt
C8—Cornell "cub" cartridge condenser, .002 mfd., 600 volt
C9—Cornell "cub" cartridge condenser, .00025 mfd., 600 volt
C10—Cornell "cub" cartridge condenser, .01 mfd., 600 volt
C11—Cornell "cub" cartridge condenser, .001 mfd., 600 volt
C12, C13—Trutest dry electrolytic dual condenser, Type D3335 (C12—8 mfd.) (C13 4 mfd.)
C14—Cornell "cub" cartridge condenser, .5 mfd., 200 volt
C15—Cornell "cub" cartridge condenser, .01 mfd., 600 volt
C16—Cornell "cub" cartridge condenser, .02 mfd., 600 volt
R1—10,000 ohm Potentiometer with 300 ohm resistance R2, and equipped with Switch —Sw1
R3—Trutest carbon resistor, 4000 ohm, ½ watt
R4—Trutest carbon resistor, 60,000 ohm, 1 watt
R5—Trutest carbon resistor, 50,000 ohm, 1 watt
R6—Trutest carbon resistor, 50,000 ohm, ½ watt
R7, R8—Trutest carbon resistors, 250,000 ohm, ½ watt
R9—Trutest carbon resistor, 500,000 ohm, ½ watt
R10—Trutest carbon resistor, 500 ohm, ½ watt
L1—Trutest Pre-Selector Coupler
L2, L3—Composite Oscillator (L2) and 175 kc. and 1st Intermediate Frequency Transformer (L3).
L4—2nd Intermediate Frequency Transformer, peaked at 175 kc.
L5, T1—See dynamic speaker, below
T2—Trutest Power Supply Transformer, 350 volts each side of center-tap, with 5 volt and 2½ volt filament windings
J1, J2—Eby Twin "Phono" Jacks, type 2M13030
V1, V3—Arcturus type -57 pentode tubes
V2—Arcturus type -58 variable-mu pentode
V4—Arcturus type Pz power output pentode
V5—Arcturus type -80 full-wave rectifier
1 Trutest direct-drive full vision dial with pilot light
1 Trutest Five-prong wafer-type socket for mounting Pre-Selector, L1
3 Trutest type 2M 13265 tube shields
1 Drilled metal chassis, 10⅞ inches by 6¾ inches by 1¾ inches
1 Dynamic speaker with output transformer, 7000 ohms primary and 1800 ohm field coil
1 Walnut-finished cabinet, 15 inches high, 12 inches wide, and 7½ inches deep
3 Wafter type tube sockets, 6-prong
1 Wafer type tube socket, 5-prong
1 Wafer type tube socket, 4-prong

Facts About DX Reception

(*Continued from page 521*)

weak signals, or where noise levels are high one is often able to catch call letters through headphones which would be entirely lost when using a loudspeaker. If possible the headphones should be connected either in the detector plate circuit or after the first audio stage, rather than in the output of the power stage. However, where it is impractical to break into these circuits and where no other provision is made for headphones, the circuit shown in Figure 1 will permit of this addition without any alterations in the wiring of the receiver. The potentiometer is not absolutely necessary because volume can be regulated by means of the regular volume control on the receiver itself. However, by turning the receiver volume control fairly high and then reducing the volume by means of the potentiometer a considerable amount of high-frequency noise will be eliminated. If the local noise is predominantly of the low-frequency variety a variable resistance of several thousand ohms in series with the phones will reduce it materially. A combination of the potentiometer and the series resistance will tend to reduce both high-frequency and low-frequency noise and by proper adjustment will attentuate everything outside of the required voice range.

Last but by no means least, the advantages of membership in one or more of the many existing DX clubs should not be overlooked by the long distance enthusiasts. Some of these clubs are local in nature while others offer correspondence memberships open to fans throughout the world. In this connection, attention of club officers should be called to the fact that RADIO NEWS will be glad to bring their clubs to the attention of readers if information concerning activities, dues, membership requirements, etc., are forwarded to the DXer's Corner, a department of the magazine which is to be reestablished next month.

With the foregoing to give him the courage of his convictions, and the suggestions incorporated in this and other articles in this issue to help point the way, the reader may find that he can accomplish DX feats that he did not heretofore believe possible. If, due to lack of a moderately good location or adequately good receiver equipment, he is unable to accomplish world-wide reception it should not be taken as an indication that others cannot accomplish it. There is definite proof on every hand that reception from the other side of the world, on the broadcast band, is possible and is being accomplished almost daily during the proper seasons, in every part of the United States. Likewise DX fans on the other side of the globe are hearing American broadcast stations with an equally fair degree of regularity.

A Low-Cost Super

(*Continued from page 545*)

oscillator. A –58 type tube is used in this oscillator-amplifier stage.

The two intermediate-frequency amplifier tubes of the –58 type are supplied with voltages below normal, in order to decrease distortion. The intermediate-frequency transformers are double tuned and also critically coupled so as not to cut the side-bands and eliminate high-frequency tones. The coils are lateral-wound of Litz wire. The wires making up the Litz cable are individually insulated with the highest grade low-leakage enamel and are then cabled 1⅛ twists to the inch and the cable covered with a heavy serving of cotton in order to reduce the distributed capacity and its associated losses. Great care is taken to see that all strands are connected and the separations are maintained uniform. These coils are tuned with mica condensers, mounted on Isolantite.

The second detector, translating the intermediate-frequency energy into audio frequency, is of the –55 diode-triode type. This tube is not burdened with the generation of any bias voltages. The circuit used provides balanced diode detection, with the manual volume control inserted in the output circuit.

This detector is fed from a low-impedance intermediate-frequency transformer which is balanced both from the electrostatic and electrodynamic standpoints and furnishes plenty of power for the detector rectifier action without loss of energy due to high leakage reactance. The coupling between primary and secondary of this transformer is such that considerable energy at intermediate frequencies may be transferred from the plate of the intermediate-frequency output tube into the diode plates.

Automatic volume control voltages are generated by a –56 triode type tube. The function of this tube is solely that of rectification with filtration. The automatic volume control voltages are rectified from energy taken from the intermediate-frequency output tube at its plate, and these voltages are fed back to the grids of the preceding tubes through a filtration circuit, with a time lag of less than one-tenth of one second. A portion of the automatic volume-control voltage is fed to the grid of the "statomit" tube, releasing its grid and permitting it to unblock the audio amplifier.

This "statomit" tube is of the –57 type and is used in a "trigger circuit" for generating negative voltages. These negative voltages are applied to the grid of the first audio tube, completely blocking the audio amplifier when no signal is tuned in. This static suppressor action is controlled by a knob through various degrees of sensitivity so that the operator may set the cut-off point at any level desired.

