Blueprint Section Every Month

RADIO AGE

The Magazine *of the* Hour

March
1926

25¢

Blueprints of a wavemeter ¶ Sidelights on naval radio ¶ New means of getting bearings at sea ¶ What interfering waves mean

Complete Broadcast List and Log

In Each Issue

Send for this New Hookup

S-C

Four Tube Receiver

Here is the outstanding radio receiver development of the season, in which is combined the genius of two of the most successful and distinguished radio engineers, assisted by the engineering and laboratory staffs of seven prominent radio manufacturers. Here is a receiver for the home builder that will represent for several seasons to come a far greater value than any other design available. Send for the book. Read how to obtain the following

Startling New Features

SINGLE CONTROL—But one tuning or station selector control.

SELECTIVITY—In a residential district of New York City, within a few hundred yards of powerful stations, thirty-five stations were heard between 9 and 10 p. m. on the loud-speaker. KFI, in Los Angeles, was heard with ample volume to fill two rooms. Tests in Chicago brought in either coast with ample speaker volume and indicated that a consistent range of 1,000 to 2,500 miles might be expected.

QUALITY—Two new-type Thordarson power amplifying transformers possessing a substantially flat frequency characteristic over the range of 40 to 6,000 cycles give a quality of reproduction so perfect that comparison by the best trained human ear with other types of amplifiers will not reveal any superior type.

VOLUME—In all cases the volume will exceed that obtainable from other four-tube receivers, and in practically all cases equal or exceed that obtainable from standard five and six-tube receivers.

UNLIMITED WAVE LENGTH RANGE—Through the use of interchangeable coils, the wave-length range is practically unlimited.

WIRING AND ASSEMBLY—All wiring is carried in a special harness. Since each wire is exactly the right length, and has a special color, it is impossible to go wrong in wiring. No soldering is needed unless preferred by the builder. Only a screwdriver and a pair of pliers necessary to assemble this set in less than two hours.

Overall design, rugged and solid. Adapted to practically any standard cabinet, any standard tube, any battery or eliminator source of supply, outdoor antenna or loop. While the parts are the best that the leading laboratories of the country afford, the set can be built at an extremely low cost. Full description of the receiver will be published in the March issue of Popular Radio.

Get the hand book at your nearest Radio Dealer or clip the coupon and send with 25 cents TO-DAY. Address

The S-C Merchandising Company
107 S. Wabash Ave.
Chicago

The S-C Merchandising Company:
107 S. Wabash Avenue · Chicago

Gentlemen: Please find enclosed 25c, for which send me hand book of the new S-C Receiver.

NAME_____

ADDRESS_____

No choicer group of radio products has ever been embodied in a single radio receiver. Not only are these manufacturers nationally known and accepted as the leaders in radio design and construction, but they have developed for the S-C receiver many new features which will create a new standard in reception throughout the radio world.

Represented Manufacturers:

Belden Mfg. Co.
S-C Wiring Harness

Central Radio Laboratories
Centralab Resistance

Polymet Mfg. Corporation
Fixed Condensers, Leak and Leak Clips

Silver-Marshall, Inc.
Variable Condensers, Coil Sockets, Coils, Tube Sockets, Vernier Dial, Mounting Brackets

Thordarson Electric Mfg. Co.
Equiformer Audio Transformers

Poster & Co.
Drilled and Processed Front Panel and Drilled Sub-Panel

Yaxley Mfg. Co.
Rheostat, Jacks, Switch

$50. to $250 a week IN WORK THAT IS ALMOST ROMANCE

Be a Radio Expert

Get into the great new Big-Pay Industry—Radio. If you're earning a penny less than $50 a week, **clip coupon now.** Send for AMAZING FREE BOOK. Be a Radio Expert, and draw down big money for the easiest and most fascinating work in the world. Positions everywhere. Thoroughly-trained men are in big demand. Need for Radio Experts in every community. Short hours. BIG PAY. **Free book gives all the facts.** Astonishing opportunities—thousands of them! Every day N. R. I. trained men are taking good places in the Radio field. Free book tells all about their success. Send for it now!

PROOF

Operates WMAQ

"Accepted a position with Chicago Daily News—Station WMAQ. My income practically doubled, thanks to your fine course."
KEITH KIMBALL, Chicago.

Gets Big Job

"Just been made Sales Manager of this Radio concern—a big raise in pay. Regret I did not take course sooner."
R. E. JONES, Bay City.

Get this Amazing Book

Most amazing book on Radio ever written—full of interesting facts about this great field and how we prepare you and help you start. You can do what others have done. GET THIS BOOK.

Send Coupon

Send coupon today for special limited offer, including all instruments—you'll get full particulars by return mail.

You get all of these

LEARN QUICKLY AND EASILY *AT HOME*

Master Radio Engineers will show you how to qualify quickly and easily at home, for Radio's fine jobs. We **Guarantee** to train you successfully. Lack of experience no drawback—common schooling all you need. Our tested, clear methods make it easy for you. Send coupon now for free proof.

Instruments Given with Course

All instruments shown here and many others given to students for practice work while learning. Receiving sets from simplest kind to thousand mile receiver, an UNEQUALLED OFFER. Many other big features for limited time only.

Famous Training That "Pays for Itself"

Spare time earnings are easy in Radio. Increase your income almost from the start through practical knowledge we give you. This is the famous *practical* training that *pays its own way.*

Radio Needs Trained Men

National Radio Institute
DEPT. CU-3 WASHINGTON, D. C.

LARGEST RADIO SCHOOL IN THE WORLD

ORIGINATORS OF RADIO HOME-STUDY TRAINING

MAIL THIS NOW

NATIONAL RADIO INSTITUTE,
Dept. CU-3
Washington, D. C.

Without obligating me in any way, send me your free book, "Rich Rewards in Radio," and all information about your practical, home-study Radio course.

Name.....

Address.....

Town..... State.....

Age.....

Please mention Radio Age when writing to advertisers

RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 5 / *March, 1926* / *Number 3*

CONTENTS

Radio Age is published monthly by RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Publication Office, Mount Morris, Ill.
404 North Wesley Ave.,
Address all communications to RADIO AGE, Inc.
Executive, Editorial and Advertising Offices
500 N. Dearborn Street, Chicago, Ill.

FREDERICK A. SMITH, *Editor*
FRED HILL, *Associate Editor*
FRANK D. PEARNE, *Technical Editor*
M. B. SMITH, *Business Manager*

Advertising Director
HARRY A. ACKERBURG
500 N. Dearborn St., Chicago, Ill.

Eastern Representative
DAVIDSON & HEVEY, 17 West 42nd St., New York City

Pacific Coast Representative
V. M. DEPUTY & ASSOCIATES, 515 F. W. Braun Bldg., Los Angeles, Cal.

Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Vol. 5, No. 3. Issued monthly. Subscription price $2.50 a year. March, 1926. Entered as second-class matter at post office at Mount Morris, Illinois, under the Act of March 3, 1879.

A Chat With the Editor

THE April issue of this magazine will mark the beginning of our fifth year in the radio field. A great deal of music and conversation has been picked up by aerials since we published our first magazine. That was back in the early spring of 1922 when a lot of people were skeptical about radio sets, suspecting that they might hand out an electric shock, or draw a bolt of lightning, or do something equally terrible and mysterious.

In those early days of broadcasting we were doing our best to get fans interested in crystal receivers and simple one-tube sets. We believe we may claim, without fear of being accused of immodesty, that we really did lead many fans to take their first step in home radio construction.

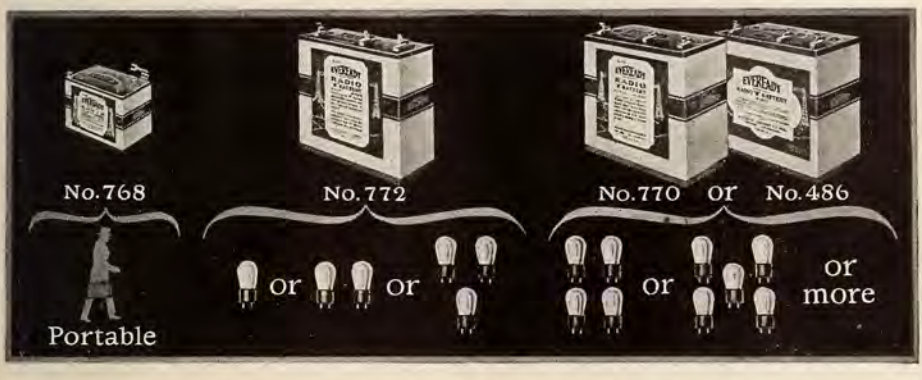
As the years have succeeded one another we have been told repeatedly that the interest in home construction has dwindled away to a negligible thing. We are assured that people are not making their own sets nowadays. Our only answer to these assertions is simply that they are not true. One newspaper received 57,000 letters in 1925 from fans who were making their own sets. Readers of RADIO AGE have increased in number steadily and their correspondence proves a continued lively interest in home construction. We do not attempt to explain why this should be true but the figures show it is true and the most difficult thing in the world is to knock out a fact.

Our latest reports show continued gains in circulation and we thank our readers for these four years of faith and loyalty.

Frederick Smith

Editor of RADIO AGE.

Perhaps you, too, can cut your "B" battery costs in half. Just follow the chart. It gives you the secret of "B" battery economy.



THOUSANDS of people have made the discovery that Eveready "B" Batteries, when used in the proper size and with a "C" battery*, are the most economical, reliable and satisfactory source of radio current.

On sets of one to three tubes, Eveready "B" Battery No. 772, used with a "C" battery, will last a year or longer, usually longer. On sets of four and five tubes either of the larger Heavy Duty Eveready Batteries No. 770 or No. 486, used with a "C" battery*, will last eight months or more.

These figures are based on the average use of receivers, which a country-wide survey has shown to be two hours daily throughout the year. If you listen longer, of course, your batteries will have a somewhat shorter life, and if you listen less, they will last just that much longer.

Here is the secret of "B" battery satisfaction and economy:

With sets of from 1 to 3 tubes, use Eveready No. 772.

With sets of 4 or more tubes, use either of the Heavy Duty Batteries, No. 770, or the even longer-lived Eveready Layerbilt No. 486.

Use a "C" battery on all but single tube sets.

Evereadys give you their remarkable service to the full when they are correctly matched in capacity to the demands made upon them by your receiver. It is wasteful to buy batteries that are too small. Follow the chart.

In addition to the batteries illustrated, which fit practically all of the receivers in use, we also make a number of other types for special purposes. There is an Eveready Radio Battery for every radio use. To learn more about the entire Eveready line, write for the booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you on request. This booklet also tells about the proper battery equipment for use with the new power tubes. There is an Eveready dealer nearby.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

EVEREADY
Radio Batteries
-they last longer

Tuesday night means Eveready Hour —9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WEAR–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO–*Minneapolis* \ *St. Paul*
KSD–*St. Louis*
KGO–*San Francisco, 8 P. M. Pacific Coast Time*

RADIO EDITORIALS

THE number of broadcasting stations appears to have reached its maximum. The editor has it on the highest authority that the number will be decreased rather than increased. Gradually the list of more than five hundred stations will be reduced. Under the legislation now being planned in Washington it will be necessary for broadcasters to show that they are using the time allotted to them before they obtain a renewal of their licenses and authority to use time on the air.

So many important groups now are desirous of using broadcasting to further their civic, educational and cultural objects that it is felt that a means will have to be found of admitting them to the air. Inasmuch as it is impracticable to add any more stations it eventually will be necessary to force stations now licensed to divide their time with new interests.

This does not mean that the Department of Commerce will adopt any arbitrary method of refusing licenses or forcing new divisions of time. The department will renew present licenses in practically all cases. But each broadcaster, as stated, must give an account of his use of time on his wave-length.

A development that is likely to take place with the passing of the years is a consolidation of broadcasting by various interests through a centrally located station which is now using full time on its own activities. It is the theory that there is too much duplication of efforts among broadcasting stations, accompanied by interference which confuses and annoys the Listeners. It is said by those who have made a study of the situation that there should not be more than two hundred broadcasting stations in this country. It is contended that radio broadcasting is getting out of the merely entertaining class into a position where it is more and more a public utility. Looking at broadcasting as a public utility for the dissemination of information it is plain that the same rules are likely to be applied to it as are now applied to the construction and operation of railways.

It would be regrettable if broadcasting should lose its independence. Competition among private interests perhaps will develop and expand the usefulness of broadcasting more satisfactorily than could be done by a group that partook of the nature of a monopoly. Steady resistance has been made to the efforts of the last four years to monopolize the air and we hope the resistance will thrive.

In any case the handling of broadcasting is almost sure to undergo important changes. Having reached the saturation point as to the number of stations we are now to witness a gentle but continuous readjustment of time schedules, wave lengths and licenses. Conditions are far from ideal but in improving them we believe the government will do everything within its power to conserve the rights of individuals and groups now licensed to broadcast.

It is comforting also to learn that there is no intention of censoring the radio programs. Radio, like the press, is to be free in America.

A CONSIDERABLE interest was aroused by our editorial in the February issue of RADIO AGE regarding the improvement in loud speakers. We have had correspondence from many sources and this response indicates how vital the question of good reproduction of sound has become in the radio art. We had no intention of advertising any particular speaker or speakers. We believer it is proper for makers of good loud speakers to do their own advertising and some of them are advertising. We repeat that the buyer of a radio set will run the risk of wasting his money if he does not at the same time make sure that he buys a speaker that reproduces sound with pleasant fidelity. If the loud speaker is bad the best receiving set cannot make reception good.

IN a recent issue a reference was made to the biblical story of Jacob and Esau. After the magazine was off the press it occurred to us that we had erred in identifying the brother with the hairy hands. No reader has yet called our attention to the mistake and we begin to suspect that blue prints may have distracted attention from the good book. We regret the error but if the father of Jacob and Esau was confused about the matter we may have some excuse for mixing it up.

IF NOTHING else was accomplished by the international tests during the last week in January we did discover that the blooper is a universal nuisance. Careless tuning of sets and the tuning of regenerative bird cages that no amount of care could save from being pestiferous made the effort to hear Europe or South America a radio nightmare. We believe that the operators of regenerative outfits learned a lesson. They found that their neighbor was smashing their hopes of getting the other side and thereby reached the conclusion that they themselves probably were interfering with their neighbor. As a result we have been receiving numerous inquiries since international week about construction of tuned radio frequency outfits. The best way to cure a blooper is to bloop back at him when he is trying to hear 2-LO or PTT. Safe to say there will not be so much interference from regenerative receivers another year.

RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication Devoted to Practical Radio
Frederick A. Smith
Editor

A Few Pages from

OUR NAVY'S RADIO *HISTORY*

Original NAA Transmitter Now in Museum; Many Radio Changes Made Since 1902

By Lieut. Commander T. A. M. CRAVEN*

IN 1902, the New York Herald arranged with Mr. Marconi for the installation of radio apparatus on certain private vessels so that newspaper reporters could telegraph to their papers the results of the International boat races off Sandy-Hook. The Navy sent a representative to witness this experimental communication. This representative immediately saw the military value of radio communications and recommended that the Navy investigate this matter as rapidly as possible. This was done and many U. S. naval vessels were soon fitted out with the new invention. The apparatus was crude and was useful for communications at short distances only.

In 1907, or 1908, the Navy conducted what was then considered long distance radio communication tests with the *U. S. S. Salem* and *U. S. S. Birmingham*. These ships put out to sea with high power radio spark sets and endeavored to communicate back to the United States each day as they cruised across the ocean. The maximum distance obtained was about 1,000 miles at night. The sets themselves were impracticable for naval use but the experiments resulted in the establishment of one of the most important technical formulas of radio engineering, the so-called "Austin-Cohen Formula." These gentlemen at that time were employed by the Navy as physicists.

Later, in 1913, the *U. S. S. Delaware*, equipped with a spark transmitter and a receiver having a crystal detector, established communication while off the Azores with the newly constructed 100 K. W. spark station at Arlington. There was great difficulty in receiving messages on board ship. This date is mentioned because it represents the active start of the present phase of remarkable development in the radio science; and it is interesting to note that this 100 kilowatt set, the first of its kind in the world, is now a historical object in a museum.

SHORTLY after this date, the Navy in conjunction with some of the leading American manufacturers conducted a series of trans-Atlantic radio telephone experiments. The apparatus was impracticable for every-day use, but it served as an excellent demonstration of the possibility of radio and resulted in further endeavor and experiments on the part of the Navy. This is believed to be the first time the voice of the United States was heard in Europe by means of radio telephone.

Beginning in 1914, the development of radio in the Navy was so rapid it is difficult to select any single outstanding item of interest. However, at the entrance of the United States in the world war, the Navy had several high powered inter-oceanic stations, several long range coastal radio stations, and almost every vessel in the Navy was equipped with radio. But this was still insufficient to meet the requirements of modern naval warfare, even though the Navy's radio equipment at the beginning of the war was far in advance of commercial apparatus then in use.

With the additional funds and facilities made available for war the Navy in conjunction with commercial electrical manufacturers made large and progressive strides in the development of radio. Radio telephony was made practicable. The broadcast radio transmitters of today are based on these war developments.

American Apparatus

DURING the war, the Navy took over the commercial radio stations and modernized their apparatus. For example, a high power radio station on the Atlantic seacoast was then under construction and there was being installed apparatus of British design, which the Navy considered of doubtful practicability. So the Navy installed apparatus of American design and this apparatus is still in operation at that station.

Long before the war was over, the Navy had in operation the largest radio net in the world. An interesting phase was the organization for handling radio traffic between the United States and Europe. The Navy system not only handled the messages for the United States Naval forces on the high seas, but also those between the War Department and the American Expeditionary Forces in France. The transmitting keys of all the Atlantic Coast high powered radio stations; namely, Marion, Mass.; Sayville, N. Y.; New Brunswick, N. J.; Tuckerton, N. J.; and Annapolis, Md. were controlled from a single room in the Navy Department Building in Washington.

From that room the Secretary of the Navy could communicate instantaneously with France, Italy, England, and all our outlying possessions, as well as with men-of-war at sea.

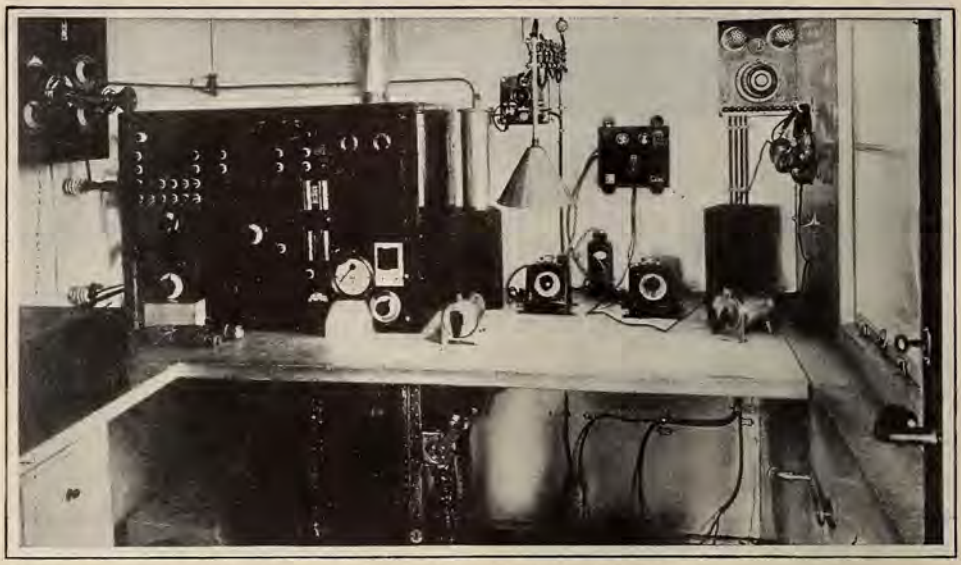
The Navy soon ascertained that this system would be insufficient to handle the rapidly increasing traffic load. So naval radio operators were sent to France to help man the French stations, and this immediately increased the speed of handling the messages. Early in 1918 the construction by the Navy of an additional high power radio station in France was commenced. This station was of 1,200 kilowatt capacity and remains the highest power radio station in the world today, although there is one larger station in this country now under construction.