The first audio tube is a variable-mu –58 type tube, chosen because of its remote and smooth cut-off point. This tube is controlled through its grid bias by the "statomit" tube, and the variable-mu feature of this tube enables it to handle audio currents of great magnitude without rectification, even though the grid bias is depressed almost to the cut-off point by the "statomit" action.

The output of this tube is resistance-coupled to a –42 super-power pentode type tube used in the driving circuit to provide the power required by the grid currents drawn by the Class B output stage. The tone control is connected across the output of this –42 type tube.

Class B amplification requires separate power packs in order to isolate the Class B surges from the B supply of the rest of the set. The new –82 type mercury-vapor rectifier tube is employed in the power pack for the Class B amplifier. The B supply for the other ten tubes in the set is taken from the conventional –80 type rectifier, with its associated filter, consisting of the fields of the two speakers connected in series.

The speakers themselves are matched to the input transformer and against the audio amplifier, in order to give practically flat characteristic response curves throughout the audio spectrum. These speakers are proportioned and phased at every part of the spectrum.

"Sprayed Micas"—A New Tube Feature

The engineering laboratories of National Union Radio Corporation, after many months of experimentation, have perfected a new method of reducing electrical leakage across the mica used in radio tube manufacture.

It is believed that this leakage is caused by an invisible deposit which forms on the mica during the manufacturing process, after sealing-in. In order to break up this deposit it has been for years common practice to "spark" tubes. 'Sparking" is the application of a high voltage, derived from a spark coil, across the elements of the tube which the mica is used to space or support. The action of the spark is to burn clear the electrical path caused by the invisible deposit on the mica.

A new method or process has been devised to overcome this trouble and is now being used in the manufacture of National Union tubes. The micas, destined for use in tubes prone to be troubled by leakage, are first cleaned and then sprayed with a fine-grain material. Before spraying, the surface of the mica presents a smooth, unbroken surface. Application of the spraying material transforms the smooth surface into one which is broken up, and thus the surface distance between any two points on the mica is greatly increased, thus presenting a longer path for travel of electrical leakage.

The use of sprayed micas has proven a much more satisfactory means of preventing electrical leakage in tubes than any other method tried and, so far as is known, is a feature available only in National Union tubes, types –27, –36, –37, –39, –55, –56 and –59.

A Correction

In the article on neon tube oscillators by Dale Pollack occurred typographical errors in the mathematical equations on page 376. The last part, starting with: "or, solving the differential equation, E_c being equal to E_b, when $t = 0$," should read:

$$E_c = \frac{E \cot\theta + E_o R}{R + \cot\theta}\left(1 - \epsilon^{-\frac{R+\cot\theta}{KR\cot\theta}t}\right) + E_b\,\epsilon^{-\frac{R+\cot\theta}{KR\cot\theta}t}$$

or,

$$E_c = \frac{E \cot\theta + E_o R}{R + \cot\theta} + \left(E_b - \frac{E\cot\theta + E_o R}{R + \cot\theta}\right)\epsilon^{-\frac{R+\cot\theta}{KR\cot\theta}t}$$

When E_c falls to E_a, $t = t_2$ and,

$$E_a = \frac{E \cot\theta + E_o R}{R + \cot\theta} + \left(E_b - \frac{E\cot\theta + E_o R}{R + \cot\theta}\right)\epsilon^{-\frac{R+\cot\theta}{KR\cot\theta}t_2}$$

or, solving,

$$t_2 = \frac{KR\cot\theta}{R + \cot\theta}\log_\epsilon \frac{E_b - \dfrac{E\cot\theta + E_o R}{R+\cot\theta}}{E_a - \dfrac{E\cot\theta + E_o R}{R+\cot\theta}}$$

which is equivalent to equation (6) in the text

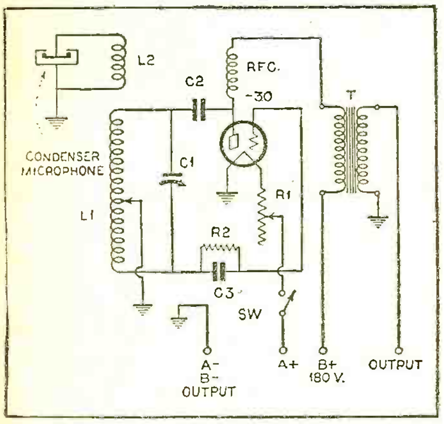
Free Employment Service

To meet the problems brought about by the continued lethargy of business, as it affected the professional technical worker then and now unemployed, "The Engineers' Club of Philadelphia," 1317 Spruce St., Philadelphia, Pa., in January of this year sponsored the Philadelphia Technical Service Council. This group consists of representatives from twelve National Engineering Societies, and the association of the State Employment Commission of Pennsylvania has been secured. Thus all requests for technical men are handled through the Committee for the Philadelphia Metropolitan area.

The work of the Committee, consisting at present of six office workers and fifteen field workers, is divided into four main divisions: Placement, Field Contacts, Publicity, Research. The primary object is to secure placement for the registrant, at the same time securing for the employer the best talent available. Since volunteers from among the registrants do the work, this valuable aid to industry is available to employer and employee alike, without any charge whatsoever.

A Correction

In the article on "A Condenser Mike Amplifier," by Glenn E. West, the diagram in Figure 1 shows a part of the inductance

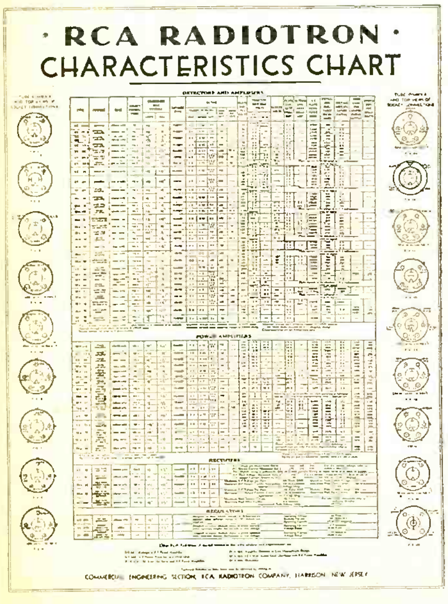


shorted. The corrected diagram is shown here.

Free Tube Charts

The Unified Sales-Engineering Service, representing RCA Radiotron Co., Inc., and the E. T. Cunningham, Inc., have brought out an extremely useful tube chart giving the data on all tubes now in use.

This chart, shown in the accompanying illustration, is made in two sizes, 11 inches by



15 inches and 22 inches by 30 inches. The larger one is excellent for wall mounting in store or shop. The smaller one, containing exactly the same data as the large one, can also be mounted on a wall or, if folded once, will fit in a laboratory loose-leaf notebook or bill folder.

Through a special arrangement these charts are made available to RADIO NEWS readers without charge. The only requirement is that all requests be written on letterheads indicating that the reader is a bona-fide radio serviceman or dealer.

Address requests, stating whether small or large chart is desired, to Department RD, RADIO NEWS, 222 West 39th Street, New York City.

Backstage

(Continued from page 557)

ances at the Metropolitan Opera House. Crooks, who took over the Firestone stellar spot upon Tibbett's departure last season, is a long established radio favorite. William Merrigan Daly again conducts the orchestra on this series and Alois Havrila resumes his rôle of announcer. The extensive NBC hook-up conveys the program to Canada and Hawaii in addition to most parts of the United States.

MANY radio observers believe that during the new administration, the new First Lady will set a record in the use of broadcasting by a President's wife. Ever ready to aid humane causes, Mrs. Franklin D. Roosevelt in recent months has made numerous radio appearances to relieve suffering and distress. Her outstanding radio deed was her agreement to aid the unemployed by appearing on a Friday series of twelve programs over the NBC between December 9 and February 24—the week preceding the Presidential Inauguration. Knowing of Mrs. Roosevelt's willingness to help the destitute, the Pond's Extract Company offered adequate compensation for a series of broadcasts, with the understanding that the proceeds could be given by Mrs. Roosevelt for any relief purpose she might designate. Mrs. Roosevelt, in accepting the offer, announced that half of what is contributed by the sponsor will be given by her each week to the unemployment fund of the State of New York and that she will distribute the other half among special cases which have already been receiving her assistance. Her talks were scheduled to deal with problems of the day, particularly as affecting women and girls, and relate them to her own experiences in private and public life. Leo Reisman's orchestra and Lee Wiley's songs were also scheduled for the programs on which Mrs. Roosevelt was to appear.

"THE Five-Star Theatre," a combine of five new radio programs, each presented on a different day of the week, was recently launched on a double network schedule. The series, under the combined sponsorship of the Standard Oil Companies of New Jersey, Pennsylvania and Louisiana, and the Colonial Beacon Oil Company, represents one of the greatest air bookings under a single listing ever effected. Three of the programs—Mondays, Wednesdays and Fridays—are heard over the NBC. The Tuesday and Thursday offerings are conveyed over the CBS. Groucho and Chico Marx, two of the famous Four Marx Brothers, are featured Monday nights in the hilarious adventures of "Beagle, Shyster and Beagle, Attorneys-at-Law." On Tuesday nights, Josef Bonine directs an especially organized symphony orchestra of forty pieces. Outstanding guest soloists are presented on these nights. The Wednesday programs consist of dramatizations of short stories by distinguished writers. The early Wednesday programs included works of such authors as Rex Beach, Fannie Hurst, Ursula Parrott and Ben Ames Williams. The Aborn Opera Company, directed by Milton Aborn, presents operettas as the Thursday night features. The Chinese detective character of Charlie Chan, popularized in the stories of Earl Derr Biggers, comes to life in the person of Walter Connolly, well-known Broadway actor, in a series of dramatizations presented on Fridays.

THE CBS Cathedral Hour heard Sundays is one of the oldest features on the network. Having been scheduled every Sunday for almost five years, the program has long enjoyed the distinction of being one of the few all-music religious programs on the air. Until the advent of the "March of Time," the Cathedral Hour ranked as the CBS feature requiring the most rehearsing. Now it ranks second to the news dramatization series in that respect. Channon Collinge, director of the hour, was born in England. He grew up in Ireland and India and spent about a year afloat with an uncle who was a sea captain. Since he became of age, Collinge has been especially attracted to music. His careful productions of well-known choral works have won him praise from listeners of all religious denominations. Collinge holds that the appeal of music stops at no line of sectarian limitations. Collinge shows no religious partiality in his selection of works for broadcasting. His fan mail regularly brings him messages from all parts of the world.

What's New in Radio

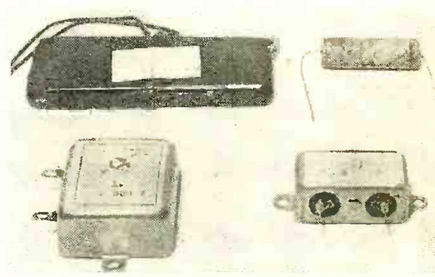
(*Continued from page* 559)

til the desired zone plate is located, which indicates the time in that country. A novel feature is that the zone plates are weighted so they always remain right side up and easy to read. The world time dial may be had separately for one's own installation, or a complete a.c.-operated clock can be had with the time dial mounted as shown, ready for use. The manufacturer also states he can make installations to order.

Maker—A. Eklund & Co., 4121 Third Avenue, New York City.

Fixed Condensers

Description—A complete line of paper condensers designed for all types of replacement work and for all radio manufacturers' requirements. The condensers are non-inductively wound with tinfoil and are made to R.M.A. standards. The uncased filter con-



denser shown in the upper left-hand corner of the illustration is made in capacities from .1 to 4 mfds. and in voltage ratings from 200 to 1000 volts d.c. The tubular type condenser, upper right corner, is available in capacities from .001 to 1 mfd. and with a voltage rating from 200 to 600 volts d.c. These tubular type condensers are also made in multiple capacity sections. The by-pass condenser, type 3-40, in the metal case, lower left corner, is manufactured in capacity ranges from .05 to 1 mfd., voltage ratings from 200 to 600 volts d.c. This condenser is made in multiple capacity units. The bypass condenser, type 111, in the metal case, lower right corner, is manufactured in capacity ranges from .025 to .5 mfd. with a voltage rating of 200 to 400 volts d.c. Manufacturers and other large users of fixed condensers can obtain samples on request.

Maker—Cosmic Products Corp., 133 Liberty Street, New York City.

P.A. Amplifier

(*Continued from page 537*)

the battery switch S9, mounted on the upper half of the panel. The microphone milliammeter, MA, is centrally placed for quick reading. In the lower half of the panel are placed the output switches S6, S7 and S8, the switch S5, the double potentiometers DP1, DP2 and DP3 and the tone control TC.

Reference to Figure 4 shows two rows of binding posts, BP1 to BP6, and by checking it will be noticed that there is a separate ground binding post for the amplifier input circuit, the microphone battery circuit and the radio tuner output. This type of connection permit short leads and simplifies the assembly.

The panel is made from No. 18 gauge steel and it is to be drilled and cut to the exact dimensional sizes as shown in Figure 5. The No. 14-20 square-head machine screw, 1 inch long, is used to fasten the panel to the rack.

The panel can be had completely drilled or, if desired, completely drilled and parts assembled, or drilled, assembled and wired ready for operation.