It is interesting to note that in the interval between 1912 and 1919, a period of only 7 years, the 100 kilowatt station Arlington had become obsolete and the newest stations were all in the order of 1,200 kilowatts. Such was the progress in radio.

Quick Traffic Work

THE use of this high power system was illustrated in an interesting manner one day during the Navy trans-Atlantic

* Radio Division, U. S. Navy.



This is an interior view of the radio room on the USS Los Angeles, showing the different types of transmitters and receivers in use

seaplane flight. Several newspaper correspondents were sitting in the radio control room at the Navy Department waiting for news of Commander Reed, who was flying from Nantucket to Newfoundland on the first lap of the flight. There had been no news of an interesting nature and the time was hanging heavy, so conversation swayed to more speedy subjects. One of the press correspondents in describing the method of distributing news said that they could flash news to every part of the United States within five minutes. In a spirit of jest, a naval officer replied:

"That is nothing. We can flash news to half the world in five minutes."

This officer then noted that one of the correspondents upon hearing this statement, left the room, seemingly with some obscure but malign intent, so the officer immediately established communication with Reed and various stations of the network, as well as with a few men-of-war in various parts of the Atlantic Ocean and the Gulf of Mexico. The correspondent soon returned with a message from the Assistant Secretary of the Navy to Commander Reed asking how how he was and sending best wishes.

This message was immediately dispatched to Reed and at the same time quoted to various stations in the Naval radio system. Reed replied,

"Thanks for your greeting. Off Cape Sable, making 90 miles per hour. All well."

This reply was also dispatched to the stations of the network. Acknowledgments were quickly received from Paris, London, Rome, Norway, Panama Canal, San Francisco, and vessels on the Atlantic. The message was also intercepted by a U. S. naval vessel in Turkish waters. A few seconds later the message had been received in Honolulu, Guam and the Philippines. The entire operation, from the time the Assistant Secretary's message started on its way until the delivery of Reed's reply to the various parts of the world took only 4 minutes 28 seconds.

Distance Means Nothing

DISTANCE meant nothing. In that little room could be pictured within a few seconds the planes in the air, vessels on the sea and under the sea, the boulevards of Paris, the bazaars of Turkey, the snows of the North and the palms of the South Sea Islands. A contrast made possible by the most modern of inventions.

The Navy has not rested in its endeavors since the war. There has been developed under Navy specifications a modern radio transmitter which has proven to be most practical for efficient long range communication on merchant ships.

The Navy's radio compass system has been improved and by this compass we assist merchant vessels in making their ports in fogs, thus enabling them to more quickly complete their voyages. This service rendered by the Navy makes possible the saving of thousands of dollars to organizations engaged in foreign and coastal trade.

As for the future, the Navy is engaged in some remarkable developments, some of which will have commercial application. There is being established, the first low power long distance radio network in the world, at least the Navy will be the first to have this new type of system on a practical traffic handling basis. This is the result of research in which the Navy has taken a leading and most active part during the past few years While it might not spell the doom of high powered radio stations, it certainly will result in large savings in operating costs.

The Navy is very much interested in the transmission of photographs by radio and in many other inventions which can not be mentioned in this article. Let it suffice to say that the Navy is encouraging in every manner within its means the development of the radio science.

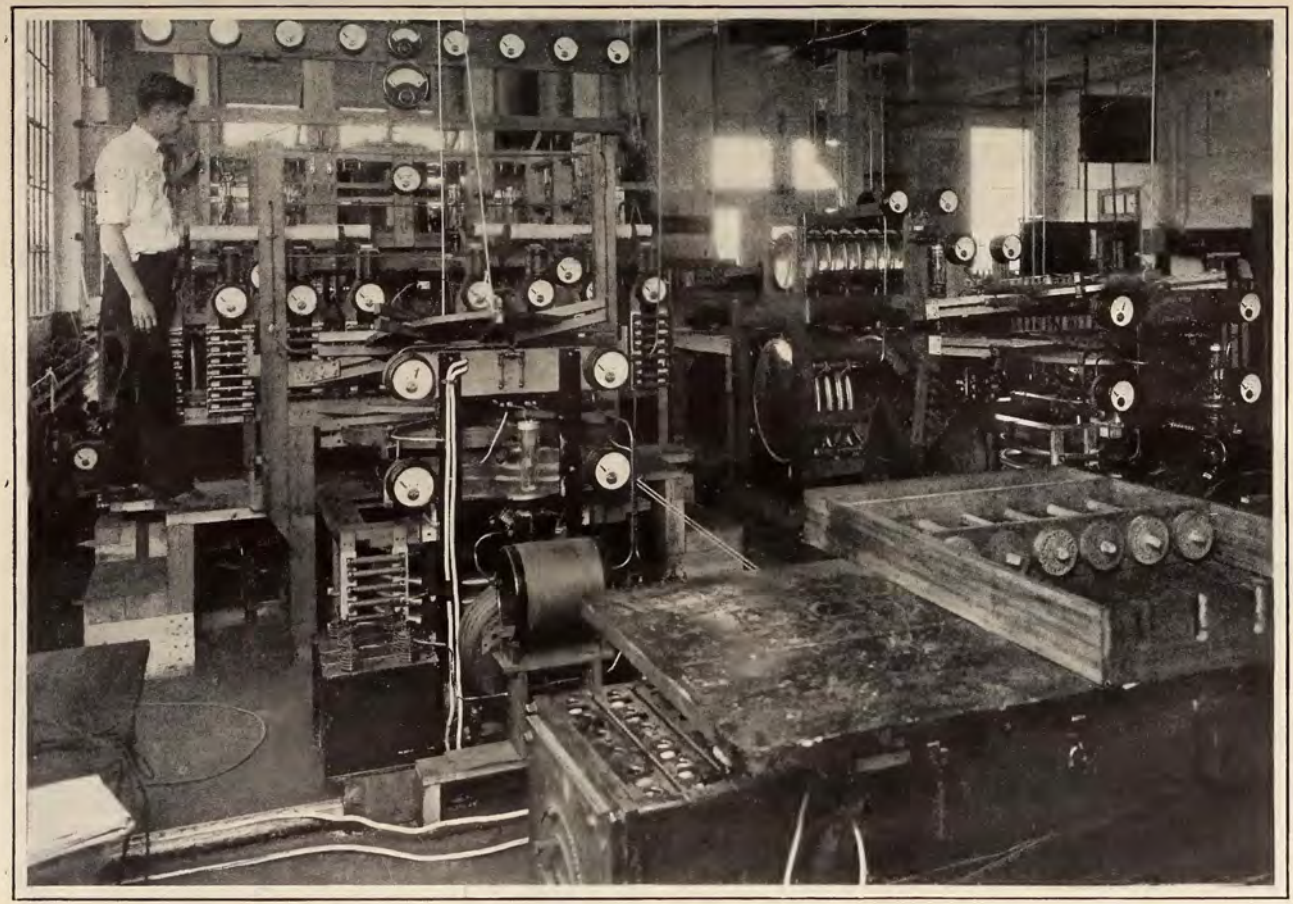
Laying a Foundation

THIS radio technical development might have been retarded considerably in this country had not early steps been taken to lay a sound foundation for the actual production of radio apparatus in the United States.

Early in the century the Navy realized the importance of radio in modern naval warfare; but, the commercial demand was not large enough at that time to warrant investments of suitable amounts of money on the part of the manufacturers. The money making possibilities of radio in competition with cables and telegraph did not seem to be very alluring.

The field of ship and coastal radio was a comparatively small undertaking for large business concerns. In other words, in the pre-war days the commercial demand for radio was so small as to make rapid technical development an impracticability.

In 1911 and 1912, radio in this country was controlled by British and German companies; the European countries being interested in radio as an adjunct to their huge foreign trade and also because they desired to bind more closely their colonies with their home government. The United States had no such incentive, her



This is a typical picture of an experimental transmission laboratory similar to those maintained by the Navy. In this picture, taken at South Schenectady, is shown, at left, the 50 kilowatt, and right, five kilowatt transmitters used for development work by WGY.

merchant marine was small and our colonies were relatively unimportant as compared to the continental United States. In 1912 the Navy had on board its ships radio apparatus made in Germany. Because of this state of affairs, the Navy except in a few minor instances had to purchase its radio equipment in Europe.

The situation as regards the supply of radio material caused by the conditions outlined in the foregoing was intolerable to the Navy. So the Army and the Navy interested the leading electrical manufacturers in the development of radio equipment for men-of-war. Orders were given for apparatus in amounts large enough to make it profitable for the manufacturers to engage in the production of radio equipment.

Ease Patent Troubles

UNCLE SAM took the initiative in eliminating patent difficulties, an obstacle serious enough at that time to make responsible manufacturers hesitate in engaging in the radio trade for fear of suits on account of patent infringement.

Actions of this nature on the part of the Navy helped speed the rapid technical progress which has made the radio of today possible.

After the war, the Navy had to return the private stations it had taken over for war use; however, the former German controlled stations were retained by the Navy permanently. Many of the other private stations were owned by a corporation controlled by British interests. The United States was again faced with the possibility of having her transoceanic and coastal communications in foreign hands.

Fortunately, one of the leading American electrical manufacturers was negotiating the sale of some very important radio patents and apparatus to these foreign controlled corporations. The patents and apparatus were American inventions and had been used by the Navy during the war with great success. The Navy approached this electrical company and requested them, on the grounds of patriotism, to withold the sale of this patent to any but American organizations. The company cooperated very willingly with the Navy but there were no American companies organized which had sufficient capital to handle the matter in a satisfactory manner. The Navy could not purchase the patent because of the necessity for retrenching its expenditures. So it was suggested that this electrical company organize a radio company of its own and purchase the British interests in the foreign controlled radio company under discussion. This was done and thus was formed the largest private radio organization in the world.

The early days of this newly organized American radio company were not encouraging but in the meantime the technical developments which had been made during the war for and by the Navy had demonstrated conclusively that the radio telephone was a practical instrument.

Immediately there was created a demand for the radio telephone. Everyone is familiar with the commencement of the radio broadcasting and the mushroom growth of this modern addition to our forms of amusements. There was now a renumerative field for radio and today radio broadcasting has created a public demand for radio equipment to such an extent that the radio trade amounts to millions of dollars yearly.

Most important to the Navy, however, is that we do not have to depend on foreign companies for our apparatus; and it is interesting to note that the early desire of the Navy to create a source of manufacture of radio equipment in this country helped speed the development of "radio broadcasting."

Although the Navy is not entirely responsible for radio as it is known in this country today, it has contributed in no small way in the early development of the radio art and of the radio trade as a whole.

This is in entire accordance with the methods the Navy has practiced in many other scientific and engineering fields. Thus the Navy is not only a protection to the country but it also renders important service in peace, the value of which few persons realize but which are certainly of direct economic benefit not only to the business interests but also to the entire population of the United States.

In this picture the radio operator on watch is shown copying a message on the typewriter. The radio room is that of one of the vessels engaged in oceanic surveys

WHAT INTERFERING WAVES DO

"Whistles" and their causes are explained for benefit of radio fans

By

MORRIS S. STROCK*

WHEN you tune your receiving set to a broadcasting station you will often hear whistling sounds in the headphones. These sounds are caused by the reaction between waves coming from two distinct sources. To be technically correct it should be stated this effect does not take place between waves in space. Actually it occurs in your receiving circuit.

These whistles in your receiving set may be due to three distinct causes:

(*1*) The radio-frequency currents generated in your receiving set may combine with the radio-frequency currents set up in your receiving circuit by the carrier wave from a broadcasting station.

(*2*) Your receiving set may pick up the whistle from the antenna of some other receiving set.

(*3*) Your receiving set may have radio-frequency currents set up in it by the carrier waves from two broadcasting stations and these currents will produce a resultant whistling sound.

Before discussing these three different kinds of whistles in detail let us see what general conditions are necessary to produce them. This requires a consideration of the musical pitch of the whistle. Pitch must not be confused with intensity or loudness; it refers to the number of impulses or vibrations in a given length of time. You may have a very loud and a very faint whistle of exactly the same pitch. The pitch of the whistle is always equal to the difference in frequency between the two waves which produce it.

How It Works

IF A WAVE having a frequency of 606 kilocycles per second reacts with a wave having a frequency of 600 kilocycles the resulting whistle will have a pitch of 606 minus 600 which is 6 kilocycles or 6000 impulses per second. If the frequency which was originally 606 kilocycles is decreased the pitch of the whistle becomes lower and lower; when the two frequencies become equal no whistle is heard. This condition is called zero beat.

Suppose that the 606-kilocycle frequency is increased instead of diminished. In this case, the pitch of the whistle becomes higher and higher until finally it becomes inaudible to the human ear. When this condition is reached, the pitch of the whistle corresponds to about 15,000 impulses per second.

Now we will now consider the characteristics of whistles as coming from three distinct causes. First, there is the whistle caused by the radio-frequency currents in your own receiving set combining with the wave of the broadcasting station to which you are tuned. This kind of a whistle will only be produced when your receiving set is capable of being adjusted to a generating or oscillating condition. Many receiving circuits will not generate, and consequently can not produce a whistle with the incoming wave. When you hear a whistle in your headphones having a pitch which changes accordingly as you adjust the dials, then you may be sure that it is produced by your own receiving circuit. This set is now acting like a miniature transmitting station, and the sounds which you hear in the phones may be sent out from your antenna in the form of waves which will cause interference to other receiving sets. Some generating receiving sets are so constructed that the whistles which they produce are not radiated. With most sets, however, this is not the case.

May Bother Neighbor

THE distance from your receiving antenna these whistles will be heard is an extremely variable quantity. Serious interference may be caused at distances of several city blocks, and a sensitive receiving set may pick up your whistles from a distance of many miles. Owners of receiving sets which produce whistles of this kind should make it a point to use great care in their adjustment. It is perhaps too much to suggest that sets of this type should be tuned in such a manner that they do not generate. With many sets of this type this is not easy to do. Nevertheless, care should be used at all times and as soon as the whistle from the carrier wave at the broadcasting station is heard, the adjustment of the set should be changed so that it is drawn away from a generating condition.

Sometimes the broadcast listener tunes his set to zero beat with the carrier wave while the broadcast program is being received, then when he tires of the program he "whistles out" by rotating the dials of his set. By waiting until the end of the talk or musical selection this disturbing whistle would not come at such an objectionable time. These whistles could be prevented entirely by first turning back the dial which is causing the set to generate.

The second kind of whistle which you may hear in your receiving set, that which comes from some other receiving set, is caused by exactly the same conditions. To identify this kind of whistle, make the following tests: First, see if its pitch is independent of any adjustment of your dials; second, see if this whistle varies in pitch. If its pitch remains practically constant for a considerable period of time, then it probably belongs to the third class of whistles described below.

Don't Retaliate!

ALTHOUGH this second kind of whistle is caused by exactly the same conditions as the first kind, you are in this case, on the other side of the fence. You must listen to your neighbor's whistles but you have no control over them. Sometimes the practice of "getting even" is resorted to, and the person who is being disturbed by some other set comes back at him with a few whistles of his own. If this practice were confined entirely to the guilty parties it might have some justification. Since, however, these whistles are picked up by other receiving sets, the program may be spoiled for other listeners-in. It is far better to suffer in silence from your neighbor's

(Turn the page)

* Radio Laboratory,
U. S. Bureau of Standards.

whistles and try to bring the matter to his attention in some other way.

The third kind of whistles, those produced between carrier waves of broadcasting stations, are, like the second kind, beyond your direct control. The easiest way to identify these whistles is to note that they are of practically constant pitch and continue so with possibly very slight fluctuations for a long period of time. As you rotate the dials of your set, the intensity but not the pitch of this whistle will change. You may have the most selective receiving set in the world but if you tune your circuit to either one of the broadcasting stations which is causing this whistle, you will not be able to eliminate it. It occasionally happens that a whistle answering this discription may be caused by a receiving set left unattended in a generating condition for a considerable length of time, but such instances are not common.

A whistle of this third class generally indicates a deviation from the assigned frequency on the part of one or both of the two broadcasting stations which produce it. This is not always the case, however. Owing to the fact that each broadcasting station can not be assigned a different frequency, it often happens that two stations of the same assigned frequency are broadcasting in different parts of the country at the same time. Now it is practically impossible to adjust both these stations to absolutely the same frequency. There will probably be a slight frequency difference between them of a few tenths of a kilocycle, and this difference often results in the production of a very objectionable beat note even though these stations are separated by several hundred miles. Slight deviations of this kind would not cause any trouble with stations of different frequency assignments, because the normal separation of such stations is 10 kilocycles and a deviation of a fraction of a kilocycle of one of these stations is too small to produce an annoying whistle or beat note with some other station of a different frequency assignment.

Set Only Causes One Whistle

FROM the foregoing discussion it is seen that of the three different kinds of whistles which may be heard in a receiving set, only one of these kinds can be caused by the set. In the case of receiving sets which will not generate, this kind of whistle can not be produced, and owners of such sets need have no fears that they are causing interference. When you are disturbed by whistles of the other two types it is best to tune away from them and try to obtain reception from some other station. If these whistles are caused by the improper operation of a generating receiving set, there is always the temptation to get even by whistling back with your own receiving set provided your set will generate. Out of courtesy to other listeners, it is best to refrain from this.

Although whistles are objectionable to broadcast listeners they serve a useful purpose in laboratory measurements. In this role they furnish an extremely accurate means of determining when two radio frequencies are exactly the same or when one radio frequency is an even multiple of the other. The source of one of the radio frequencies is varied until the whistle or beat is heard, and the adjustment is then very carefully continued until zero beat is produced.

One application of this effect is found in a method used at the radio laboratory of the Bureau of Standards for measuring the frequencies of distant transmitting stations. What would you think if someone told you that he could accurately measure the size of some object at a distance of several hundred miles? You would probably say it was impossible. This is indeed true, at least it is true as far as any practical method is concerned. The only way of making such a measurement would be by the application of some intricate system of electric signaling and timing.

Blame for all the whistles heard over your radio should not always be laid at the door of your DX-chasing neighbor. Sometimes it is the heterodyning of two out of town stations which causes that ghoulish wailing you hear when twisting the dials.

Mr. Strock's story should go far towards inculcating a little of the spirit of charity into the heart of the broadcast listener, who is ever willing to lay all responsibility for the "canaries" on his brother listener.

—The Editor.