The next and final article will describe in detail the construction of a seven-tube superheterodyne receiver of modern design, including such new developments as automatic volume control, full-wave power detection and visual meter tuning.

Parts List

BP1, BP2, BP3, BP4, BP5, BP6—Cinch type 3283 push-button binding posts
DP1, DP2, DP3—Coast to Coast type E6516A double potentiometer, 500,000 ohms
J1, J2—Eby phonograph twin jacks
MA—Weston type 506 milliammeter, 0-25 ma.
MR1, MR2—Hubbell type 6579 microphone, polarized receptacles, flush mounting
MP1, MP2—Hubbell type 6580 microphone, three-way polarized plugs
R1, 2, R3, R4—Coast to Coast type E5436 potentiometers, 400 ohms
R5—Coast to Coast 4-point potentiometer, type E6517, 50,000 ohms, or type E6517A, 10,000 ohms
S1, S2, S3, S4—Hart and Hegeman d.p.d.t. toggle switch
S5—Hart and Hegeman s.p.d.t. toggle switch
S6, S7, S8, S9—Hart and Hegeman s.p.s.t. toggle switch
T1, T2—Coast to Coast type 6164 double-button microphone transformer.
T3—Coast to Coast type 6161A low-impedance phonograph pick-up transformer
TC—Coast to Coast type 6525 multiple condenser tone control
X1, X2, X3, X4—Coast to Coast stand-off pillars for terminal board, ½-inch diameter by 3¼ inches long
4 No. 10/32 iron bolts 3½ inches long
1 Coast to Coast No 7118A, No. 18 gauge steel panel, 9½ inches high by 19 inches long
1 Bakelite panel 6½ inches long by 3⅞ inches wide by $\frac{3}{16}$ inch thick
3 Coast to Coast gain control plates
6 Coast to Coast plain control plates
9 Coast to Coast on-off toggle switch plates
1 Coast to Coast No. 7117B metal dust plate
Miscellaneous wire and hardware

Technical Review

(*Continued from page 551*)

tions and prices on a very complete line of Cornell paper and electrolytic condensers.

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36. *Broadcast Transmission, Public Address and Manufacturers' Type Audio Components.* An exceptionally complete 16-page transformer catalog giving specifications on the Kenyon laboratory, standard and all-purpose amplifier transformer line designed to meet the exacting requirements of broadcast stations, audio research laboratories and professional public-address engineers. A special section is devoted to highly filtered rectifier systems, automatic voltage regulators and special types of test equipment.

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37. *Servicemen's and Dealers' 1933 Testing and Trouble-Shooting Instruments.* A 16-page handbook and catalog giving complete details on diagnometers, set analyzers, tube testers, oscillators, ohmmeters and other testing instruments and accessories made by the Supreme Instruments Corp. It also contains complete details of a series of blueprints and kits by means of which any serviceman can build any of the above instruments at a saving, and details of a self-payment plan which enables responsible servicemen to pay for these instruments while using them.

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38. *The Microphone Mixer-Amplifier.* Complete specifications on the characteristics of the MIK-2 mixer-amplifier and power-supply unit designed and manufactured by the Samson Electric Co. to supply excitation current to, and take the output from, one to three double-button carbon microphones. The volume of each microphone position is independently variable and free from "interlock."

PLEASE NOTE: *To avoid disappointment, please make your selection of booklets from the latest issue of* RADIO NEWS, *since our supply of booklets not listed in the current issue is exhausted. The list and coupon contained in this (March) issue should not be used after March 31, 1933.*

March, 1933
RADIO NEWS Free Technical
Booklet Service
222 West 39th Street
New York, N. Y.

Gentlemen: Please send me, without charge, the booklets or folders I have filled in below:

Numbers ....
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☐ Serviceman in Business for Myself
☐ Serviceman Employed by: ☐ Manufacturer, ☐ Jobber, ☐ Dealer, ☐ Service Organization
☐ Radio Engineer
☐ Experimenter
☐ Laboratory Technician
☐ Dealer
☐ Jobber
☐ Professional or Amateur Set Builder
☐ Licensed Amateur
☐ Station Operator
☐ ....
☐ ....

I am a ☐ subscriber ☐ newsstand reader.

I buy approximately $.......... of radio material a month.

Name ....
Address ....
City .... State ....

PLEASE USE PENCIL AND PRINT, IN FILLING IN COUPON

Electronic Arts

(*Continued from page 527*)

such tube counters will require correcting."

While all these instruments and apparatus described are excellent for scientific investigations, they do not have the necessary ease of operation which is required for applying these valuable methods in the office of the ordinary physician.

Integrating Counter Necessary

There is one more important detail that makes us look for other methods, and this is the necessity to *integrate* the total registered amounts properly, because the working conditions under which the radiation is generated in an X-ray plant are subject to many variations.

The following are the most important causes of inconstant radiation:

A. The not inconsiderable fluctuations in line voltage which occur in municipal and still more in rural supplies and which affect the particular X-ray plant, especially when switching on and off motors, elevator motors and other current-consuming apparatus in the neighborhood of the X-ray apparatus. These fluctuations are particularly noticeable when the lines or the transformer are not properly dimensioned.

B. Aging of the valves, which finally causes a reduction of 10% in the output of the plant.

C. Alterations in the X-ray tube. These only appear gradually during operation and therefore usually escape direct notice. They often cause a considerable decrease in the dosage output. Apart from the normal effects of aging of the X-ray tube, cases are known such as, for example, the roughening of the anode or the bending of the anode holder caused by overheating of the tube. This can result in a reduction of 50% in the dosage.

D. Dust; increased humidity of the air during bad weather; flaws in the high-tension leads, etc., which cause a decrease in voltage in the X-ray plant and, consequently, alterations in dosage.

E. Alterations in the insulation of the condensers in voltage-doubling plants, which involves variations in the secondary voltage and therefore in the output (even as much as 20 kv.).

It therefore seems to be almost impossible to reproduce conditions absolutely accurately or as often as desired. It follows, therefore, that dosage methods, whereby only single values of radiation are taken and then (with these measurements as a basis and presuming a constancy of all operating conditions) the dose is given simply according to time, *cannot give absolutely correct values*. The deviations found in actual practice are astonishing.

With most ordinary methods of measurement mistakes which may easily occur on the part of the staff cannot be detected and are therefore a source of danger to the patient. If filters or diaphragms are forgotten or the wrong one used, it is only after some time that the incorrect dosage, usually resulting in burns, is discovered.

With an integrating dosimeter, however, the actual dose applied is measured. The newer types of integrating dosimeter measure directly at the point of irradiation, so that no calculations are necessary.

* Dr. L. F. Curtis: The Vacuum Tube Amplifier for Feeble Pulses. Bureau of Standards, Journal of Research, Volume 9, No. 2, Pages 115 to 120.