Although a measurement of that kind can not be made we *can* measure the frequency or wave length of a broadcasting station hundreds of miles away with extreme accuracy, in fact, just as accurately as it can be measured right at the transmitting station. The reason for this is simple: It is that the frequency or wave length comes to the measuring apparatus. Suppose your receiving set is tuned to a distant broadcasting station. Alternating currents are now set up in the wires in your circuit and these currents have exactly the same period or frequency as they have at the transmitting station. To measure that frequency a miniature transmitting station is placed near the receiving set. This piece of apparatus is commonly called a radio frequency generator. It sends out a continuous wave in just the same way that the broadcasting station sends out a continuous carrier wave. The wave from the distant station reacts with the wave from the generator, producing a whistle in the phones of the receiving set. The frequency of the generator is now changed so that the pitch of the whistle grows lower and lower until finally it can not be heard. This is zero beat; it indicates that the generator is adjusted to exactly the same frequency as the broadcasting station. By the use of a wave meter the frequency or wave length of this generator is measured, and since the generator has been adjusted to the exact frequency or wave length of the distant station, the measured frequency is the same as the frequency of the broadcasting station. In this measurement we have actually transferred the frequency or wave length of the distant station to the laboratory.

Measure Broadcasters

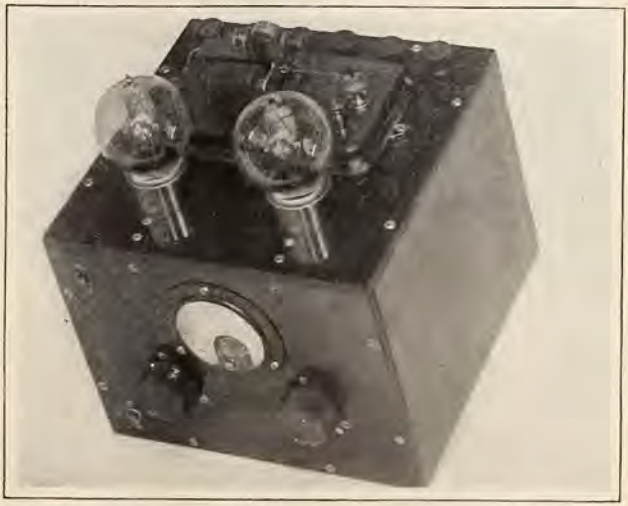
IN just this way the Bureau of Standards makes measurements upon distant stations. As a result of these measurements, certain stations are found which maintain very constant frequencies close to their assigned values. A list of these stations is published each month in the Department of Commerce Radio Service Bulletin. These stations are called "standard frequency stations" and are available as frequency standards to any radio laboratory equipped with a receiving set, a generator of R. F. currents and a wavemeter. These stations are received in exactly the same manner as described above. They are in this case used to obtain a calibration of a wavemeter or to check a calibration previously obtained.

The next time you listen in with your receiving set, try to identify the three different kinds of whistles discussed. Remember that the first kind of whistle, that which is produced by your own receiving set adjusted to a generating condition, is under your control. Since this whistle is radiated from your receiving antenna and picked up by other sets, you should make an effort to reduce it as much as possible. in regard to the whistle which your own receiving set picks up from some other improperly operated set, you may by taking some sort of action in your community, bring this matter to the attention of the owner of the set with resulting benefit to a great many broadcast listeners. There is very little to be done about the third class of whistles which are caused by the carrier waves of broadcasting stations. As previously mentioned, these whistles can not be tuned out on the receiving set; they can be eliminated only by tuning to some other station.

Radio Sound Ranging Device

Latest Aid to Navigation Is Described

By S. R. FALL



Amplifier and relay used on shipboard in radio-sound ranging. It is a two stage low frequency, transformer coupled set.

THE use of a radio compass on shipboard is obviated if a new method of determining the positions of vessels is adopted. By means of a combination of sound and radio, the Bureau of Standards and the Coast and Geodetic Survey have jointly devised a novel system whereby a ship may determine its position on the map, at any time, despite fog or other adverse weather conditions.

Radio waves, as is generally known, travel at the speed of light or at a rate of 186,300 miles per second. The velocity of sound in sea water, on the other hand, travels at a rate of only 1,600 yards a second. Therefore, this new method of ranging consists of firing a bomb, a charge of TNT, and the sending of a radio signal at the moment that the sound wave reaches its destination. The distance from the source of the sound is measured by noting the time elapsed between the creation of the sound wave and the instant the radio return signal arrives at the sound source.

This system of locating positions of ships is called radio-sound ranging. It is necessary to maintain stations on shore as well as to use special instruments on shipboard. For instance, the observing points on land necessitate the use of hydrophones, sensitive devices for detecting sound in water. These under-water microphones, somewhat resembling in operation microphones in broadcasting stations, are submerged 60 feet under water. They are located just off shore, with a cable leading from the hydrophones to the observing stations on land.

Fire off Bomb

A SMALL bomb is discharged from a ship desiring to find its position in fog or other weather which makes it difficult for the navigator to see ahead. This bomb-created sound wave, upon reaching each of the three under-water microphones, automatically releases a radio signal which is recorded on board the vessel at the moment of arrival of the sound at the shore station. The distance of the ship as well as its position from

(*Turn the page*)

Pier at La Jolla, Calif., where Scripps Station is shown at pier head. Experiments are being made at this station.

shore are then a matter of mathematical calculation.

If each shore station transmits a single radio signal, there will be only three time intervals on the sheet of the chronograph, or recording instrument. Each of these time intervals is multiplied by the velocity of sound in sea water—1,600 yards per second—to indicate the distance of the ship from the corresponding under-water microphone. In the use of radio-sound ranging, the locations of the three hydrophones are pre-determined and their positions plotted on a map. Then, according to geometrical calculations, the position of the vessel at the instant of the firing of the bomb is determined.

The apparatus necessary for charting the ocean by use of a combination of sound and radio, include the following units: A radio receiving set, amplifier and relay, chronograph and pen magnet, radio transmitter, triple pole firing and marking switch and safety switches. The radio receiver, for instance, employs a detector and two stages of amplification. Type WD-12 electron tubes are used, the filaments of these being lighted by dry-cell batteries. The amplifier and relay, designed by the Bureau of Standards, is a two-stage, low frequency, transformer-coupled unit. The chronometer and relay used are of standard designs.

Automatic Operator

THE chronograph recorder and pen magnet were designed by the Bureau of Standards, the latter being similar to the one used in automatically copying radio-telegraph signals. The recorder, however, had to be modified, making allowance for the rolling and pitching of a ship. The hanging weights used in supplying motive power when serving on land as an automatic radio recorder had to be discarded. Instead of these weights, a one-twentieth horsepower motor is employed for motive power and in controlling the speed of the chronograph.

The equipment used at the shore observing stations includes the following units: Hydrophones, power amplifier and relay, radio receivers, automatic keys and relays, transmitters, and power supply. The power amplifier increases the energy charge produced by a sound or radio signal so that it will operate an electromagnetic relay. This amplifier is different from those used for reception of broadcast programs in the particular of having the grid of the last vacuum tube negatively biased to the point that no current is flowing in the relay circuit. The radio receiver at shore stations is a duplicate of that used on shipboard. A standard naval aircraft transmitter is used. A supply of eight trays of batteries is required at shore stations. The rectifiers for charging these batteries consist of an air-cooled generating unit of an output of 600 watts at 32 volts, and a 4-horsepower water-cooled charger, rated at 1,250 watts.

As revolutionary as this method of locating positions of ships may seem, it has already been put into practice on the Coast of the Pacific Ocean. Here, where the Coast and Geodetic Survey is making depth soundings and otherwise charting the sea, shore stations have been established and vessels equipped for introducing this system of determining ship positions in the absence of a radio compass. Tests have indicated that this method is operative over distances from zero to 40 miles.

An Exact Science

NAVIGATION is an exact science and throughout its history man has been developing safety appliances for use at sea. The life boat, the life preserver, the radio, flag signalling, sky rockets, watertight compartments and many other improvements have been born as a result of man's desire to at least meet the elements on an equal footing.

It is only natural that with the advent of radio there should be increased activity towards eliminating error in reckoning a ship's position. Originally the radio compass, years ago called the "goniometer," gave valuable service in locating a vessel by triangulation in which two or more land stations acted as observers on a signal from a vessel at sea. Despite the many refinements introduced in the radio compass, there remained a possibility for error due to the unstable conditions of radio transmission and the shielding effect of bodies of land and absorptive objects.

The radio-sound ranging device brings into play an added factor which had not been considered heretofore—viz—the speed of sound under water. In this development underwater sound has happily been combined with radio waves, and the result is a much more effective method of determining to a nicety a vessel's position. In good weather such devices do not come into play, but when fog, sleet, rain or clouds obscure the heavens and prevent "shooting the sun," the new device is called upon for service.

Hydrophone or under-water microphone used in new method of determining ship's position. This is submerged 60 feet under water just off shore, as at the end of the pier shown in the picture on page 11.

Rheostatless Tubes *in* Resistance Coupled Receiver

Tubes With High Mutual Conductance Good for Detection Too

By T. T. WILLIAMS

WITH the recent introduction of high mu tubes it means the broadcast listener now has at his disposal a different type of tube which in time will probably find additional uses other than for just resistance and choke coupled audio frequency amplification.

Manufacturers of such tubes have been careful to advise the set-owner that due to their different characteristics these tubes will not give perfect service in transformer coupled amplifier systems. The reason for this lies in the fact that high mu tubes generally have a plate to filament resistance of about twice that of a 201-A tube, and, since the present type of good audio transformers have primary windings whose impedances are equal to the plate resistance of 201-A tubes, it will be seen that high mu tubes require transformers of different input windings.

A short time ago the writer, upon analyzing the characteristics of the Daven MU-20, came to the conclusion as a result of technical considerations that it should make a good detector tube.

Practical Tests of Tube

WITH this in mind a series of practical tests were conducted in an effort to prove these theories. It quickly became apparent that since the tube plate resistance was greater than a 201-A tube, the coupling and amplifier must of necessity be of the resistance type. Because quality was a prime requirement, it will be seen how the problem worked out.

Using the MU-20 tube as a detector the "B" battery plate voltage was varied over wide limits—from 22½ to 135 volts. It proved that the plate voltage was not at all critical, and that its best value, since the tube is in series with the coupling resistor of the first audio amplifier stage, was about 90 volts.

Another series of tests were conducted with the tube grid circuit. The grid return lead was experimented with by placing it first to the negative filament, and then positive. Best results were obtained, as was to be expected, when the grid return was connected to the positive filament terminal. In this way not only was a better signal and distance received, but where regeneration was employed this connection gave best stability.

A Leakandenser was used for the grid leak and condenser with excellent results; the capacity and resistance of this unit was found to be .00025 mfd. and 5 megohms. For best over-all results considering signal volume, sensitivity and distance, use a grid condenser of .00025 mfd. capacity and a grid leak of approximately 5 megohms.

Final results from the use of such tubes working as detectors revealed the fact that volume was about 20 percent to 25 percent greater than where a 201-A type of tube was properly used within the set. Distance, too, was greatly improved since in such cases where frequently only the high frequency carrier wave of a distant station could be heard on a 210-A type of tube, the MU-20 tube brought in clear but weak modulations which were of such strength as to be amplified.

Further tests showed the tuning circuit ahead of the detector could either be a plain primary and secondary winding working directly from an antenna and ground, or a multi-stage radio frequency amplifier system, but following the high MU detector tube the audio frequency amplifier must be resistance coupled.

Simple High Quality Receiver

Since the writer was essentially interested in a simple receiver with a regenerative detector that was followed by a high grade amplifier, he used the method shown in the wiring diagram shown in Fig. 1.

The three-circuit tuner was wound as indicated later. This covers the entire broadcast waveband. The resistance coupled amplifier can be home made or of the completely assembled types. The writer found that, not only was it possible to get a resistor mounting and coupling condenser of right capacity, but due to its completeness and cheapness, the amplifier could be built for much less than one of transformer type. Correct resistance values are also shown in the diagram.

All tubes were MU-20 type except in the last stage which was a MU-6. This arrangement proved very satisfactory. Incidentally these tubes operate directly from the "A" battery without the need of rheostats or ballast tubes. The detector was found to give best results when the filament current could be varied, and for this reason a rheostat is suggested for better control. A "C" battery should be used with the amplifier for biasing purposes so perfect quality can be maintained.

Winding Data

IN MAKING up the receiver shown in the schematic circuit, the reader may wind his inductances either in spider web fashion; may use the honeycomb coils, or may wind the coils solenoid form on a 3-inch insulating form. The primary may have from 5 to 10 turns of No. 22 DCC wire; the secondary about 45 turns of the same sized wire, and the tickler between 30 and 35 turns. The exact value of the tickler will depend upon a little experimentation on the part of the maker. The variable may be a .00035 mfd.

In the diagram a dotted line separates the tuner and the audio amplifier in the event the builder desires to have the three circuit tuner and the amplifier in two sections. The use of a bypass across the resistor in plate circuit of tuner is necessary and its value may be seen in the drawing.

The stator plates should go to the grid of the detector tube and the rotor to the filament connection. The grid return, as will be noted, is made to the positive side of the filament.

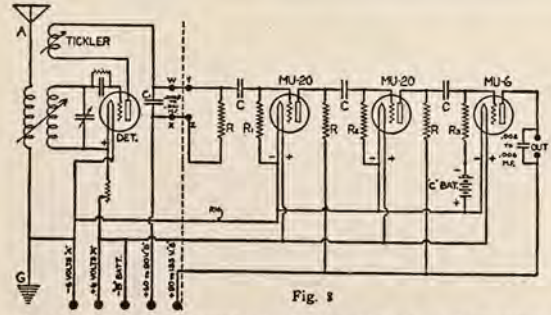


Fig. 1.—The schematic circuit shown above gives the electrical wiring of the three circuit tuner and the resistance coupled amplifier. The three circuit tuner may either be wound by the reader or purchased from manufacturers of inductances. There are a number of good units on the market.

HOOVER WANTS

Laws to *Save* Broadcasting

536 Stations With Only 89 Channels and 250 on Waiting List

Secretary Hoover in a recent statement before the committee on Merchant Marine and Fisheries, which is considering one of the radio bills for the solution of radio's perplexities, has touched on a number of interesting details.

Radio Age is giving herewith the text of Mr. Hoover's statement on account of the interest which this subject holds for our readers.—The Editor.

THE Radio Bill, H. R. 5589, on which this hearing is based, is the culmination of the great amount of study and consideration which has been devoted to conditions during the past few years. The subject is of the greatest importance to our people. The radio public is now numbered in millions and embraces every class in every section. When we consider legislation, we deal with matters which profoundly and intimately affect the daily lives of these millions of American citizens. They are entitled to radio service on the highest plane that inventive genius and mechanical progress permit. The law in force in the United States today does not permit of the establishment of such a system. The situation and the service can be improved only by careful regulation under legislative authority. I consider it highly important to the development of this great means of public communication that legislative relief be given at the present session of Congress.

You are not entering upon the subject hastily. It has received exhaustive consideration from all angles. Your committee devoted time and study to a similar bill at the last session of Congress, and after lengthy hearings unanimously reported a draft with which, in its main provisions the bill now before you is in full accord.

You have also before you the recommendations of the Fourth National Radio Conference which considered the subject at its meeting at Washington in November of last year. This conference was made up of some 600 representatives of all the numerous classes who are interested in radio development, including broadcast listeners. Some of the members of this committee attended its sessions and are familiar with its proceedings. The conference adopted resolutions expressing the views of its membership as to the principles upon which legislation should be based. H. R. 5589 substantially follows these recommendations.

The primary condition that makes legislation necessary is the congestion in broadcasting. This situation has existed for some time. I have hoped that natural laws, working with scientific and mechanical advance, would themselves solve the problem without legislative intervention. But such has not been the case. Inventive genius has not been able yet to furnish us with more broadcasting channels. The desire to broadcast daily becomes more widespread, the demand for licenses steadily increases, we have today more powerful stations in operation and more applications that cannot be granted than ever before. The law has imposed the duty of providing for every applicant so far as possible, with the result that we now have too much crowding together, unscientific geographical distribution, overlapping, confusion. The interference between stations has become so great as to greatly minimize their public service.

Classes of Stations

RADIO stations in the United States now fall into the following classes:

Amateurs	*15,111*
Ships	*1,901*
Land stations	*558*
Broadcasting	*536*

making a total of 18,096 stations. The principal administrative problems, however, are confined to the broadcasting class.

The 536 broadcasting stations must operate on a total of 89 wave channels. There are no more in the broadcasting band. It is simply a physical fact and many of these wave lengths are below effective use. No two stations can operate at the same time in the same vicinity on the same wave length. There must be certain separations between them. The problem has been to try to divide 89 wave lengths among more than 500 stations, which means an average of over 6 stations to each wave length. Satisfactory division has been a mathematical impossibility. Only by time division, power limitation, geographical separation and other expedients has it been possible to preserve any order at all in the ether. There are some 250 applications for new stations before the Department now. If they were allowed, and the number thereby increased by nearly 50 per cent, the whole broadcasting service will be affectively destroyed. From the viewpoint of public service, we need fewer stations rather than more. The present bill permits the correction of this condition.

All Approve It

I THINK, therefore, that in discussing this bill, we may take three facts as settled: first, radio legislation is absolutely and immediately essential if we wish to prevent chaos in radio communications, especially broadcasting; second, the bill now proposed has already received substantial approval and third, the principles declared in this bill have received the approbation of both the radio industry and the radio public.

The distinctive features of this draft, which I consider of the greatest importance, are as follows:

First: The bill affirmatively asserts and assumes jurisdiction in the federal government over all phases of radio communication in so far as such communication constitutes or affects interstate or foreign commerce. I believe that federal supremacy is absolutely essential if this system of communication is to be preserved and advanced. There can be little question of the interstate character of this service. Every word broadcast traverses state lines.

Second: It provides an administrative organization by which federal control is to be exercised. It requires a federal license as a prerequisite to the operation of a transmitting station. This licensing system has been in effect since the passage of the Act of 1912, and has demonstrated its soundness in spite of other deficiencies in that law.

Third: It retains complete control in the federal government of all channels of radio communications. It declares there shall be no ownership or vested right in wave lengths and that the period of use allowed under the license shall be limited to five years, subject to renewals. In so doing, the bill carries into law the system which now exists by department practice. While the law of 1912 contains no limitation whatever on the license period, so that long time privileges or perpetual franchises might have been granted, the department has been heedful to prevent any such situation. It has limited its licenses to short periods. Ship and amateur licenses run for two years, land stations other than broadcasting one year, and broadcasting 90 days. Due to this policy, there is today complete governmental control of air channels and the situation is clear for your action. If the bill now under consideration is passed, there will not be outstanding a single broadcasting license whose expiration outlasts the effective date of the law. There is no vested right in licenses or wave lengths today, and under the provisions of this bill, there need be no fear that vested interest will ever override governmental control.

(*Please turn to page 46*)

IMPROVING *Your* Browning-Drake *Set*

Resistance Coupling Betters Tone and Makes Receiver More Compact

The picture above shows the use of an amplifier unit connected to the conventional receiver. Its use simplifies a good deal of the wiring and makes the set more compact.

RECENTLY the Browning-Drake receiver has received widespread publicity due to the fact hat it is a simple circuit to assemble and, if constructed with the proper equipment, is highly selective and efficient. It also has been acknowledged that the tone quality is very good even when standard audio-frequency transformers are used in the two-stage audio-amplifier of the standard circuit.

Helps Quality

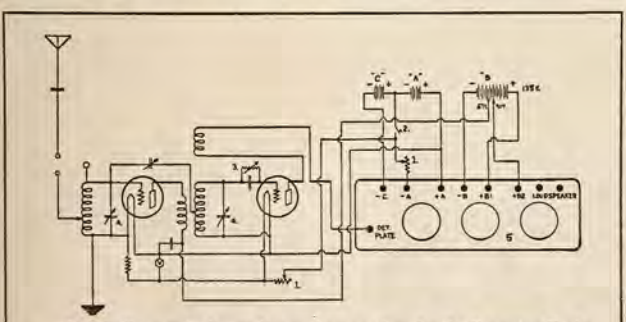
DURING the past year or two the constant demand for improved tone quality has led radio engineers to develop the resistance-coupled amplifier. This type of amplifier dispenses with the usual audio-frequency transformer and substitutes in its place fixed resistance units that amplify the audio-frequency scales without distortion. Inasmuch as the resistance-coupled amplifier provides less amplification per stage, it is necessary to use three stages of audio-frequency amplification to provide the same volume as the two-stage transformer-coupled amplifier. The use of three tubes, however, actually reduces the drain on the B-batteries because the three-tube resistance coupled amplifier has a total B-battery current drain of about one-fifth that of the transformer-coupled amplifier with two tubes. According to a prominent battery manufacturer, reducing the current from 10 milliamperes to 2 milliamperes increases the battery life from about 400 hours to 1,800 hours. Therefore, even though a higher B-battery voltage is used with the resistance amplifier, the life of the B-battery is greatly increased.

Units Improved

ONE of the important features of the resistance-coupled amplifier is the construction of the resistance units used. One of the outstanding successes is the solid molded resistor made out of solid resistor material equipped with silver-plated caps at each end. This type of unit can be soldered into the amplifier and thereby avoid the frequent trouble from loose contacts that occurs when resistance units, enclosed in glass, are used.

The diagram and illustrations accompanying this article illustrate the method of installing the Bradley-Amplifier in the Browning-Drake receiver. The use of this amplifier makes the set extremely flexible because the tube sockets are designed for both the standard 201-A tubes and also the new UX tubes and, since a C-battery connection is provided, the maximum efficiency and volume can be obtained by using the new tubes in the amplifier. Furthermore, by using Bradleystats for filament control and the Bradley-leak for grid leak control, it is possible to shift from 201-A tubes to 199 tubes without altering any connections because the rheostat range is sufficient to handle all tubes.

If a 3-volt tube is desired in the radio-frequency amplifier and if 5-volt tubes are desired in the other circuits an extra Bradleystat can be placed in series with the first tube so that the main Bradleystat can control all tubes and yet allow only three volts to be applied to the first two. Except for the installation of the amplifier, which is a complete ready-assembled amplifier unit, no changes are made in the standard layout of the Browning-Drake receiver. The use of the ready-built Bradley-Amplifier saves much time in assembling the set and assures the most perfect tone quality from this highly successful receiver.



In this diagram is shown the usual connections for the Browning-Drake receiver, together with the pictorial view of the connections for the addition of the resistance coupled amplifier unit.

Many *Big* Tube Sets Built *for* Commercial Transmission

Developments along these lines during 1925 are outlined

By JOHN LISTON*

OUTSTANDING developments of the General Electric Company in radio transmission during 1925 consisted of the production of large high-power kenotron rectifier sets, improvements in low-power sets for transmission from ship to shore, and developments in broadcasting on different wavelengths from a developmental station provided with the most powerful and up-to-date apparatus available.

The more important high-power sets developed can briefly be described as follows:

A 50-kw. output kenotron rectifier was constructed which was designed to deliver 3.3 amp. of direct current at voltages adjustable from 2500 to 15,000 and to draw power at 220 volts, 3-phase, 25 cycles. The output ripple was reduced to less than 0.25 of one per cent by means of a two-stage filter.

A 20-kw. output transmitter of the most modern type used for long-wave continuous-wave telegraphy utilizes a kenotron rectifier to obtain high-voltage plate power, master oscillator to control the output frequency, and a power amplifier to generate the required power. The output is variable from 5 to 20 kw. over a frequency range of 60 to 76 kilocycles.

A 40-kw. output transmitter for use at Kahuku, Hawaii, was the largest tube set built for commercial use at the time it was shipped and is only exceeded in output rating by sets now in process of construction. The design comprises a kenotron rectifier, a master oscillator, and a power amplifier. The master oscillator employs a 20-kw. vacuum tube while the power amplifier requires four of these tubes.

A special feature is the type of coils employed, these permitting of so compact a design of the transmitter that it requires a floor space of only 12 ft. 6 in. by 29 ft. The wave-length range is believed to be the longest of any commercial tube set, viz., 14,000 to 17,000 meters. The set may be operated at keying speeds up to 100 words per minute at outputs of 5 to 40 kw.

The power amplifier circuit is of the push-pull type which is the first time this arrangement has been used in a high-power tube set.

THREE 80-kw. output transmitters were completed similar in design to the 40-kw. set but of double the output, and are the highest power transmitters using vacuum tubes which have been produced commercially. A feature of these sets is the use of water-cooled kenotrons in the rectifier which is designed to deliver 10 amp. at potentials of 5000 to 15,000 volts.

A number of ship transmitters with an output of 200 watts were produced which have a wavelength range of 600 to 900 meters and any wavelength within this band may be selected quickly by the operator. The master-oscillator—power-amplifier circuit is used, resulting in good frequency stability which is necessary for reliable continuous-wave communication.

The possibilities of radio telephone communication from a tug boat to a shore station were investigated and several successful demonstrations were carried out. Radio equipment on a tug boat enables the pilot to receive orders directly from the dispatcher on shore, so that much time is saved when maneuvering in a crowded harbor.

Several applications of quartz crystals as a means of frequency control for a radio transmitter were developed. One of the characteristics of quartz crystals, when oscillating in suitable circuits at the natural frequency if the crystal, is to maintain the frequency of the crystal with great steadiness despite the variations which normally occur in high frequency circuits. Broadcast station WGY is crystal controlled.

SOUTH SCHENECTADY was picked for a large radio developmental station where experiments in all conceivable forms of broadcast transmission are being carried out. On an area of 54 acres there are located three 300-foot steel towers, a 150-foot tower, a number of wooden masts, a main brick building and numerous smaller buildings. In the center building is located the power supply apparatus for the entire plant, the modulating equipment for all of the high-power transmitters, a super-power 380-meter transmitter, and a 1560-meter transmitter.

The power supply is obtained at 2300 volts and is converted by means of high-voltage kenotron rectifiers to plate supply for the large transmitting tubes at pressures of 15,000 and 30,000 volts. There are also many auxiliary machines which supply low-voltage power for filament excitation, and intermediate voltages for plate supply of smaller tubes and for biasing potentials.

For some time the WGY programs have been broadcast from the developmental station on 41.9, 109, and 1560 meters in addition to the regular 380 meter radiation. Reports of reception of these various wavelengths have given valuable information in regard to the results achieved. The 41.9 and 109 meter transmitters have been heard on every continent.

The 1560 meter transmitter has distributed the programs of WGY with great reliability up to distances of 250 miles and Station WCAD of the St. Lawrence University, at Canton, N. Y., has been picking up these programs and rebroadcasting them. This commercial radio rebroadcast service has proved entirely satisfactory over a considerable period of time.

One of the greater accomplishments was the construction and operation of a super-power broadcasting transmitter. At the regular WGY wavelength, powers up to 50 kw. have been radiated since the first tests in July. Last August, in cooperation with the Bureau of Standards, a special series of tests was conducted which demonstrated that improved service can be supplied to more broadcast listeners, without serious interference to reception of other stations in the immediate vicinity, by transmitting at much greater powers than are now normally used. This superpower transmitter, the first of its kind, is now handling an increasing number of programs.

DURING the last two months of the year, very extensive wave propagation tests were conducted. Measurements were obtained at various points in this country and abroad on eight different wave-lengths ranging from 15 to 1500 meters. As a result of these studies, the best wavelength, the best form of antenna, and the best power value for each type of broadcast service may be discovered. It is probably the most extensive investigation that has been undertaken with the avowed object of improving broadcast service.

SEVERAL improvements and extensions were made in carrier-current service. The single-frequency duplex system, which at the beginning of the year was still a new development was incorporated in three types of sets as well as in modifications of equipment already in service.

A typical set has the multipower feature for operation normally at 7.5 watts out-put and in emergency at 50 to 75 watts. The change is accomplished by means of a switch.

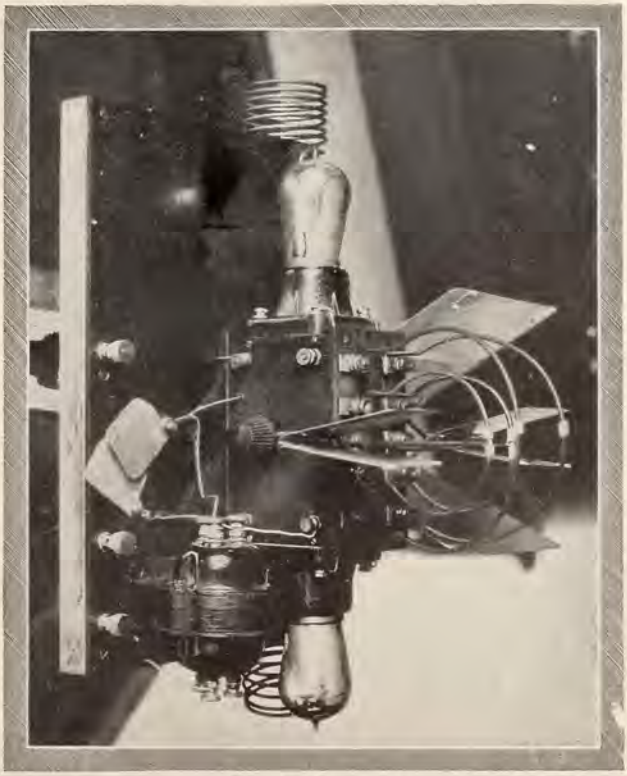
A complete new design uses but one type of pliotron throughout, the 7.5 watt

(Please turn to page 50)

* General Electric, Schenectady, N. Y.

RADIO EYES *for* PLANES

By
S. R. WINTERS



The complete radio transmitter which serves as the eye of the airplane is shown above. The wavelength used is 5 meters; the top helix being the antenna and the bottom one the counterpoise. The device is called the altimeter and accurately gauges the deviation of aircraft from a predetermined height

TRAGIC circumstances surrounding the ill-fated death of Pilot Charles H. Ames, of the air mail service of the United States Post Office Department, may be spared a repetition in the future if air navigation is robbed of some of its hazards by the application of a new invention. Fittingly designated as a radio altimeter or altitude finder, designed by C. Francis Jenkins, this apparatus utilizes radio waves, for the first time, in determining the height from the ground at which an airplane is flying. Unlike the conventional altimeter on aircraft—which, in effect, is a barometer—the radio altimeter measures the altitude from the ground at all times instead of computing the distance in feet above sea level. Thus this new application of the invisible waves is enabled to take into account mountainsides and other immense elevations or depressions of land over which the flying craft navigates.

Fog and Stygnian darkness should hold no terrors for pilots of government and commercial aircraft if this invention merits in practical application the experimental possibilities which it augurs. For, by means of this equipment, costing less than $100—a tiny lamp on the instrument board of the flying craft—the pilot is repeatedly and momentarily warned when hovering over a mountainside. In fact, this danger signal is insistent in waving the proverbial red flag—and the nearer the airplane approaches the mountainside or other threatening obstruction the greater the frequency at which the lamp lights and extinguishes itself in rapid succession. It is an SOS for the pilot to climb higher or to divert his course from the immense elevation of land. On the other hand, if the airplane navigates at a safe altitude above the ground—say 10,000 feet—this lamp glows without flickering or complete extinction, as in the event of immediate danger. Thus, in addition to being an altitude finder, it is an indicator of a haven of safety from the danger of crashing through fog or darkness into a mountainside.

ANALOGOUS to the achievements of Professor A. A. Michaelson in measuring distances by means of light waves, the radio altimeter employs the principle of determining distances by use of radio waves. Just as a mirror reflects objects, demonstrations conducted by Francis W. Dunmore of the Radio Laboratory of he Bureau of Standards, and other scientists, have shown that ultra short radio waves are reflected readily in a similar manner. In case of the radio altimeter, a wave length of 5 meters is employed and when propagated from an airplane to the ground it is reflected back to the transmitting source. The reflection is either in phase or out of phase, which distinction serves to indicate whether the pilot is flying at the pre-determined altitude.

The radio wave propagated from the airplane—5 meters in length, for instance—does not pursue a straight line to the ground, but forms a letter "S" and, in its reflection on coming back to the airplane, travels a reversed "S" route. Thus, the outgoing and returning waves form what radio engineers term a figure "8." If, then, the returning wave is in phase with the transmitted wave, the strength of the returning wave is

added to the strength of the propagated or transmitted wave. As a result, there is a maximum current value or sufficient current for lighting the electric bulb, which resembles a telephone switchboard lamp. With the radio set adjusted to operate at a pre-determined altitude, the two "S" shaped curves will meet at that point—in other words, be in phase, thus producing the effect of lighting the lamp.

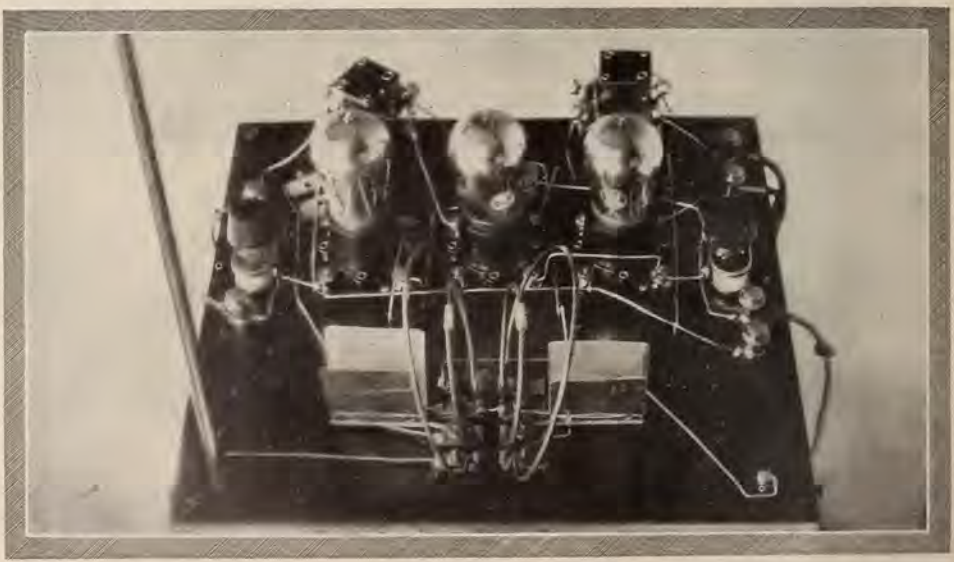
THE opposite effect is quite as pronounced. That is to say, when the propagated wave and the wave returning from the ground are out of phase the tiny electric light bulb fails to yield a visible signal. In effect, it is like placing minus current opposite plus current with the result that there is no electrical reaction. This blotting out or balancing effect is indicated by a failure of the lamp to glow, and accordingly the pilot is warned of approaching an upwarping of the crust of the earth or great depression—either a mountain or a valley. It is an indication that the machine is flying at an altitude in variation from the pre-determined level, —say, for instance, 10,000 feet above the ground.

The apparatus comprising the radio altimeter is not so complicated as its far-reaching purpose would seem to suggest. It consists of a 5-meter transmitter and a three-tube radio receiving set. The sending outfit makes use of two ordinary radio receiving vacuum tubes, the two having an output of about one-half of an ampere. The transmitting antenna resembles a tuning coil, it consisting of two two-inch coils each composed of 7 turns of wire or a total length of 50 inches. One of these coils serves as a conventional antenna and the other gives a counterpoise effect. A storage battery and 90 volts of "B" battery are used. This transmitting set, with its rated output of one-half ampere, is designed to operate when the altitude finder functions approximately 10,000 feet above the ground. Of course, at a greater altitude a more powerful transmitter would be necessary—probably a 7½ watt electron tube.

The radio receiving set is a midget outfit, employing three ordinary radio receiving vacuum tubes. In preliminary experiments, a curtain rod was used as an antenna, this having the advantage of being lengthened or shortened at will. The receiver, of course, corresponds with the transmitter in the respect of functioning at the ultra short wave length of 5 meters. A storage battery is used for lighting the filaments of the vacuum tubes and 90 volts of "B" are employed, ordinarily. For very fine tuning, a coil resembling an inductance unit serves the purpose of a variable condenser with its usual vernier attachment. The radio receiver is shielded from the transmitting set, and by observing this requirement the apparatus may be placed at any point in the airplane. In practice conditions, however, the two units were located in two far corners of the cockpit.

THE small electric light bulb is installed on the instrument board of the airplane. This visual signal is, in effect, a sensitive device for measuring the strength of the radio signal reflected back from the ground. This indicator, however, instead of measuring current in milli-amperes, reveals the strength of the signal in terms of feet, since the strength of the returning signal will vary in accordance with the altitude of the airplane above the earth. The measuring scale will read backward, the higher the machine flies the weaker the current returning. The entire apparatus is automatic in operation, it only being necessary for the aviation pilot to turn on the current and then keep his eye on the tiny electric lamp.

The radio altitude finder, an absolutely fresh application of the invisible waves, has advanced beyond laboratory experiments. Preliminary tests involving the use of this apparatus, have been conducted by the air mail service of the United States Post Office Department. Results of these experiments would seem to indicate that both government and commercial aircraft will eventually be penetrating fog and the darkness of night without the usual hazards, by consulting the radio altimeter. If Major Martin of the 'round-the-world flyers had been provided with this device his flagship probably would have avoided a collapse on an Alaskan mountainside; Air Mail Pilot Charles Ames would have been spared from such an untimely end had such apparatus warned of a mountainside landing; and numerous previous accidents could have been averted if radio had come to the rescue when similar dangers threatened.



The radio receiver, essentially a simple affair and similar to the conventional sets used by thousands of broadcast listeners, except for the wavelength range which is something on the order of 5 to 10 meters

U. S. Questions WJAZ's Wave Right

Commander McDonald Outlines Zenith Policy On Controversy

RECENTLY station WJAZ has been broadcasting on 329.5 meters instead of the 322 meter time division arrangement with KOA. This step brought about an investigation by the Department of Commerce with a possibility of legal action to determine the right of a broadcaster to assume a wave channel other than the one assigned to him.

E. F. McDonald, Jr., in the statement below, outlines the position taken by his station:

My attention has been called to articles appearing in the public press, from which it appears the United States government is about to institute some sort of legal proceedings against Zenith Radio Corporation, of which I am President, with the idea of punishing the corporation or certain of its employees for operating its radio broadcasting station WJAZ for more than two hours per week, the time allotted to it by the Secretary of Commerce. If the government does take some action it will not be a surprise to us as we notified the government authorities we intended to go on the air for the purpose of making a test case in order to determine whether or not there is such thing as "freedom of the air."