† H. Geiger: Verh. d d. Phys. Ges. 1913, 534. H. Geiger and W Muller, Phys Zeitschr. 29, 839, 1928.

‡ Kovarik Phys. Rev. 13, 272, 1919. Kolhörster Z S f. Phys. 2, 257, 1920.

With the Experimenters

(*Continued from page 553*)

nals coming from either end but relatively insensitive to those, or noise, coming from the sides. Its property of noise suppression is explainable on the same assumption: noise coming from either side will be greatly attenuated.

The first of these aerials made was a 30 foot length of wire over which another wire was wound for almost the whole length of the first wire. Turns were spaced two inches apart. No electrical contact was made between the two wires. One of the wires was grounded at the far end and the other wire brought to the set. This aerial must be erected at right angles to the direction from which the interference comes in order to reduce noise. This simple arrangement kept seven sets "sold" for the store.

Since that time I have improved the antenna system and made it more efficient as shown in the sketch. The specifications for this installation are: Length of aerial 80 feet of Belden shielded lead-in wire. This wire has 25 feet of its shielding removed, beginning at a distance of 35 feet from one end. This left a wire which was shielded for a distance of 20 feet at one end and 35 at the other end leaving an unshielded space of about 25 feet between. The 20 foot section is the lead-in. Under no circumstances should the shield over the lead-in be grounded. At the other end of the aerial the opposite state obtains; and the end of the shield—not the core wire—is grounded to as good a ground as can be made via a resistor. The ground wire from the set is shielded and the shield is not grounded either to the set or to the ground. The two resistors are of 2000 ohms each; wire wound with a precision of at least 3% and non-inductive. They are mounted in cardboard tubes filled with paraffin wax. One is connected across the binding posts on the chassis with leads not exceeding 3 inches. The other is connected in series with the end of the wire shield at the far end of the aerial and as close to the ground as possible. It should preferably be mounted on the ground rod itself.

The ground should be two six foot lengths of galvanized iron pipe for temporary jobs and copper or brass pipe for permanent installations. Don't use a water or gas line as a ground either for the set ground or for the aerial. Don't leave more than 3 inches of pipe or rod above the ground. Don't fail to solder all joints. Don't spare insulation. And don't do a slovenly job.

If any readers put up a job like this, I would be glad to know the results obtained.

M. D. YANOSKO,
Pittsburgh, Pa.

Mathematics in Radio

(*Continued from page 548*)

$$\frac{dx}{dx} = 1 \text{ and } \frac{d}{dx}(v^n) = nv^{n-1}\frac{dv}{dx}$$

Then (d) becomes:

(e)
$$\frac{(r_o+r)^2 \times e^2 - e^2r \times 2[(r_o+r)]\frac{d}{dr}(r_o+r)}{(r_o+r)^4} = 0$$

This becomes:

(f)
$$\frac{e^2 \times (r_o+r)^2 - 2e^2r\,(r_o+r)}{(r_o+r)^4} = 0$$

Which is:

(g)
$$\frac{e^2(r_o+r) - 2e^2r}{(r_o+r)^3} = 0$$

If the denominator were placed on the right-hand side, the above expression would obviously become:

(h) $e^2r_o + e^2r - 2e^2r = 0$

(i) $e^2r_o - e^2r = 0$

(j) $e^2r_o = e^2r$ or $r_o = r$

Therefore, calculus has proven the same relation which was shown above. Now, the circuit of Figure 1 is very similar in every respect to the equivalent vacuum tube circuit of Figure 3 of the previous installment. Therefore, the maximum power output of an amplifier tube is obtained when the output resistance is equal to the input resistance of the tube.

D.C. Set Tester

(*Continued from page 538*)

R9—Shallcross resistor, type 6-T, 750 ohms.
S1, S2, S3, S4, S5—Yaxley pushbuttons, No. 2001
S6—Yaxley switch, No. 720
S7, S8, S12—Yaxley switches, No. 730
S9, S10, S11—Yaxley switches, No. 760
VT2—Naald 4-prong socket, No. 242
VT1, VT3—Naald 5-prong sockets, No. 425
VT4—Naald 6-prong socket, No. 426
VT5—Naald 7-prong socket, No. 427
1 Naald 6-prong analyzer plug, No. 906WL, with 7-wire cable
1 Naald 6-to-4 adapter, No. 964DS
1 Naald 6-to-5 adapter, No. 965DS
1 Naald 6-to-5 adapter, No. 965GGDS
1 Naald 6-to-7 adapter, No. 967SS
2 Eby binding posts
1 carrying case
1 drilled and engraved panel, No. 651

Radio Time Chart

(*Continued from page 522*)

immediately above and below this zone.

Running along the line of your zone, find the numeral representing the local time. Then in the vertical column in which that hour appears you find the corresponding hour for any other zone.

Example: Suppose you live in New York and it is 5 p.m. You wish to know what time it is in Japan. Looking in the list of countries, you find U. S. A. Eastern Standard Time falls in Zone 18. Japan is found to be in Zone 4. Now refer to the conversion chart. On the line beginning with West 75 degrees, Zone 18, find the heavy figure 5, meaning 5 p.m. Then following up this column until you reach the line of Zone 4, you find a light figure 7, which means it is 7 a.m. in Japan. The triangle of figures in that upper right-hand corner is marked "tomorrow." Therefore it is 7 a.m. tomorrow morning in Japan. It is obvious that someone in New York always starts out with the line of Zone 18, hence the reason for marking it.

Another example: Someone living in Rome wishes to know what time it is in Vancouver, B. C., when it is noon, Rome Time. The list of countries shows Italy to be in Zone 12 (this zone has central European Time). British Columbia is listed under Canada and is in Zone 21 (Pacific Standard Time). In the chart, refer to the line of Zone 12 and the figure 12 noon. Going downwards to the line of Zone 21, you find 3 a.m. in the morning of the same day as the time in Vacouver. Some countries have a standard time which differs from the time of a standard zone by an odd number of minutes.

S.W., DX Reception

(*Continued from page 524*)

the signal or may vary rapidly and cause an exceedingly rapid fluctuation in signal strength so as to make the program items unintelligible. This latter condition is known as "rapid fading" or "fluttering" and is generally noticed or is more pronounced before or after the signal is at its peak in the locality of interception. This phenomenon may be experienced whether the station be only a few miles distant or thousands of miles distant.

The fascinating pastime of tuning in foreign stations has attracted men and women of all ages from every walk of life. It has been said that "Distance lends enchantment, except when you're out of gas." The motorist and the aviator must prepare for such emergencies but the short-wave enthusiast can travel, without a care, to many countries of the world over the shortest possible distances in fractions of a second, hear the native music of far-off Java, Indo-China and Japan, listen to the delightful Spanish language of Central and South America, the English accents of Great Britain and Australia and other interesting features peculiar to countries whose customs, language and music are vastly different than our own. Romance, via the high frequencies, exists for the owner of a short-wave radio receiver, regardless of sex, nationality, position or age!

De Luxe "Super" Design

(*Continued from page 543*)

concerned, but will also reproduce noise and interference of the high-frequency type. In the reception of strong signals such as those from local and even many distant stations, noise is not ordinarily encountered, but when stepping out for real distance reception where the action of the automatic volume control on weak signals permits the sensitivity to rise to extreme degrees, a reduction of the high-frequency response by means of the static control tends to reduce this type of noise and results in a more favorable signal-to-noise ratio. This feature is therefore one which is not essential, but represents a refinement which will be appreciated under certain conditions and in certain locations.

The second new feature of the audio amplifier is the automatic acoustic compensator, consisting of the choke, resistor and condenser connected in series between the midpoint of the volume-control potentiometer and ground, in the grid circuit of the first a.f. tube. It is the purpose of this unit to maintain tone quality constant regardless of output volume. It is a generally recognized fact that the best tone quality of which a receiver is capable is obtained only when volume is turned relatively high. Where conditions make it essential to operate the ordinary receiver at low volume levels, the tone suffers. It is to overcome this that the automatic compensator was designed.

The last important change in the receiver is found in the loudspeaker equipment. The early model was equipped with dual speakers. These speakers are still available, but there is also a new type auditorium speaker available for those who prefer this type. This is a single speaker of wide frequency response range and high efficiency.

In addition to the improvements described, all of the features of the earlier receiver have been retained. These include the line-voltage compensator switch, which permits the receiver to be instantly adapted to operation from line voltages which are considerably in

INDEX TO ADVERTISERS

excess of or below the normal 110 volts; a jack into which headphones may be plugged when desired and which automatically cuts off the loudspeaker when headphones are used; connections for a phonograph pick-up; full chromium plating on all visible parts of the chassis; dial calibration in frequency, accurate to better than 1 percent maximum; a separate unit which includes the power supply and power output stage; simple connections consisting of a single cable and plug between the tuner and power supply and another cable and plug between power supply and loudspeaker equipment; and last, but by no means least, a band-selector switch on the front panel which permits instantaneous selection of any one of four bands.

Some idea of the effectiveness and consistency of the receiver is found in the results of the RADIO NEWS tests, started late in November and continuing through to December 16.

In carrying on operating tests of this receiver, the RADIO NEWS staff gave particular attention to broadcast reception, for the reason that in the reports on the tests of the earlier receiver most attention was given to short-wave results. The short-wave ability of the latest receiver was taken as a foregone conclusion and just enough short-wave testing done to confirm this opinion.

The tone quality of the new receiver was found to offer a noticeable improvement over the old one. This was first made apparent by a study of the curve of Figure 5 in comparison with a similar curve on the earlier model, as shown on page 81 of the August issue. In the case of the earlier model, the high-frequency end of the curve (at 1000 kc.) dropped to 10 db. down at about 2700 cycles, whereas in the new job this drop is reached only at 4400 cycles and higher. Thus the reproduction of the high notes and overtones was much better on the new one, giving greater brilliance and better definition in the reproduction of music. Also, the curve of Figure 5 shows response flat to within 2 db. (the minimum variation discernible to the ear) from 30 cycles to 2000 cycles—an unusually wide range and one which includes substantially all voice frequencies, making voice reproduction exceedingly natural.

The operating tests *carried on in a New York City apartment house* showed the selectivity of the receiver to be just about all that one could desire. During the heart of the evening, for instance, it is possible to bring in out-of-town stations on channels immediately adjacent to those occupied by local stations, even when using an antenna 100 feet in length, overall. The only exception to this is an occasional difficulty found in bringing Shreveport or New Orleans (850 kc.) while WABC, a 50,000-watt local, is on the air on 860 kc. WLW and WGN can readily be brought in on either side of WOR, and this is quite an achievement, as anyone will admit who is familiar with receiving conditions on the upper west side of New York City.

As for the sensitivity, the tests made were quite extensive. Fourteen West Coast stations were received during the tests, for instance. KFI, Los Angeles, was brought in between 6:00 and 9:00 p.m. (Eastern Standard Time) during every one of the seventeen evenings during which the tests were carried on between these hours. Three other evenings, when tests were limited to later hours, this station was also brought in. The only evenings on which it was not heard during the entire test period of 22 days were two on which tests were concluded before 6:30 p.m.

Three other stations tried for quite regularly were KOA, Denver; WCCO, Minneapolis, and WFAA-WBAP, Texas. During the 22-day test period the Texas stations were heard every evening, WCCO was missed only one evening and KOA was heard 15 evenings. The KOA record was poorest because during part of the evening other stations work on this same channel or on split frequencies sufficiently close to 830 kc. to cause audible heterodynes, and it was therefore sometimes impossible to positively identify KOA. Reception was not counted unless each station was positively identified.

One of the remarkable things about this record is found in the fact that two evenings, November 28th and December 10th, KFI was brought in before 6:30 p.m. (Eastern Standard Time) or 3:30 in the afternoon in Los Angeles. KOA, a station of lower power, was brought in two evenings, December 8th and 11th, before 7:00 p.m. (E.S.T.); Minneapolis before 6:00 p.m. on November 27th and December 1st, 8th and 10th; and Texas was brought in 10 evenings before 7:00 p.m. During many of these evenings all of these stations were received well enough to be valued for their pure entertainment value and well enough to be classed as an extremely close approach to "local reception."

In addition to the above broadcast records, the log shows reception of numerous low-power stations throughout the U. S., Canada and Cuba.

One question may arise in the minds of readers concerning the reception of KFI around 6:00 p.m. while WAIU of Columbus is operating on the same channel. This was, of course, not accomplished without interference from WAIU. The greatest frequency difference between these two stations was found to be only about 6 cycles per second. This frequency difference did not, of course, result in an audible heterodyne and both stations could be heard. On numerous occasions when the two were transmitting dissimilar programs, as when one was announcing and the other transmitting music, each could be distinguished from the other, and frequently the announcement of one could be distinctly understood through the other. Incidentally, the frequency difference mentioned above was estimated by watching the tuning meter image. With a 6-cycle difference the indicator would swing back and forth six times per second, as a result of the changing phase relationship of the two carriers.

Some of the other West Coast stations were heard during the early evening, notably KNX, Hollywood, and KPO, San Francisco. The balance of the 14 mentioned previously were heard during the two evenings when tests extended past midnight. No attempt was made for the extremely distant foreign broadcast stations, which can only be heard shortly before sunrise, but judging from the DX performance of the receiver during early evening hours, it appears more likely that had tests continued until daybreak it would have given a good account of itself on the Hawaiian, Australian and Japanese stations operating on the broadcast band.