Fail to Get Wave

BEFORE doing this we made every effort to obtain from the Secretary of Commerce some fair and reasonable division of time. I spent weeks in Washington with my attorney, Irving Herriott, pointing out the various channels that were open. All our efforts met with failure. The Department even arbitrarily refused to permit us to use a wave length that another station enjoyed and offered to us.

We feel that not only we, one of the pioneers in radio broadcasting, but scores of other stations have been discriminated against. The Secretary of Commerce claims to have wide discretionary powers in the division of time between the broadcasting stations. I question whether or not he has such discretion, but if he has, I wish to state that in my opinion he is abusing this discretionary power, not only in our case, but in many others, to the detriment of the public and the radio industry.

The present chaos and congestion in the air which makes it almost impossible for the listener with the average radio set of limited selectivity to separate one broadcasting station from the other, is not due to the great number of broadcasting stations in the United States, but is the result of the abuse of the discretionary power which the Secretary of Commerce claims to have in the division of wave lengths and operating time, and in spite of this chaotic condition for which the Secretary of Commerce is responsible,

Eugene F. McDonald, President of the Zenith Radio Corporation, Owners of Station WJAZ

he is today asking Congress to pass legislation which will confer upon him even broader powers of discretion than those which he now claims to have.

As a further indication of the extent of this abuse of this alleged discretionary power, I want to point out the fact that the Secretary of Commerce, has licensed 27 broadcasting stations on one particular wave length, yet permits other stations to enjoy an exclusive wave length, with no time limit. It is obvious that 27 stations cannot operate simultaneously, on one wave length, and be heard. In our own particular case he has licensed us to operate only two hours each week and has licensed another station to operate on our wave length the remaining 166 hours each week, and even our little two hours is subject to cancellation at the request of the General Electric Company. The public is justly complaining about the congestion, yet if there were an equal division of time and wave bands, and no favoritism shown, all could be heard and the public would receive real service without interference. In the litigation which according to newspaper accounts the government is about to institute, there will be envolved necessarily the right of citizens of this country to use the air and have a fair division of it, but there will also be presented the question (if the government has this right), shall it regulate in favor of monopoly and against the independent interests and the public generally?

Air Monopoly?

THE radio public today is fully aware of the fact that certain interests now claim to have what virtually amounts to a monopoly of many exclusive wave bands. In my opinion any institution other than one whose business is to disseminate news should have nothing which approaches an exclusive right to any wave band. News agencies are in the nature of public utilities, and their use of the air is of vital interest to the public generally. Such broadcasting should necessarily be given preference over music and other entertainment, but I say that none other than such should be given preference.

Settle Question

WITH the idea of settling one of the greatest questions presented by the development of modern science, Zenith Radio Corporation intends to litigate in every way possible the questions involved. We naturally desire a reasonable division of time for our own broadcasting station, but if we can by litigation settle the question of freedom of the air and a fair and equitable division of time in the interests of the public and the broadcasters is obtained, Zenith will consider its efforts well worth the sacrifice, even though it might itself be unsuccessful in obtaining a reasonable share of the time for its own use.

Our action has been referred to in the press as "Piracy of wave band not in use by any broadcasting station in the United States." With reference to this I am reminded of the statement by one of the most eminent leaders in England's politics, when in discussing the land laws of his country said "What finger wrote the law that made us trespassers in the land of our birth?" With apologies to the Honorable Lloyd George I say, "what finger wrote the law that makes us pirates in the free air of America?"

In conclusion I wish to state that our position is that we fight for principle rather than for personal gain.

Audion *is* Now *Twenty* Years Old

Three element tube contributes much to progress of radio

By H. L. LANPHEAR

TWENTY years old in 1926 says the birthday book of science in noting the invention of the now famous, the long unrecognized, vacuum tube which Lee DeForest christened the "audion," and which, in these intervening years, has made possible a startling series of events in the way of human progress —the radio telephone, transcontinental telephony, world wide radio telegraphy reception, the transmission of voice and music from broadcasting stations, multiplex telegraphy, or wired wireless, the transmission of pictures by wire, talking motion pictures, a revolution in the art of the phonograph, and many other marvels too numerous to mention.

The real story of the audion goes back to September, 1900, when DeForest worked for the Western Electric Company in Chicago, at a salary of $8.00 a week, doing French translation at night for the "Western Electrician," and three nights a week teaching classes in mathematics at the Lewis Institute. An accidental observation of the fluttering gas flame above his little study table in his $2.00 per week room gave him the idea that heated gas around incandescent gas mantel or incandescent lamp filament could be made sensitive to hertzian waves, and thus provide a detector more sensitive than anything conceived of, employing solid or liquid media.

In the next succeeding years DeForest was too busy building the first long distance radio telegraph stations at Key West, Guantanamo, Porto Rico, and Panama, to investigate further his discovery of the "gas effect." Thrown on his own resources in 1906, he again took up his experimental and development work alone, under financial hardships which would have discouraged many another young man. It was in a small, poorly equipped laboratory in the old Parker building at 4th Avenue and 19th Street, New York, that DeForest built his first crude three-element vacuum tube, with his grid or control electrode in the form of a plate. Later on he discarded the plate form for an actual miniature grid, locating it between the anode plate and the filament.

In this old Parker Building laboratory incidentally took place the first report of broadcasting. One night, as the story goes, a navy operator at the Brooklyn Navy Yard, while listening to code messages in the form of dots and dashes, suddenly heard the strains of operatic phonographic selections. What he heard as he afterwards said, almost threw him out of the chair—his being able to pick up music on hertzian waves.

In the summer of 1907 audions were installed as an integral part of radio telephone on the destroyers and warships which made the Roun I The World Cruise under Admiral Bob Evans.

The first reporting of any news event by the broadcasting method, according to the inventor, took place on Lake Erie, in the summer of 1907, when a yacht race was broadcast, and between the news bulletins came selections from a gramophone attached to the broadcasting microphone.

It is interesting to note that as early as 1907 DeForest published a little volume announcing the full extent to which radio broadcasting could be put in the transmission of news and music, but his prophecy, as is usual in the case of pioneers, was looked upon merely with skepticism.

DEFOREST early pointed out that the audion could be used as a relay for long distance telephone communication, an achievement long sought by telephone engineers, but it was not until 1912 that he himself was invited to appear before the telephone engineers to demonstrate the possibilities of his audion lamp. Development work on the DeForest tube by the telephone engineers made possible the opening of the long distance telephone communication across the continent early in 1915. These same engineers in 1915, using the audion as an oscillator, startled the world by transmission of voice by radio from Arlington to Honolulu, a distance of more than 3,000 miles.

In spite of these achievements, however, and ignoring the fact that DeForest himself was conducting a broadcasting station at Highbridge, New York, reporting the results of the presidential campaign of 1916, the world at large, as well as the telephone engineers in general, were still skeptical of the value of radio broadcasting.

It was not until September 1, 1920, when the Detroit News established a station with a little portable DeForest set, that the first permanent broadcasting station in the world was formally opened. A few months later came the Pittsburgh station of the Westinghouse Company, and thereafter the long-dreamed-of radio age, for which DeForest had been struggling, became an accomplished fact.

Another interesting point in connection with the history of the audion is the fact that the company for which DeForest had worked at a salary of $8 a week in 1900, was the one which afterward paid him $300,000 for licenses to operate under his audion patents.

PROGRESS in the development of the audion art is noted step by step throughout the years as follows:

1906—*Patent application filed by Lee DeForest on his three element vacuum tube or audion as a thermionic detector and relay of minute electric currents.*

1907—*Audion used in first telephone broadcasting from the DeForest laboratory in the old Parker building, at Fourth Avenue and Nineteenth Street, New York City.*

1907—*Yacht races on Lake Erie broadcast by DeForest radiophone, the first actual transmission of a news event by the microphone, the audion detector being used.*

1907—*Audion as a detector demonstrated before the New York Electrical Society.*

1908—*Battleship and destroyer fleets equipped with the DeForest radio telephone and success obtained at that time largely due to the use of the audion detector.*

1908—*Warships of the British and Italian navies equipped with the DeForest telephone making use of the audion detector.*

1909—*Manufacture of DeForest tubes begun for the use of radio amateurs in wireless telegraphy reception.*

1910—*Grid leak invented by DeForest.*

1911—*Audion amplifier used as recorder in the first practical automatic and high speed transmitting recording system of wireless telegraphy invented by DeForest.*

1911—*The audion applied to telephone wire transmission made possible multiplex telephony.*

1912—*Cascade audion amplifier invented by DeForest.*

1912—*The oscillating audion discovered by DeForest.*

1912—*Audion relay or telephone repeater exhibited to the engineers of the American Telephone & Telegraph Company.*

1913—*Exclusive wire telephone rights under twelve audion patents purchased by the Western Electric Company for the sum of $50,000.*

1913—*The DeForest Radio Telephone & Telegraph Company established by DeForest.*

1914—*Radio rights on the audion patents purchased by the American Telephone & Telegraph Company for the sum of $90,000.*

1914—*Plate circuit modulation of audion discovered by DeForest.*

1915—*Trans-continental telephone service between New York and San Francisco established by the American Telephone & Telegraph Company by the use of audion relays, without which there would be no long distance telephone.*

1915—*American Telephone & Telegraph Company using the oscillating audion and amplifier in larger sizes and quan-*

(Please turn to page 49)

Air Core or Iron Core?

Type of Intermediates for Supers Seems to Be a Moot Question

By H. M. BISHOP

THIS is probably one of the most mooted and least settled of all radio problems in connection with the superheterodyne. Each type of transformer has its advocates, and both camps are right—to a certain extent. On the whole, the writer feels that the balance of superiority rests with the *high-grade* iron core type; the type supplied with individual laboratory curves, and manufactured by a reputable company. Why—he will endeavor to explain below.

The features most generally advanced in favor of the air core type are that it is more sharply tuned and that hysteresis and eddy current losses due to the iron core in the other type are absent. This is undoubtedly true, and theoretically, in a high frequency circuit, the air core transformer is more efficient. In a superheterodyne designed for code reception, this sharp peaking, preventing the passage of practically all side bands, would be of a distinct advantage, always provided all stages and the filter coupler are *accurately* tuned to exactly the same peak. This involves not only the constancy and accuracy of the transformer coils and the condensers used to peak them on the same wave or frequency, but also the wiring associated with each stage, especially, of course, the grid and plate leads. The latter factor is probably the more serious of the two, since it is almost impossible to control, due to a thousand different causes, among which may be mentioned: (1) changes in resistance of joints due to minute deposits of corrosion in both soldered and clamped joints and to variation of contact pressure in clamped joints; and (2) inevitable feed-back between the wiring of the different stages. It will be seen from the above exposition that the sharp peaking of the air core type of transformer is of doubtful value, tending to defeat its own object, namely, high efficiency, even in the code reception super-heterodyne (where it is at its best, due to increased selectivity resulting from the passage through the amplifier of only a very narrow band of frequencies, thus utilizing to the fullest extent the sharp tuning possible with a well-designed loop and oscillator system.) In short, since it is nearly impossible to tune all stages and the filter to *exactly* the same peak, the efficiency of the air-core transformer type of super-heterodyne is generally paper or theoretical efficiency, which is in no wise consistently borne out in actual practice.

Music and Speech

COMING now to the super-heterodyne for the reception of music and speech, which is the type we are most interested in, we find that the extremely sharp tuning of the air-core type of transformer is highly disadvantageous to the quality of reception, which is almost all-important in this type of receiver. This is due to the fact that any music which is pleasing to the ear is not composed of pure tones, but is literally loaded down with different multiples of these tones, known as overtones or harmonics. The pure tone is a tone such as that emitted by a tuning fork, which gives off a rather unpleasant whining note, absolutely pure and free of harmonics; very useful, it is true, as a means of obtaining a true note for tuning instruments, but not very entertaining. It is readily inferred from this fact that the air vibrations causing music must cover a very considerable band of frequencies, and such is indeed the case. The range of audible or audio frequency extends from about fifty to five or six thousand cycles per second, and, while this band is relatively narrow when translated into a radio frequency current, it is still sufficiently broad to prevent passage in its entirety through a sharply peaked intermediate frequency amplifier utilizing air core transformers at their highest efficiency. This results in the cutting of this band of frequencies, (which for convenience we shall hereafter call the "tonal band,") eliminating the high and low overtones, and resulting in an unnatural and often unpleasant tone, in which the high tones are "fuzzy" or "rough" or "metallic," and the low tones either altogether absent, or possessing a "drummy" or "barrelly" sound. This deplorable state of affairs can be obviated in an air core transformer coupled amplifier in two ways, both of which, however, greatly reduce the efficiency of the circuit and practically defeat the original idea of the superheterodyne, which is to give radio frequency amplification at its peak efficiency. These methods are as follows: (1) Causing each stage of intermediate frequency amplification to peak at a slightly different frequency, and the filter at still another, thus allowing the entire tonal band to pass when these stages are coupled in cascade, and (2) Making the filter-coil and the intermediate air-core transformers of very high resistance, thus broadening the peak and allowing the tonal band to pass. Of the two methods, the second is probably the better, and is by far the most frequently used, but both of these methods are wasteful and inefficient, necessitating more tubes, higher "B" voltage, and greater "B" current to get the required results.

Nearer the Ideal

TURNING now to the use of iron core intermediate frequency transformers in the super-heterodyne for broadcast reception, we find that we approach much nearer to ideal conditions. In the first place, the iron core transformer gives a much higher voltage amplification, due chiefly to the fact that a much greater energy transfer is secured, which is in turn due to the fact that the iron core greatly increases the magnetic coupling between primary and secondary, without perceptibly increasing the capacitative coupling between them. True, there is some hysteresis loss due to the presence of the iron core, but the gain in amplification is so great as to completely overbalance this. Secondly, the iron core causes the peak of the transformer to be broadened, without materially increasing the resistance of the windings, at the same time, due to the increased magnetic coupling, actually lowering the resistance of the whole device below that of the average air-core transformer. This means, then, that with proper design we can obtain an iron core transformer, whose peak covers just a broad enough band of frequencies to pass the tonal band without materially decreasing the selectivity of the receiver, whose efficiency is very high compared to even the best of air-core transformers, and which can be perfectly matched with the other intermediate frequency transformers and the filter coil or transformer, without danger of imperfect or distorted tonal qualities in the completed receiver. Also, the broadened peak is sufficient to take care of any *slight* irregularities in the matching of the transformers and filter without noticeably decreasing the efficiency of the amplifier. This feature is sufficient to take care of any ordinary irregularities in wiring,—irregularities which would be capable of seriously impairing the efficiency of an air-core transformer coupled amplifier.

Hard to Secure

SUMMARIZING the efficiency usually attributed to air-core transformer coupled amplifiers is very difficult to obtain in practice, and, when secured, usually results in impairment of tonal qualities. On the other hand, the iron-core transformer coupled amplifier, in spite of certain hysteresis and eddy current losses, has a higher voltage amplification and consequently a higher overall efficiency,—yet this efficiency is attained with practically no decrease in selectivity, and with tonal qualities markedly superior to that obtained with air core transformers in the same fundamental circuit.

What the Broadcasters are Doing

N. DEAN COLE, chief announcer and studio director of station WHO of the Bankers Life Company at Des Moines, Iowa. This station broadcasts on 526 meters and is well received over the country.

Now We Have Voice Culture by Radio

VOICE culture by radio! This is the latest airway attraction to be chalked up by KOA, Rocky Mountain broadcasting station of the General Electric chain at Denver.

Fundamentals of correct singing, how to exercise the vocal organs and proper training are the keynotes of this unique course which is to be launched as a feature of the educational program from the mile-high station every Monday evening, commencing Feb. 1.

Lessons will require thirty minutes each, it is explained, and are strictly non-technical. Instruction by radio, officials declare, is arranged primarily for laymen and thousands who otherwise would be unable to obtain authoritative guidance in singing. In slating this new radio attraction, staff members assert the course is not intended as a substitute for personal vocal instruction but rather as a supplementary feature. Likewise, it is expected to be of material aid to music teachers in small centers of population.

Conducting the course will be John C. Wilcox, famous music master of Denver, to whom the opera "The Sunset Trail" was dedicated several months ago by the composer, Charles Wakefield Cadman.

"KOA's course in voice culture should appeal to broadcast listeners who know something of singing and want more," Wilcox said, "and also, it should reach those who know nothing of singing and want something. Discussions will not be technical, although questions embracing technical points in music will be welcomed. In general, our lessons should provide a better understanding of singing and undoubtedly will encourage voice culture."

Mr. Wilcox, who is director and head of the vocal department in the Wilcox studios of Denver and instructor in vocal pedagogy at the Denver College of Music, has won national recognition in musical circles. He is widely known as the former editor of an internationally read musical periodical and still retains a wide following as the author of articles appearing in metropolitan newspapers and music publications.

For several years, Mr. Wilcox was conductor of the Denver municipal chorus during which time many standard oratorios and operas were produced. Later, he organized and trained opera companies for the Denver Music Week association.

Westinghouse Now Has Four In Relay Link

SUCCESS of KDKA's experiment with short wave relay apparatus in putting its daily evening concert on the air foreshadows a time when this method of transmission will be used generally for relaying programs from one station to another in Westinghouse's short wave relay system.

Instituted about one month ago, the short wave relay system, operating on 61 meters, has been used to transmit the regular evening concert, from 6:30 to 8 o'clock, to Westinghouse stations KYW, Chicago; WBZ, Springfield, Mass., and KFKX, Hastings, Neb. The same program also is broadcast on KDKA's regular wave length of 309 meters.

At the above relay points the concert is re-broadcast, each station using its own particular wave length.

An important contribution to the reliability of these relays has been achieved through application of the Piezo crystal control, which removes the slight frequency shifts, previously the source of so much trouble.

As a result of the successful experiment music from Pittsburgh at the several in-between stations goes on the air with as much volume and clarity as if it were being played directly at the relaying points.

KDKA's short wave relay apparatus has greatly extended the area over which its programs may be heard.

WSM Puts On Late Jazz Program

BEASLEY SMITH and his orchestra will give a special frolic of popular dance tunes every Tuesday night from 10 to 12 o'clock for WSM, The National Life and Accident Insurance Company's station, Nashville, Tennessee, broadcasting on 282.8 meters. Requests will be answered and with Mr. Smith will appear several popular singers.

WSM has added this frolic to the regular schedule. Heretofore the station has been silent on Tuesday night.

Uncle Sam Plans Farm Features

THAT vast fund of popular and scientific agricultural information which originates on the farms and in the laboratories of the United States Department of Agriculture will soon be tapped in a new place. This is the announcement made by Sam Pickard, chief of the newly created radio service in the department. Steps will be taken immediately, he said, to furnish a variety of agricultural program material to commercial broadcasting stations serving farmer audiences.

Much of the material furnished by the radio service will be prepared for presentation in a radically different manner than the present almost universal practice of reading manuscripts. Broadcasting stations cooperating will be asked to provide personalities who have unmistakeable qualifications to voice the information and material which in most cases will be presented in popular style and in the form of dialogue or questions and answers.