In closing, stress should be laid on the fact that all reception discussed here was obtained in an apartment house, located on a heavy traffic artery with one street-car line in front of the door and another crossing it about 125 feet away. The antenna used during most of the tests consisted of an outdoor wire about 60 feet long, located on the roof with a dozen or more other broadcast antennas. The lead-in was roughly 40 feet in length, making the overall length of the system about 100 feet.

The Service Bench

(*Continued from page 555*)

rollers, pressing them into place with the end of a strong permanent magnet. An excellent magnet for this purpose will be found in discarded telephone receivers. A tack is picked up by touching one pole of the horseshoe magnet to its head; and then the tack is pushed through the silk, into the wood, using the magnet as a handle."

Grounded Auto Antennas

Specializing in Silver-Marshall radios and Cadillac automobiles, it is reasonable enough that George T. Kloor, proprietor of Kloor's Garage in Alexandria, La., should be somewhat of a specialist in auto radio installations. Just to demonstrate his versatility, he finds trouble with a Philco model 7 Transitone in a Ford eight, due to the chicken wire screening being grounded to the metal side of the car.

"The construction," writes Mr. Kloor, "is such that this trouble will probably be quite prevalent, and any serviceman making an installation on this car will do well to revamp the antenna system. This can be done with little labor by removing the inner lining and side pads, cutting about two inches off each of the four sides of the antenna screen and resupporting with duck or canvas strips."

A Noisy By-pass Condenser

"Most complaints describing intermittent and noisy reception have been traced to poor tubes, loose connections and faulty volume controls, but in the case of an Atwater Kent Model 40, the correct diagnosis was none of these. The tubes tested okay, the voltages were normal, the volume control quiet in operation, and inspection showed no microphonic connections. A continuity test finally disclosed a leaky by-pass condenser located on the right-hand side of the volume control. This condenser by-passes the speaker choke, the terminals connecting to one speaker post and to the plate of the –71." J. R. Smolcha, McKees Rocks, Pa.

Dead Autodyne Oscillators

Wilbur M. Jackson finds that the almost universal effort to reduce the number of tubes in small superheterodynes by use of the autodyne circuit often results in unreliable oscillation over different portions of the scale. He writes, in reference to the Gloritone 99 series and the U. S. Apex 7, that "the sets go dead on the lower frequencies, and replacing the autodyne tube does not improve matters. However, lowering the bias resistor will restore the oscillator to the normal frequency coverage. Do not lower the resistor too much, as then trouble will be encountered on the other end of the dial or the receiver will go completely dead."

MARCH, 1933

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☐ I am not yet a subscriber to RADIO NEWS.

☐ I wish to become a subscriber to RADIO NEWS, and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.

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Midwest Owner in Newfoundland Hears Trotsky in Copenhagen, Lord Lyttleton at Geneva and Picks up French, German and Italian Stations with Ease! Midwest 16-Tube Set Accomplishes What Nine Other Radios Could Not Do.

. . . and Mr. Hampton's experience is being duplicated daily by thousands of Midwest owners all over the world. Send for additional proof! The superlative performance of this powerful set has established entirely new records of radio reception. Clearness, selectivity, faithful reproduction of tone, tremendous volume under perfect control . . . a thousand new delights await the radio enthusiast who has never enjoyed the untold thrills of one hour with a Midwest 16-tube ALL-WAVE set.

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15 to 550 Meters

Completely Assembled with Large Dual Speakers

Read This Letter

Bishop Falls, Nfld., Dec. 2, 1932

Midwest Radio Corp.
Cincinnati, Ohio

Dear Sirs:

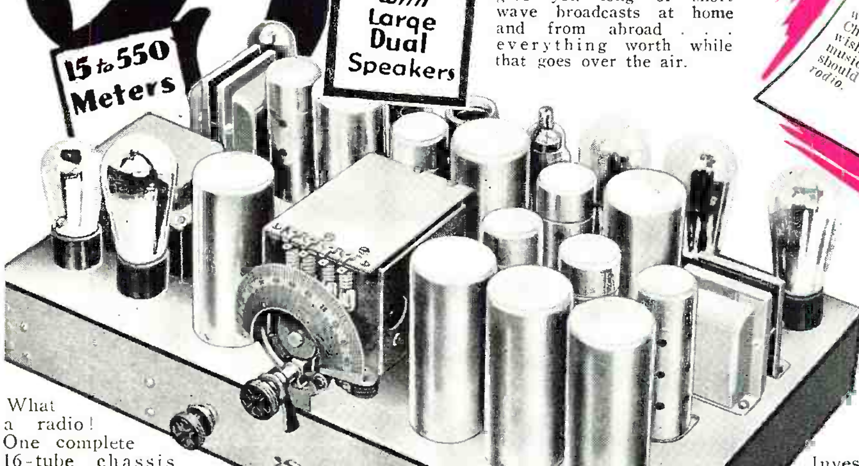
Yesterday and today we have had Springfield on long wave since 3:00 P.M. Newfoundland time, or 1:30 U. S. A. time—something I have never been able to do before, although I have had nine *other radios before getting this Midwest 16-tube.*

Any time after 3:00 P.M. Newfoundland time, we can get French, German and Italian stations on long wave, loud and clear. Sunday, November 20th, on short wave we heard Trotsky speaking on the Russian Revolution from Copenhagen, Denmark. If his English had been good we would have understood every word he said.

Sunday, November 13th, on short wave we heard Lord Lyttleton speaking on the China-Japan affair from Geneva. Anyone wishing to get far away stations and hear music without any hissing or frying, *should get a Midwest and enjoy perfect radio.*

Yours truly,

J. C. HAMPTON



What a radio! One complete 16-tube chassis with one dual-ratio dial—new Super-Heterodyne circuit with a range of 15 to 550 METERS. . . . No plug-in coils. . . . No trimmers to adjust. . . . STAT-OMIT TUNING SILENCER gives in-between-station silence . . . no tuning meter or Neon light required. . . . Large acoustically matched Dual Speakers. . . . New CLASS "B" PUSH-PUSH Super-Power Amplifier with six times the power of ordinary amplifiers. . . . Full band Automatic Volume Control. . . . Color-Lite Multi-Wave Band Selector. . . . FULL FLOATING VARIABLE CONDENSER. . . . Complete Scientific Shielding . . . Absolute tone fidelity. . . Image Frequency Suppressor. . . . Fractional Microvolt Sensitivity. . . Latest TYPE TUBES, Super-Triodes, Dual and Triple Grids. Two Full Wave Rectifiers. DUAL POWERED—two separate power transformers. A bigger, better, more powerful, more selective, finer toned radio than you've ever seen before . . . offered at an amazingly low price direct from the big Midwest factory.