"Uncle Bert" the garden expert, one of Mr. Pickard's phantom characters, will entertain and instruct the boys and girls of the Radio Order of Junior Gardeners with nature-study information. Some of the juniors themselves will be heard over the radio as they ask questions of Uncle Bert.

"Fifty Farm Flashes" will soon be offered as a regular feature on the air. The "flashes" will consist of interesting current information sought by farmers through the several thousand letters received each week by the department.

Other special feature programs are under consideration, among which are the "Housekeeper's Half-hour," and the "National Farm School." In the latter the farm will be considered as the student's laboratory. Timely lecture courses which dovetail with the daily farm work will be developed, and laboratory assignments will be made which necessitate putting into practice the subject matter taught. These will be supplemented with a file of bulletins dealing with the subject matter broadcast.

CANADA'S FINEST

By

E. D. CAHN

NORMALLY the range of CFCA of Toronto, Canada, is from northern Saskatchewan across northern Ontario and Quebec to the maritime provinces, down the Atlantic coast as far as Florida, across Texas, north through Nebraska and its neighboring states and back to Saskatchewan. A tremendous territory which comprises the greater part of the American continent.

On occasion it has been heard as far away as New Zealand and Central America. It was reported in Glasgow during the last series of inter-continental programs, and it is by no means an entire stranger in California or northern Mexico.

CFCA is owned and operated by the Toronto Daily Star, which is one of the most public-spirited and progressive newspapers in Canada and which, though intensely Canadian in inspiration and outlook, can never be accused of the over-conservatism which according to her critics, is Canada's distinguishing trait.

The Star has never been afraid of new things nor what may have appeared at first as revolutionary ones. It has a positive genius for discovering which way the winds of public interest are going to blow and being there with the bellows of its enthusiasm to help them get up a gale.

ITS interest in radio was immediate and exuberant and CFCA in becoming the pioneer station of Toronto was also one of the first not only of Canada but perhaps in all America. It celebrated its entry upon its fourth year of service early in April of this year with a special gala program.

The Star has always had a very special interest in music and had spent a tremendous amount of energy, money and newspaper space—even before the days of radio—in trying to bring it into every home in its immediate community by means of concerts, informative talks, discussions in the paper and every imaginable other means. It revived interest in the old songs, in chorals, rounds, madrigals. It informed the younger generation of many things concerning the honorable history of music which it was in danger of never knowing at all. It introduced Bach, Mozart, Gounod and many others to the generality by using church rooms, schools and halls; by community sings and jolly informal talks by the inimitable Augustus Bridle of its staff.

Mr. Bridle, who is not only a keen critic of music but one of the most impartial men writing on the subject today, adds humor to erudition and knows how to reach and hold a popular audience. It is impossible to over-state the value of his work in connection with this movement or to estimate its far-reaching effects.

(Turn the page)

Burton E. Till and his orchestra who produce exceedingly smooth and listenable jazz from CFCA

Jessie Butt, who with Frank Oldfield are called two of CFCA's lark throated radio favorites

Luigi von Kunitz who directs the Symphony Orchestra in its rendition of the twilight Symphony program given at Toronto and broadcast by CFCA.

HAVING practically created a special audience of its own, CFCA was never at a loss for good things to supply its demands. Mark Hambourg, the internationally famous pianist, has been heard many times and the cello of his brother Boris is loved by a faithful audience.

The Huntsville band, which is conceded by able judges to be one of the finest organizations of its kind in the world, and which plays at the Toronto Exhibition—an annual fair which is the model for all others—has also been featured. Creatore's band is well liked. The National Chorus of which Canada is so properly proud has been heard through this station and many other vocal and instrumental organizations as well.

Nellye Gill, Toronto's own soprano, often sings for this audience. Frank Oldfield and the lark-throated Jessie Butt are great favorites.

The city's fine Symphony Orchestra under the direction of Luigi von Kunitz has broadcast its Twilight Symphony programs for the delight of a multitude of admirers. This concert begins at five-fifteen p. m. and is over at six o'clock. It is given in Massey Hall, which is so located that business people and shoppers can be there in time to hear the whole program and leave for home in good season. The music given is always of superior calibre but not too heavy for the enjoyment of the average taste. Prices are exceedingly reasonable and public support has been so constant as to leave no doubt as to the general approval.

CFCA is non-political and non-sectarian, broadcasting the religious services of various churches and welcoming them all.

In addition to its daily program of music, general news, stock and weather reports CFCA's policy calls for the broadcasting of election returns not only of its own city, province and nation, but those of Great Britain and the United States.

Here we find Nellye G. Gill, Toronto's own soprano, who trills for CFCA's invisible audience

DURING the great blizzard of February, 1924, when telephones and telegraph were put out of service it sent out a steady stream of news bulletins for the benefit of the snowbound thousands. The Canadian Press Association requested CFCA to broadcast a service for them for the benefit of newspapers unable to receive their ordinary dispatches.

At the time of the total eclipse of the sun in January, the Star made special experiments as to the effect of the eclipse on radio transmission and reception and the records of these important experiments were presented to the Toronto University to be a permanent memorial of that great event.

In the midst of an open-air session of a convention of social workers which was held in and broadcast from the Quadrangle of University college one day last summer, a robin's song found its way into the magic disk and so reached and delighted countless listeners.

CFCA kept the public reassured at the time of the King's illness. It went onto the air immediately after the earthquake which shook the entire east and reported the extent of its range and damage. This thoughtful service was much appreciated by the public in general and the always abundant and complimentary mail swelled to enormous proportions in consequence.

THOUGH the Toronto Star has newspapers to sell it invariably seems to forget the fact when there is an event of great and widespread interest and generously broadcasts the news at the earliest possible instant.

The speeches of a long list of notable men and women which include the Prime Minister of Canada and David Lloyd George have been given from this station. And as Toronto is a great favorite as a meeting place for various medical and scientific organizations CFCA has been able to broadcast the speeches of eminent scientists from every country.

At Christmas time its microphone is put at the disposal of jolly St. Nicholas and his message is breathlessly awaited by children all over the continent.

CFCA has always made a feature of broadcasting by remote control and Ernest Dainty's Hippodrome Organ concerts are well liked. E. J. Bowers, the announcer for CFCA always smiles when it is time for Burton E. Till and his jazz orchestra to go on the air. Till produces exceedingly smooth and listenable jazz and his admirers constitute a mighty host.

F. W. Hewitt, the Radio Editor, is the man who broadcasts all the sporting events and his reporting of the hotly contested hockey matches in detail as the games progress is emphatically approved of by an army of devotees.

CFCA was installed under the supervision of C. A. Culver of Northfield University in Minnesota and for the first part of its existence was in the Star building. Laterly however it was moved to new quarters where it is freed of the restraining influences of the steel buildings in the downtown area.

Among the sick and the shut-ins; among the war veterans in the Ontario hospitals CFCA is well beloved for they consider it their own personal station which theymay always depend upon to keep them in its rememberence and which often provides entertainment for their special benefit.

In the far country of the north where a few men mine and trap and explore and carry on the work of civilization out of sight of all their fellows, alone in forests and on waters never heard of by the world at large, CFCA is an ever-faithful friend bringing them news and relieving the tedium of their loneliness.

CFCA is called "Canada's finest" and it deserves the name. It aspires to cover America and because every effort is being made to keep abreast of the times from a technical and radio engineering standpoint, and because the spirit behind it is advanced and enlightened it will no doubt realize its ambition at no distant date.

Veni, Vidi, Vici—*By Radio*

Caesar's Immortal Words Epitomize Cincinnati's Musical Conquest

IN THE early days of history, cities vied with one-another for dominion over the then known world. Rome, Athens, Troy, Carthage—cities of armed men and fair women, of grandeur and power, each a kingdom unto itself, each inspired with the desire to subjugate and loot the others. They are the conspicuous and brilliant examples of the crowning community aspirations of their times. Each city with any pretense to greatness was possessed of the overpowering ambition to capture some other city in order to add to its own lustre and store of worldly goods. They colored the pages of history with the intensity of their pursuit of conquest.

History moved on. Times changed. Cities are no longer kingdoms unto themselves. And yet, in the year 1925 A. D., the world beheld the spectacle of a city setting out to capture an entire continent!

Not with armed men, or catapults, or decoy wooden horses, but solely with the power of music, the city of Cincinnati has set out on its campaign of conquest. Not with any desire to loot or devastate, but inspired solely with the ambition to win good will, Cincinnati set out to capture the North American continent.

Radio was made the medium of attack. Cincinnati, as a community, was made articulate, and its voice was lifted on the wings of the ether, penetrating to the lonely, snowbound cabin of a trapper in farthest north Canada; to the mountain wildernesses of West Virginia miners; to the camps of the lumberjacks in Minnesota; to a fishing schooner off the coast of Nova Scotia; to the night shift at work in a salmon cannery on the Columbia River; to the homes of the movie stars in California; to an electrical engineer down at San Salvador, Central America—to thousands, perhaps millions, whose ears have become miraculously attuned to the voices of the air. It brought joy to a lonely parsonage in Nevada. The cashier of a bank in Arizona wrote: "If I hear many more of these concerts I will be tempted to move to Cincinnati," The invasion was beginning to tell!

BUT to start at the beginning: The idea of giving the community a voice developed in the fertile brain of Fred Smith. Mr. Smith is one of the pioneer studio directors of America, and his voice had become as familiar to millions of radio listeners as those in their own families. During his years of service with Station WLW the vision of the possibilities of radio became more and more tangible in his mind. His task as studio director and announcer had become to him more than a mere routine, necessary as a means to a livelihood. It became an art, a subject for careful and scientific study, requiring an intelligent and sympathetic understanding. He studied it in the environment of the studio. Realizing that there was much yet to learn, he made it a point to visit other stations; and then he made an extensive tour of Europe, studying the European stations and their methods. His knowledge and vision broadened, he returned to Cincinnati to develop some of the

Fred Smith, the originator and director of the Cincinnati Community radio programs

ideas that he had formulated as a result of his studies. He had come to the conclusion that radio is still in its infancy, that the surface of its possibilities has not yet been scratched, and that the industry, or the art, or whatever else one might term it, is in need of men who will dedicate themselves wholeheartedly to its service. He severed his studio connections that he might devote himself to constructive development work.

The first fruit of his broadened vision was a plan for a series of "community programs"—concerts that would symbolize the voice and spirit of Cincinnati. There had been isolated programs here and there given by Chambers of Commerce; but they had been haphazard affairs, with no mark of distinction, and principally to advertise the organization presenting it. The undertaking Mr. Smith proposed was something far different—a series of concerts, to be given weekly over a series of twenty weeks, with the best talent obtainable; a series that would be comprehensive and cohesive and that would reflect Cincinnati's pre-eminence as a center of art and culture; each concert to be a "super-program" that would compel the attention and interest of radio listeners. The good faith of the community was to be demonstrated by keeping the programs free from the least suggestion of commercial advertising—they were to be purely entertaining and instructive.

Mr. Smith went with his plan to Thomas Quinlan, Manager of the Convention and Publicity Department of the Cincinnati Chamber of Commerce. It met at once with his enthusiastic approval and encouragement. He, in turn, presented it to Sol H. Freiberg, Chairman of the Convention and Publicity Committee, and officers of the Chamber of Commerce. They too, approved the plan and pledged it their backing and support. They organized a special Committee, the Community Broadcasting Committee, to supervise the development and execution of the plan. Edward J. Hoff was chosen as Chairman of this Committee.

THE Community Broadcasting Committee at the very outset made an important decision. Inasmuch as the undertaking was to be in the name of the community, the spirit of the venture demanded that the support actually come from the community, rather than from the Chamber of Commerce as an organization. The project therefore was taken up with business men individually, and met with a wholehearted response. Many substantial contributions were received for the Community Broadcasting Fund, even though the donors were warned in advance that they would receive no advertising of any kind out of it, not even a newspaper acknowledgment. On top of all this, the owners of Station WSAI, agreed to donate to the community the use of their station for two hours every Monday night, even though they were informed that their name would not be used in making announcements from the studio.

Nov. 30th was fixed as the date for the opening program.

In order to obtain the widest possible notice for the community concerts, the Committee inquired of Cincinnati business houses if they would mail to the out-of-town customers and other business correspondents "invitations" asking them to listen in. A total of 205,000 such announcements were asked for in advance of the first program. The "invitation" was a four-page affair.

On the two inside pages were the first four programs.

It may not be amiss to mention here, in passing, that there were some who took the invitation in its most literal sense and sought admission to the broadcasting studio on the night of the opening program.

In addition to the 205,000 invitations thus sent out, a number of concerns devoted space in their respective house organs to the announcement and programs, reaching probably 100,000 more people in this way. In the public schools the members of Civic and Vocational Leagues, an organization made up of pupils of the upper grades, pledged themselves to write to their out-of-town relatives and friends calling their attention to the community concerts. The Cincinnati Electric Club wrote a letter about it to every Electric Club in the United States and Canada. The Franklin Typothetae, the Rotary Club, the Kiwanis Club, the Exchange Club, and nearly every other organization of the same kind wrote to their affiliated organizations throughout the country, asking that the letters be read to the members, and the latter be invited to listen in.

It was quite logical that Mr. Smith should be appointed director and announcer of the community programs; and the very first concert justified the confidence thus reposed in him.

The opening program, in the opinion of many who heard it, marked a new era in radio broadcasting. Its high quality and wide variety pleased many tastes.

THE program opened with a concert by the Cincinnati Symphony Orchestra under the personal direction of its illustrious conductor, Fritz Reiner. It was quite appropriate that this, the leading cultural organization of Cincinnati, should launch the community concerts. It ranks as one of the great symphony orchestras of the world; and it may be added here that so splendid was the impression it made, so enthusiastic were the telegrams and letters that poured in from all parts of the continent praising it, that the Orchestra was engaged for three additional community concerts, those of Jan. 18, March 1 and April 5. Idella Banker, soprano, and Emil Heermann, violinist, the concertmaster of the orchestra, were soloists on the opening occasion. The second part was given over to a thematic program entitled, "The History of the Dance," in which the evolution of dances was traced in music. Part Three was the Syncopated Hour, during which the best of up-to-date jazz music was presented.

The thought back of the community concerts was voiced in a brief address by Phillip O. Geier, then president of the Cincinnati Chamber of Commerce. He said in part:

"Cities, like people, have character. Cincinnati has an interesting personality, and in these 20 nights it hopes to make the acquaintance of untold thousands of radio listeners and through its personality as expressed in music and other forms of entertainment prove that it deserves your friendship. Some of America's best musical talent will sing and play for you; the cleverly humorous will amuse you, all to the honor and for the advancement of Cincinnati, a good place to live, a good place to work, a good place to play—a city which in these 20 nights will try to add something worth while to the lives of our countrywide invisible audience.

"In the concluding part of the program tonight you will hear an interesting account of the origin of our beloved city, Cincinnati, brought out of the wilderness by the matchless energy of the early pioneers. They builded better than they knew. Tonight, nearly 150 years after the founding of our city, Cincinnati is again pioneering in initiating the comprehensive community broadcasting program. Through these air messages its citizenry is proclaiming that Cincinnati has kept the hopes and the faith of its founders, that the community has perhaps the most homogenous population of any city of similar size, that it has a population glad to live under our country's flag, a city most free of radical tendencies, industrious, productive, saving, law-abiding, a people revering their government and the church, a people of home owners and home lovers, demanding the highest educational facilities for their children, a people appreciating and supporting the finer arts."

Edward J. Goff, chairman of the community broadcasting committee of the Cincinnati Chamber of Commerce

MR. GEIER also extended greetings to Herbert Hoover, United States Secretary of Commerce, and the Governors of more than a score of states, all of whom had indicated, in response to a special invitation sent them, that they would listen in.

It required but one minute of the time of the program to tell "The Origin of Cincinnati," and to tell it in an interesting and striking way. W. C. Culkins, Executive Vice President of the Chamber of Commerce, was the speaker; and, to prove that such a narration need not be a dry, academic thing, but can be given the dress of romance, it is reproduced herewith:

"One day in the spring of 1788 a pioneer merchant of the name of Benjamin Stites, who had brought his flatboat, loaded with provisions, down the Ohio, tied his craft to the trees on the Kentucky shore at the mouth of the Licking River, and went up to the settlement in the hope of doing some business. But the settlement was in such an uproar that no one paid any attention to Stites, who asked: "What's the matter?"

" 'Matter?' yelled one of the settlers, 'the Indians have stolen our horses."

" 'Did they steal all of them?' asked Stites.

" 'No,' was the reply, 'We had fifteen and they got away with six.'

" 'Come on, then,' yelled Stites, who had summed up the situation in a flash, 'let's get on the rest of the horses and go after the Indians.'

"And that's what they did. Away they went, along the Indian trail over the hills on the Kentucky side, pursuing the marauders across the Ohio and far into the forest to the north. They finally gave up the chase without catching the Indians or recovering the horses, but they did find something a great deal more valuable. On their way back they made a short cut through the beautiful Miami country, and Stites said, as he viewed the magnificent scenery: 'Here I will build a city.' And the result was our present great city of Cincinnati."

Short—not long enough to wear out the radio listener; adventurous enough to hold his interest—and yet, constructive advertising for the community of Cincinnati.

The success of the opening program surprised even Cincinnati, arousing her to a new self-respect. One business man who had contributed $200 to the community broadcasting fund telephoned to Mr. Hoff that he was so delighted with the program that he desired to double his subscription. Later in the day he telephoned again: "I have changed my mind—put me down for $500." A hotel manager who had not been solicited for a subscription voluntarily came forward with a $150 contribution and offered to raise $500 more within a week. Many other business men offered the criticism that the fund originally proposed for community broadcasting was insufficient, declared it should be doubled and volunteered to help solicit the additional funds.

And while each succeeding concert added to the good will that Cincinnati was winning outside the city, it added also to the civic spirit within the city. It was like one who discovers for his voice new uses—like a man realizing for the first time that he can sing far better than he had himself suspected possible.

As elsewhere stated, there had been requests for 205,000 of the first announcement to mail out of the city. Mr. Hoff's committee decided to print such an

(Turn to page 61)

BROADCAST SHORTCOMINGS

Beethoven and Sausages do not Sit Well With Critic

By Dorothy B. Stafford

IF PERCHANCE, some clear, cold winter night one might broadcast the question: "Who doeth all those things which he ought not to have done, and leaveth undone all those things which he ought to have done?" we can readily imagine the answering chorus of listeners from Maine to California, tuned in one great antiphony, "The Program Director!"

For, whether he gets his radio diversion from the head-phones of a home-built two-tube set, or from the mahogany cabinet of the last word in superheterodynes, the attitude of the average listener seems to be to disparage all the efforts of the harassed impressario who ladles out our etherial entertainment. Though holding no brief for the gentlemen in question, our sympathies have heretofore been most decidedly with this much maligned class of amusement purveyors and we have been going along with the general impression that they do mighty well as a whole, when it comes to the Herculean task of trying to please the entire well-known world and his wife. The program directors whom we know personally are earnest, intelligent young men, usually well endowed with a knowledge of human nature and a saving sense of humor, combined with a meticulous care for doing the right thing at all times. But that the best of them are liable to fits of mental aberration was strikingly demonstrated to us a few nights since, and for the moment we felt that all the ridicule poured forth by our anti-radio friends, who regard the whole system of broadcasting as the most inane, mad-hatter form of amusement, was justified.

RECEPTION had been ideal all evening, and after an hour of exquisite music carefully and artistically rendered by the Royal Salon Orchestra, eleven o'clock found us in a singularly peaceful mood. All the worries had been straightened out and the cares that infest the day had pussy-footed off into the limbo of forgotten things. God was in his heaven, all was right with the world and what a blessing was radio,—when we were brought up standing by an authoritative voice.

"Prof. Brugglesmith will now tell you of his experiences in the leper colony in Umquat."

Shades of Beethoven! Gone was all the illusion, all the sense of peace and well-being wrought by the music of the masters. Who in all this broad land wanted to hear about lepers at eleven o'clock at night? Commenting audibly upon the stupidity of program directors in general and this one in particular, we yanked the dial around in the hope of recapturing our erstwhile comfortable mood. In boomed a voice,—by reason of his knowledge of his subject apparently that of "le boucher" himself,—penetrating to every part of the house, and the burden of his oratory was what? Of all things in the world,—sausages!

There at ten minutes past eleven we vowed that never again would we speak a word in defense of the program director. Two stations, both of high standing in the radio world, inflicting such utterly irrelevant and absurd subjects upon their listeners, at an hour, when relaxation and diversion could be the only logical demands of the normal mind. If we must have lepers and sausages, why not put them in the arid stretch from seven to eight when the dinner concerts are over and the evening programs not yet begun? Or launch them forth on Sunday afternoons or holidays when the radio owner searches the air in vain for anything like entertainment.

WHILE upon the subject of the misdeeds of the broadcasters, might one ask by what method of induction have the majority of studios arrived at the conclusion that it is fitting and proper to close down their broadcasting plants on holidays? True, it is nice for the hard working personnel to have a day off. But aren't they supposed to be in the entertainment business? And what other branch of the amusement industry would dream of shutting up shop on a holiday? The artistes of the footlights, the forces of the cinema-shops, the cabaret entertainers have never known a Thanksgiving or Christmas without heavy work. These are the days when the public is searching for amusement. Usually the home is filled with guests, and naturally the radio enthusiast turns to his set for diversion. But where, in ordinary times seven stations fight for the wave length, an unbelievable silence reigns. After a disgusted twisting of dials, they dust off the Victrola, (if it hasn't been sold,) or go to the movies.

It is time some broadcaster awakened to the possibilities of the holiday. And it will come eventually. Witness the perspicacity of the Atwater-Kent people in selecting Sunday night for their presentations. A year ago, on the one night in the week that finds the greatest number of people with the time and inclination for listening, the Capitol theatre program was the one outstanding event on the air. Now millions look forward to the Sunday night program as the gala affair of the radio week.

Though at the moment our attitude toward the program director is anything but charitable, we have a sneaking feeling that there is a time coming when he is going to be entitled to all the sympathy that can be extended. For a cursory examination of the programs that pour into our desk from the east, the west, the north and the south brings the startling thought that there is bound to dawn an awful morning, when one of our bright, young directors will awaken to find himself in the great Alexander's shoes, confronted with the situation, "That's all there is, there isn't any more." For with every station on the air striving and straining for higher quality in its programs,—operas, sonatas, fugues and scherzos have been done and re-done to the point of being frazzled,—and it seems that the bottom of the bin will soon be staring the program arranger in the face.

WITH the overabundance of good music pouring out upon the air, we look back with something of amusement to our early days as a listener, and recall our almost pathetic eagerness to get a certain program where the Peer Gynt suite was to be rendered by a standard concert organization. For, in the past year Asa has died and Anitra has danced to the ministrations of such a countless number of concert bands, symphony orchestras and studio ensemble that one feels inspired at this time to start a movement for a closed season of at least ninety days on Grieg. Just what is to be done about the situation is one for older minds than ours to handle, but it does seem that a famine in the supply of good music must inevitably develop.

The striving after novelty, and the effort to do something that has not already been worked to death has brought about a curious custom,—one which invariably arouses comment from musicians who are listening to radio presentations for the first time. Compositions that were written for symphony orchestras are played by a banjo and piano; violin arrangements are being sung; and we happened one night upon a large orchestra wailing through a negro spiritual. And nothing has escaped the dance orchestras,—old Neapolitan songs, opera arias and delicate bits like "To a Wild Rose" are now orchestrated in jazz and played by everything from three horns to a full organization with harp and kettle-drums. The hardened radio listener takes it as a matter of course, but the old-fashioned music lover covers his ears in horror when the majestic Kammenoi-Ostrow comes reeling in all "ginned up" by the saxes and banjos. It has reached the point where one may expect to hear some ambitious tenor singing the concerto in B minor, or the Largo al Factorum performed upon a bicycle pump.

SO TIRED has the public become of this messing up the classics that the director's only hope of providing acceptable innovations lies outside the realm of music, as witness the popularity of two highly original features of this winter, viz: the historical lectures, with appropriate musical settings provided on the Waterman hour early in the fall, and the weekly bridge lessons. Both these features represent real thinking on the part of someone, and were received with great appreciation by the majority of radio listeners.

After bringing the argument up to the point where it is evident that to be a successful program director a man must combine with all his other virtues a genius for invention fully equal to that possessed by the expert who perfects the instrument that translates his programs into sound, we find we have defeated our own ends. He *does* have our sympathy.

SHE was one of those intense souls whose reactions are always violent, and she was listening to her first radio concert.

"It is perfectly thrilling," was her throaty comment. "I feel as though I were hearing the music of the spheres."

The Engineer turned from his task of trying to pull WGY in clear and clean, without the overhang of tinkling jazz, which heralded the fact that the millionaire realtors were dancing down in Miami, and regarded the ebullient one over his glasses.

"Did you ever hear a woman announcer?" he asked her.

'Tis ever thus. However much they may disagree on every other subject, it is the clear, unlacquered truth that the radio public stands solidly united on the question of the feminine voice in their loud speakers. They do not like it. The average man is perfectly willing to let women be governors, sit on the bench and prosper in the professions, but he wants them to stay away from the microphone. Consequently the path of the woman announcer is rough and full of pit-falls.

We recently read an article, doubtless in the erudite New York Times,—in which the writer endeavored to explain at some length just why the American woman's voice does not fall pleasantly upon the ears of her hearers. The net result of several columns and many diagrams seemed to be that she lacks range of tone in her speaking voice, runs along in one key, and that too high. Her Italian sister vocalizes in a lower, more vibrant key, with a pleasant modulation, and as a result her conversational tones have more of the soothing effect of the singing voice. However, voice culture is supposed to produce all these refinements and act as an aesthetic sand-paper; and since the first requirement of a radio announcer is musical training, this scientific analysis fails to throw much light upon the cause of the unpopularity of the feminine air speaker.

One suspects rather, that in most cases it is the result of too much culture. There are several women announcers, who, from the very fact that they try to speak so properly, give the impression of affectation, and that is what so riles up the listener. Away from the microphone these women are probably agreeable, unaffected people, but the moment they are confronted by the baleful little black disc they lose all sense of proportion and become simply insufferable. The most delightful feminine voice we have ever heard on the air came from New Orleans. It was that of a non-professional,—simply a cultured southern woman with the charm of the old South in her accent, and generations of French hospitality behind her to give her poise.

Ann Charles, announcer and program director of station WEAO, Columbus, Ohio

THE worst offenders, in popular opinion, seem to be that army of well-meaning but futile women who cater to the wants of the smaller fry in the radio audience. The average, normal child will have none of their evening song-offerings. He wails:—

"I don't want to hear the lady with the funny voice. Turn her off."

All of which is rather discouraging to the many capable women who have been looking to radio as a pleasant, interesting and profitable profession. One woman, in her middle years asks:

"Why couldn't I get into studio work? I am a good accompanist, have had years of musical training and learned my French in Paris. I surely wouldn't mispronounce the titles of compositions as so many of the men do."

She undoubtedly could find her *metier* in a studio,—as musical director, pianist and hostess,—but, unless she is an exception, not as an announcer; and in the small studio these positions are usually filled by one omnipresent Poo-Bah.

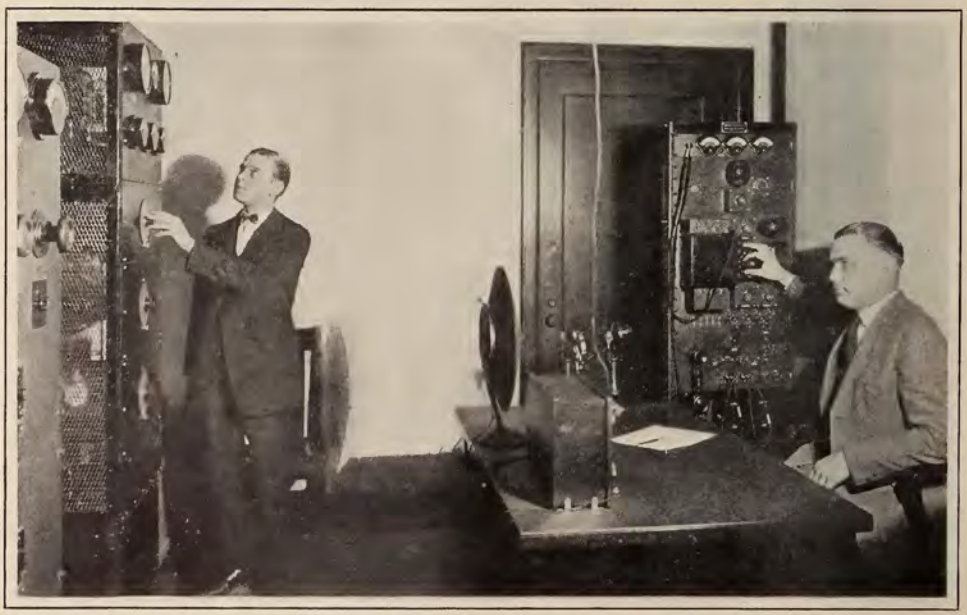
All of which digression brings us to the happy exceptions which are usually to be found in most hopeless situations. There are possibly half a dozen women announcers in the country who seem to be making a success of the business. But in all cases they approach the microphone in a simple, unaffected manner, and make no effort to obtrude their personalities upon their listeners.

One whose pleasant voice and natural manner have attracted us is Ann Charles, who for the past two years has filled the position of announcer and program director at WEAO, the Ohio State University Station at Columbus. Mrs. Charles possesses tact and common sense, and none of the glaring defects of some of her sisters. She is a violinist of ability, contributing often to the programs of this very good small station. She is the wife of F. G. Charles, Professor of Horticulture at the university, and the mother of two fine boys.

Scenes at WHO, Des Moines, Iowa

Remote control broadcasting is handled at WHO by means of an operator and the truck shown in the picture above

Here is a pile of mail and telegrams received by WHO after broadcasting the world's series last year



Operator Bennett, at the panel, and Operator Ryan, at desk, of the radiophone transmitter belonging to WHO at Des Moines, Iowa

Every Station *is the* Best *in the* World

Gwen Wagner Makes Startling Discovery But Remains Unmoved

IN making the rounds of the various Chicago radio studios during the last six months, I have been surprised to learn from announcers, directors and others vitally interested, that each station is the best in the United States, or, if it come right down to it, in the world.

Perhaps I should have said I used to be surprised, for of late I refuse to be thrown into a kind of panic when an announcer or a director takes me aside and tells me confidentially that his is the best station on the air. XYZ may be a good station, but, just between him and me, it can't compare with ABC, which, of course, is his.

Now it is obviously impossible for each station to be the best. Even I, who am naturally of a trusting nature, have at last been able to see that. Indeed, there have been times when I have wondered whether or not some of them were very good stations.

Beane is a Clam

EDGAR A. BEANE, supervisor of radio, for the ninth district, tells me there are 24 radio stations in and near Chicago, 17 of which operate in the city proper. He also tells me that 20 of these 24 rank among the best stations in the country. Six of these 20 stations, according to Mr. Beane, belong in the front row.

Mr. Beane is a man of discretion. When I attempted to learn which stations he included in this magic half dozen, he immediately emulated the well-known clam. If he, in all his manifold wisdom anent radio, refuses to designate Chicago's premier stations, certainly I would blush to think of doing such a thing.

In presenting this brief review of Chicago radio stations I shall not, therefore, attempt to classify them as to their relative virtues. Neither shall I attempt to carry the reader down the list of the entire 24. I haven't been in all the studios for one thing and for another I think a review of 24 of anything is too much for one sitting.

Review at Random

BECAUSE I have occasion to visit the studios a great deal, I have recorded the names and telephone numbers of the stations in a little book. They have been put in there at random and have nothing to do with the status of the stations. In reviewing the studios I am going to follow the list in my book.

WOK appears first. It has been a long time since I have been in the studio and I don't recall having been particularly impressed when I was there. Perhaps it's because radio studios, like all other places, have always struck me as having their own peculiar atmosphere and WOK, as I remember it, had so little of this "atmosphere" as to be almost negligible.

In speaking of KYW, I shall have to refer to two studios—one which is in the Hearst Square building and one which is in the Fine Arts building. I have never been in the Fine Arts building studio. I am told, though, that it looks like a king's palace and that the programs which are broadcast from there (and which, by the way, consume but one hour each day), are priceless gems of radio entertainment.

The Hearst Square studio is different. If I sang or played the piano before a microphone I think I should prefer to do it in the Hearst Square studio. Not that I think this is an ideal studio. I don't. It has an air of gypsy-like abandon about it that is, I suppose, not entirely the proper thing. Singers and musicians stroll in and out in the most carefree manner imaginable. Even the programs from this studio have always struck me as having been put on in much the same carefree way. Thus, the standard achieved is a wavering one—sometimes high, sometimes low. But for myself, I rather like this carefree—and careless—atmosphere.

Nutty Club Doings

ON a cold and wintry night I was taken out on the roof of the Broadmoor hotel and piloted to the little cabin affair that houses WBBM's machinery. At that time I was told it was about as powerful as could be obtained for broadcasting. I don't know anything about radio equipment. Unfortunately, I don't believe that WBBM's station in general

lives up to its equipment. So far as I have been able to discover, its most distinctive feature is the "Nutty Club," one of those entertainments that start at midnight and continue until everybody has either shut off the receiving set for the night, or torn it up. On this "Nutty Club" program, requests are answered and snatches of conversation, alleged bits of humor, etc., broadcast, all designed, I believe, to interest that type of listener who wants to make a night of it. I have heard listeners complain to high heaven about the station holding the air with such nonsense but for myself I found it rather funny—even though silly.

WBCN has a feature something like WBBM's "Nutty Club." It's called the "Pirate Ship" and all the listeners are taken on a trip on this fearsome-sounding vessel. I was rather intrigued with the way they dipped water out of a bucket in front of the microphone to make it sound like the slashing of waves and I thought it was funny when they rattled a lot of broken bottles and things around in a box in imitation of clanking chains and shivering timbers, but otherwise I was somewhat bored. I mention the "Pirate Ship" because I have found that it is WBCN's chief bid for fame.

Jerry's Accent

JERRY SULLIVAN plants himself in front of the microphone, throws out his chest and carols "Chi-CAW-go," and WQJ's chief gun is fired. Whenever anyone mentions WQJ they mention this "Chi-CAW-go." I hear little comment on anything else. If I were a woman who kept house, though, I'd listen in to WQJ's home economic program conducted by Helen Harrington Downing. I once interviewed her and she is vastly interesting and endowed with that gift so rare among women—a sense of humor.

The first time I visited WHT's studio was fully six months ago. At that time I went away thinking, "That is probably the most beautiful and the most soulless studio I have ever seen." It had everything to make it perfect—gorgeous surroundings, a pipe organ, a piano, all kinds of devices a radio studio had ever heard of, and it was as cold and uninspiring a place as I have ever been in.

Pat Pat on the Back

SEVERAL months ago I went back to WHT and although the studio and the equipment was the same, the whole atmosphere was different. The place glowed. It was alive. It was warm and cheerful and inviting and I enjoyed being there so much I almost forgot to leave. Where the credit for this change belongs I cannot say. I suspect Pat Barnes, the announcer, and Al Carney, the organist, for if two people ever worked in better accord or ever had a clearer and finer vision of the possibilities of radio than Pat and Al I don't know who they are. They even take so forbidding a subject as the weather report and make it so scintillating (by introducing musical effects, etc.), that if you haven't heard it you've missed one of the most distinctive features on the air. Everything in and about this studio lives up to this standard of excellency, in my opinion, save for the introduction of advertising announcements which I think are as obnoxious as anything could possibly be.

They've got a little four or five piece orchestra out at WENR that's a corker. It sounds like a whole symphony and it furnishes the most tantalizing, hypnotizing music I have ever had the pleasure of listening to over the air. How they manage to get so much music out of so few pieces I don't know, but I do know that that corking little orchestra lifts WENR out of the class of being merely a "nice little station," which, were it not for that orchestra, it would be.

To be quite frank and honest I've never given WMBB much thought. Whenever anybody mentions WMBB I always think of Clyde Hager, until recently the announcer, and lever of the station itself. Mr. Hager has shown me gobs and gobs of letters proving his contention that WMBB is the best station on the air and I have always wound up by thinking that Clyde Hager is a peach of a chap and that I like him very much. This probably doesn't mean a great deal and yet, perhaps it does.

The first time I was in the studio of WGES I heard a long dissertation on the subject of flowers given by a woman who possessed the most beautiful speaking voice I had ever heard. After the magic of her voice was gone I felt somewhat clammy. In other words, all the life had gone out of the studio. It never came back. For me, it hasn't to this day.

High Brow Station

WHENEVER I hear WMAQ mentioned I think of some great artist, playing the piano or the violin before a select, but small, audience. In plain language, WMAQ is Chicago's "high brow" station. You could listen in from now until WMAQ sings its swan song (if it ever does), and you would never hear a single song, a single word or a single breath of any kind that would give you the slightest offense. The only thing is that you might find it difficult to move for a great while in such a rarified atmosphere. I believe this is exactly the kind of an atmosphere that Miss Judith Waller, the capable woman in charge of WMAQ's programs, set out to create. Her idea is that radio should be educational as well as entertaining and she is pioneering along this line.

WJJD is, you know, the Mooseheart station. Consequently, the children who live in Mooseheart appear frequently on the programs. It gives WJJD a somewhat juvenile air that some folks like and some folks don't. It is not, I would say, a particularly well-balanced station in the way of program production.