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The big new Midwest catalog shows gorgeous line of artistic consoles in the new six-leg designs. Mail the coupon now. Get all the facts. Learn how you can save 30% to 50% on a big powerful radio.

Investigate . . . mail the coupon . . . get all the facts before you buy a radio. Learn how to get a bigger and better set at a saving of 30% to 50%. Midwest sweeps aside the costly old-fashioned way of selling through distributors and dealers. You buy direct from the Midwest factory. You save all of the middlemen's profits. Mail the coupon now. Get the Midwest catalog. Learn about our sensationally low factory prices, easy payment plan and positive guarantee of satisfaction or money back. Mail the coupon, or write us a postal NOW!

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Dear Mr. Silver:

"Your Masterpiece was put side by side with an extremely good, standard broadcast receiver in my home, and it out-performed it especially on the short wave bands. Your receiver is especially hot on the 40-meter band. I received plenty of South American stations, Mexican stations and Canadian stations—they all came in with tremendous volume. On this particular night the standard short wave job of mine would not receive American stations with any degree of satisfaction.

South American amateurs on your job came pounding in at extreme volume. On the 20 meter band amateurs came in very well. Pittsburgh was received on the 21000 band with fair volume. I think the broadcast band of your job is unusually sweet—I found it absolute 10 kc. over the entire dial.

I was especially impressed with the selectivity between 850 and 1400 kc., KYW, WOC, KDKA, WENR, KWKH, WABC all being received with absolutely no overlapping. XER was received also with absolutely no overlapping as well as WOR, CNRM and WLW.

This receiver in my mind justifies everything you have said about it—it certainly is the best receiver I have had in my home."

Lt. S. M. H., Former Instructor and Technician
U. S. Signal Corp Radio School, Camp Vail, N. J.

Dear Mr. Silver:

"The receiver is giving complete satisfaction. It is far superior to anything we have ever seen or heard. It will be an immense comfort and cheer in our home up here in the Adirondacks."

G. H. B., Crown Point, N. Y.

Dear Mr. Silver:

"In one day's test on the short waves the following stations were received: Pontoise, France—RXC Panama City, HJB Bogota, DJB Germany, besides numerous 6 mc locals, 3.5 and 14 mc amateur phones."

J. H. P., Washington, D. C.

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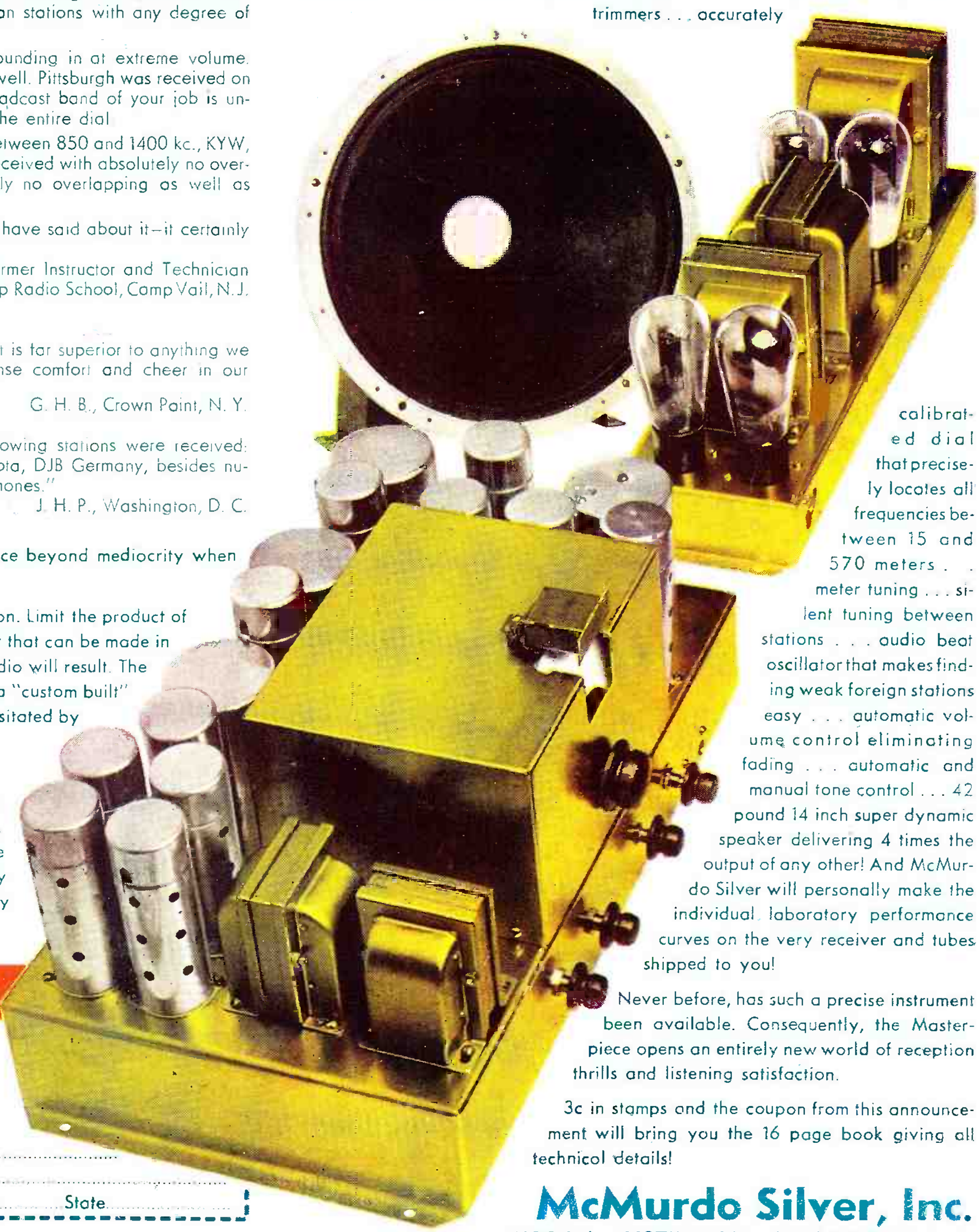

calibrated dial that precisely locates all frequencies between 15 and 570 meters . . . meter tuning . . . silent tuning between stations . . . audio beat oscillator that makes finding weak foreign stations easy . . . automatic volume control eliminating fading . . . automatic and manual tone control . . . 42 pound 14 inch super dynamic speaker delivering 4 times the output of any other! And McMurdo Silver will personally make the individual laboratory performance curves on the very receiver and tubes shipped to you!

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