One of Magic Six

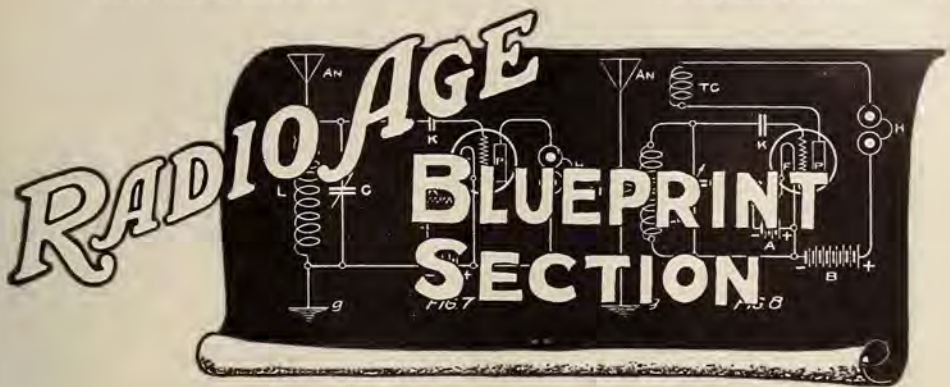
ROBERT BONIEL, announcer for WEBH, always refers to his station in a kind of bated breath, as though he were talking of something almost too wonderful to be true. If you must stand around in awe of good radio stations, then WEBH is a good place to do the standing. I am sure it is one which Mr. Beane includes in his magic half dozen. If I were making such a list I know I should. WEBH has practically everything to its advantage. It is ideally situated in one of Chicago's most beautiful hotels and its windows open onto Lake Michigan. It has the music of the Oriole orchestra to broadcast and it has an excellent staff of musicians and singers. I have thought that many of them appeared too frequently for their own and the station's good, but that is merely a personal opinion. WEBH has, as you know, recently become associated with the Chicago Herald and Examiner.

There's something sound and stable about WLS. It makes its greatest appeal, I believe, to listeners who live in the country, but it also furnishes distinctly enjoyable programs for any listener anywhere. WLS suffered much, however, when it lost George Hay, its announcer for many months. Even if you didn't care anything about the program it was a joy to listen to George Hay's voice. They have not found any one to replace him and I doubt if they ever will. Incidentally, their new studio is a very gorgeous place.

I was in the studio of WSBC just once and that was to cover a program put on by children 10 years old and under. I enjoyed this immensely. However, I have never been back and I don't believe I have ever heard of this station since.

WGN Gets Palm

IF one can judge a station simply from having heard it on the air, I should like to hand some kind of a palm to WGN. This fondness that I seem to have developed for WGN began, I think, when I heard Quinn Ryan broadcast a football game. I know nothing about football. I might add that, up until I heard Mr. Ryan broadcast a game, I didn't care anything about it. But I enjoyed Mr. Ryan's description of the game so much that ever since I have been itching to see a football game. He made that game live. He threw in the rain and the mud and the lowering clouds and all the other things necessary to create the atmosphere and to paint the picture. That demands intelligence and there's just as much room for intelligence in a radio station as there is in anything else.



How to Build

A Simple Frequency Meter

By S. R. WINTERS

WHEN approximately 600 broadcasting stations are operating on the wave bands between 550 to 1,500 kilocycles (545 to 200 meters), with a separation of only ten kilocycles, and with a dozen other services similarly restricted at the upper and lower ends of the wave spectrum, there is not only justification but a demand for means of measuring frequencies of transmitting stations. In fact, this necessity may become so insistent and widespread in the future that great numbers of radio amateurs and broadcast listeners will equip their receiving stations with apparatus for determining the frequencies or wave lengths of distant broadcasting stations.

In contemplation of an increasing need for information about methods and means of frequency measurements, Morris S. Strock of the Radio Laboratory of the Bureau of Standards has designed and built complete equipment for making such determinations. Fortunately, this apparatus is not necessarily restricted in production to laboratories, with their elaborate facilities, but may be duplicated by experimenters who are in the habit of "rolling their own," as this stock phrase applies to the making of home-made radio receiving outfits. Then, too, the cost need not be excessive—in fact, Mr. Strock specifies low cost and adaptability to available apparatus of experimenters among the requirements sought in the original design.

COMPACT and portable (in the sense of not requiring a "carry-all" or motor truck to haul it around) are among the other possible requirements specified. This is accomplished, in a measure, when we are told that there are only three units including your radio receiving set. The other integral parts of this equipment are a frequency meter (wave-meter) and a radio-frequency generator. Any wave length between 545 and 200 meters, the band assigned to broadcasting services, can be measured by means of this apparatus. By the use of harmonics, measurements of frequencies used by radio amateurs may also be made. Accuracy, by all means, is stressed as an absolute requirement of this equipment and, if the instructions outlined by the Radio Laboratory of the Bureau of Standards are followed unerringly, an accuracy of 0.5 per cent may be reasonably expected.

The frequency meter or wavemeter included in this portable measuring apparatus consists of an inductance coil, a variable condenser and a resonance or tuning indicating device such as a D. C. milliammeter. The latter serves the purpose of making known when the instrument has been properly adjusted to the signal of the distant broadcasting station or other source of radio-frequency power which is subject to measurement. The use of a variety of sizes of coils of wire, thus varying the inductance, gives a larger latitude of wave lengths or frequencies which may be measured. Minimum variations in inductance of the coils of wire and in capacity of the variable condenser for any arbitrary setting of the condenser should be required in choosing such parts for the purpose outlined in this article. Only the rotating-plate type of condenser is suitable, and this rotation should be continuous through 360 degrees, inasmuch as stops may shift the position of the rotating plates. Other requirements specified by the Bureau of Standards are: A condenser dial capable of indicating minute changes in adjustment; means of obviating the effect of body capacity and of obtaining a slow movement of the rotating plates; and a circuit of low radio-frequency resistance. Of necessity, the frequency meter must be calibrated before being placed into this particular service.

A SENSITIVE type of resonance indicator, designed by the Bureau of Standards and described in its Scientific Paper No. 502, is recommended for use where the experimenter is not already equipped with a suitable frequency meter. This government type of resonance indicator essentially consists of a crystal detector and a direct-current milliammeter, the latter measuring device affording a full-scale deflection with not more than one or two milliamperes. Anticipating that objections will be raised to the use of a crystal detector, Mr. Strock promptly meets this protest with this assurance, "It has been found, however, that if a detector of substantial mechanical design which is equipped with a good galena crystal is used, no difficulty is experienced in maintaining a sensitive adjustment." A complete description of this type of resonance-indicator, including information on the number of turns of wire constituting the coils, is contained in Bureau of Standards Scientific Paper No. 502, which can be purchased for five cents from the Superintendent of Public Documents, Government Printing Office, Washington, D. C. To secure sufficient sensitivity, however, for use with the low-power generator described, the coupling coil used in the resonance-indicating circuit should have

(*Turn to page 36*)

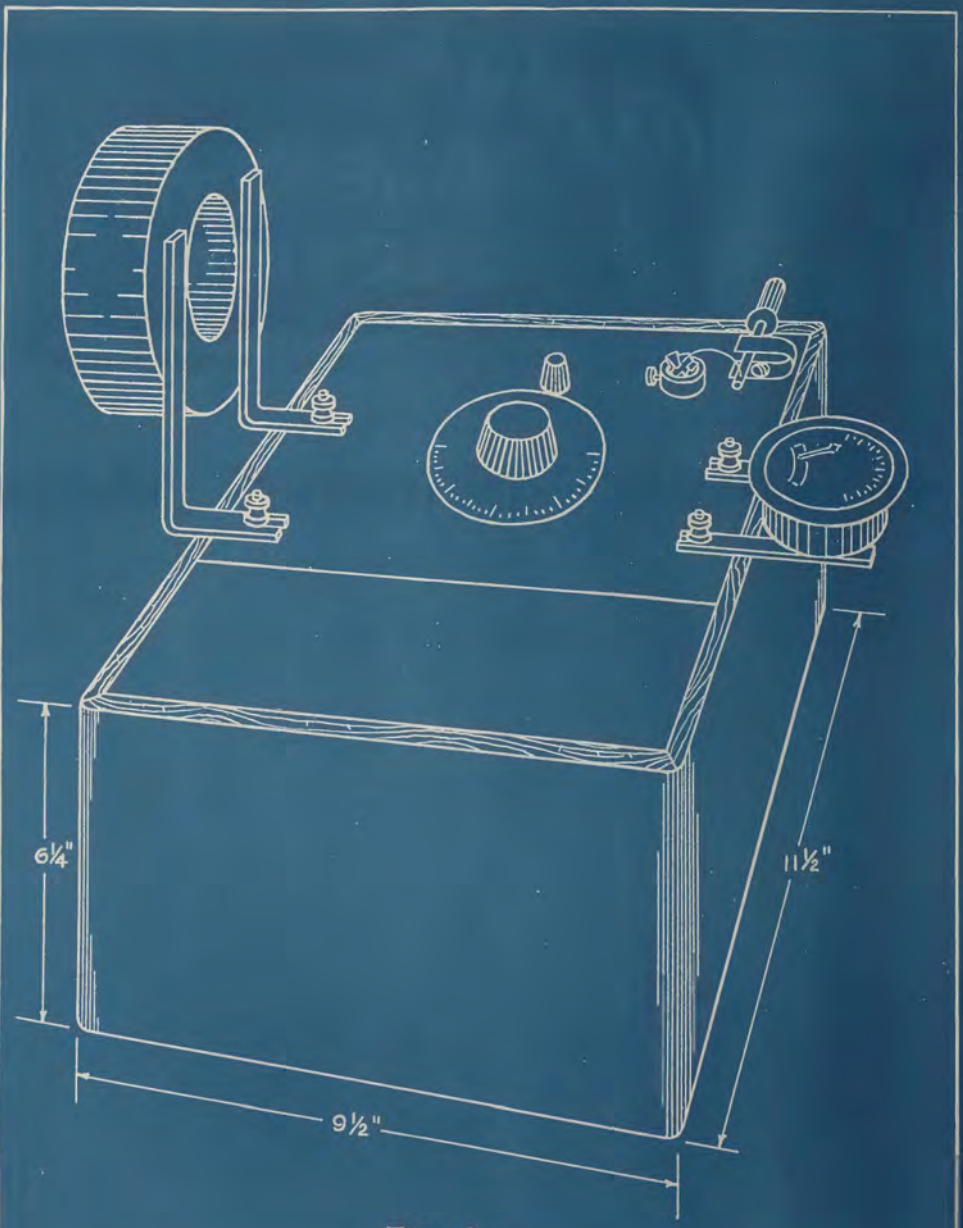


FIG. 6

THE COMPLETE FREQUENCY (WAVE) METER

W.T.GARLAND

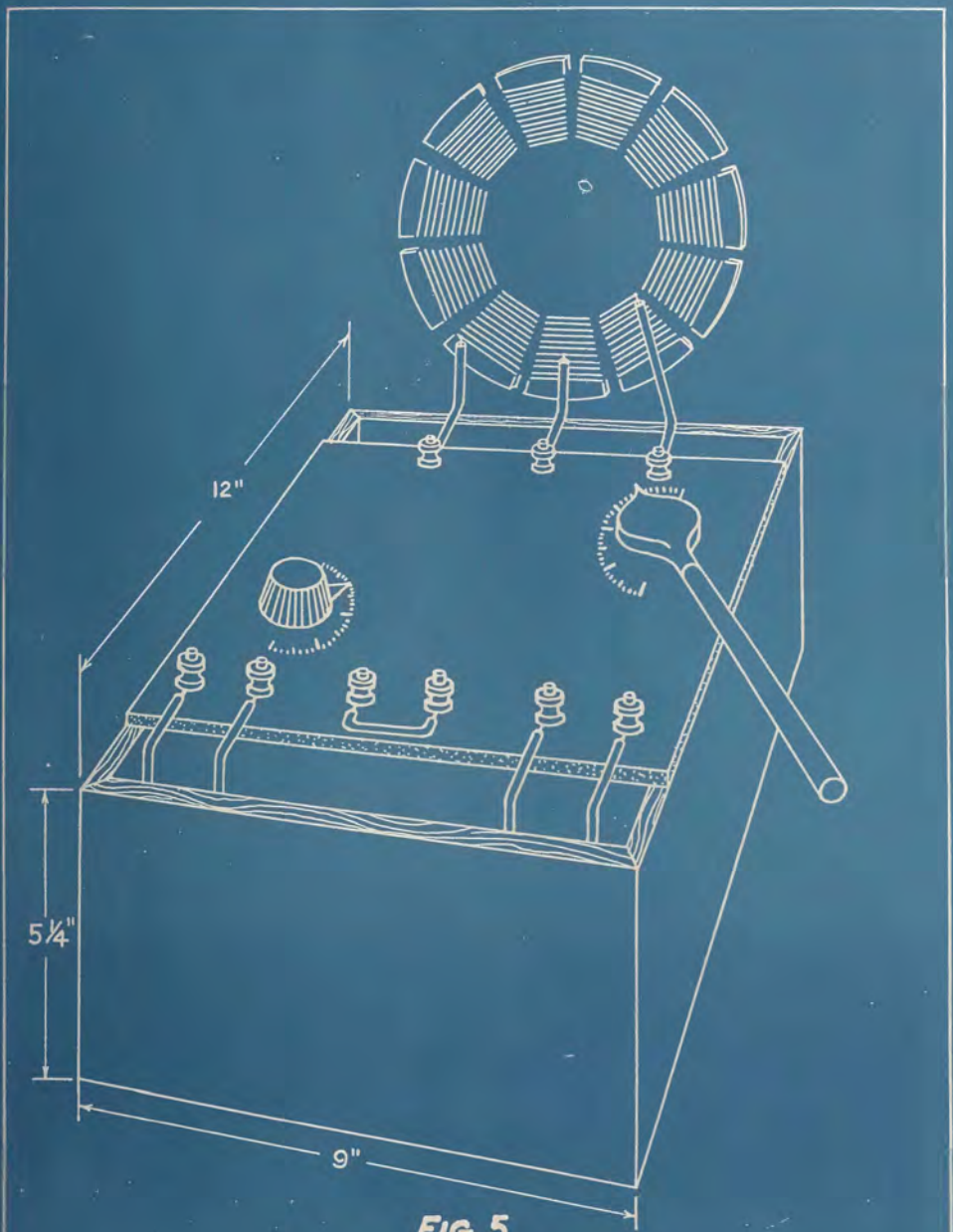


FIG. 5
THE COMPLETE GENERATOR

W.T. GARLAND

more turns than those specified in Scientific Paper 502.

The radio-frequency generator, the third requisite unit of this wave-length-measuring equipment, embodies the use of a coil of wire, a variable condenser, and a vacuum tube. The wave length range of this generating device may be extended by the use of different sizes of coils of wire, thus varying the inductance. "A fundamental requirement of a generator when used in conjunction with a frequency meter and radio receiving set," specifies Mr. Strock, "is that it be of sufficient power to permit precise adjustments of the frequency meter. The latter device when equipped with the type of resonance indicator previously described permits the use of a low-power generator having an electron tube operated by dry batteries. Other requirements of the generator are that it be capable of gradual frequency variation, that it be simple in operation, and that it maintain a constant frequency, for a particular adjustment during the time interval required for a measurement."

HARTLEY'S circuit, so widely used by radio amateurs, is employed in this generator. The cost of constructing the latter is even less than that imposed in building the frequency meter, previously described. A schematic diagram reproduced with this article indicates to experimenters the manner of construction. The necessary frequency range of this generator is from 300 to 3,000 kilocycles (approximately 1,000 to 100 meters). This wave-length latitude is insured by virtue of two coils of wire and a variable condenser, the capacity of the latter being 0.001 of a microfarad.

The generator model built by the Radio Laboratory of the Bureau of Standards is self-contained, space reservations being made for the dry-cell "A" and "B" batteries and for the inductance coils. The variable condenser, vacuum-tube socket, and rheostat are mounted on the under side of a wooden panel. The parts are arranged compactly on the panel, which is in the interest of short connecting wires and accommodations inside of the cabinet for batteries. The "B" battery consists of at least three 22½-volt units, and the kind of vacuum tube employed permits of the use of dry-cell "A" batteries. If, however, portability and compactness can be sacrificed, it is advisable to employ a higher voltage than 67½ volts on the plate of the vacuum tube. The boosting of the plate voltage increases the power of the generator, with the added advantage of using looser coupling between the generator and the frequency meter. In a final analysis, this means a liberalizing of precautions that would otherwise be necessary in measuring the frequencies of the broadcasting stations.

Inductance coils used with the generator are of the spiderweb design; chiefly, because they are easily wound to the required inductance without the necessary selection of a cylindrical winding form of a specified diameter. Then, too, the spiderweb type is compact. Where it is desired to embrace a frequency range from 300 to 1,400 kilocycles, 50 turns of No. 22 American Wire gauge double cotton-covered wire are required; the completed coil being 6¼ inches in size, outside diameter, and 3 inches in size, inside diameter. If, however, the frequency range to be covered extends from 800 to 3,000 kilocycles, the coil consists of 20 turns of No. 20 double cotton-covered wire. The size of the finished inductance coil is 6 inches in diameter, outside measurement, and 3 inches in diameter, inside measurement. The two terminals of each coil are anchored to the cardboard form, projecting outward about six inches; while a third terminal is formed by soldering a wire to a point near the center of the coil. These three terminals are identified with binding posts on the panel of the generator. This type of coil is recommended for convenience and compactness, not because it is any more efficient than a cylindrical coil.

VARIABLE condensers adapted to this use require a maximum capacity of 0.001 of a microfarad. This is the determining factor upon which is based the number of turns of wire in the inductance coils, described in a previous paragraph. The capacity and inductance thus provided permit of embracing the range of frequencies from 300 to 3,000 kilocycles (approximately 1,000 to 100 meters). The condenser should be equipped with a dial and a type of knob which will permit attaching a wooden strip of about fourteen inches in length. This will allow adjusting the condenser without causing body capacity effect or making it necessary to shield the outfit. A diagram illustrating this article indicates the manner of wiring of the generator.

"The method of obtaining primary frequencies," explains Mr. Strock in describing the method of calibration and use of this frequency-measuring equipment, "for the calibration employs the principle of zero beat and permits of a high degree of precision. If an unmodulated primary frequency signal is being received (WWV, the Radio Laboratory of the Bureau of Standards or 6XBM, Stanford University, California) it will be most convenient to first adjust the receiving set to the point of self-generation. If a non-generating receiving set is used, it is necessary to tune it approximately to the transmitting station and then adjust the generator until an audible beat note is produced in the head telephones of the receiving set. Retuning the receiving set slightly will produce a beat note of maximum intensity. If a broadcasting station is being received, the set is tuned to maximum signal, but is not adjusted to a generating condition. The generator is then tuned until it produces an audible beat note with the incoming carrier frequency.

WHEN the desired transmitting station has been tuned in on the receiving set, the local generator must be adjusted to a condition of zero beat while the receiving set is in a non-generating condition. This adjustment transfers the frequency of the distant station to the local generator. It must be made with

(Turn to page 55)

Morris S. Strock, of the Radio Laboratory of the Bureau of Standards, and the equipment designed for use by amateurs and broadcast listeners in measuring frequencies of a distant transmitter. By this method you can also calibrate your receiver

Some Data on

Storage Battery Elimination

This Scheme Only for Loud Speaker Operation

By Brainard Foote

PROBABLY the most common way of getting rid of a storage battery and its necessary care is the substitution of dry cells. This requires the use of dry cell tubes—which are known to be somewhat inferior to storage battery tubes in many respects. Besides, the upkeep cost of a dry cell set is not inconsiderable.

Where one uses a regenerative receiving set of the ordinary type, coupled with two stages of transformer-coupled audio amplification, a very effective plan consists in employing a dry cell detector tube and storage battery type amplifier tubes, the latter to be lighted through a transformer on 110 volts alternating current from the house lighting service.

It is well known that a dry cell tube is as good as a storage battery tube for detection purposes—and that where the dry cell tube fails to compare with the larger tubes is in the amplifier. Of course, one may adopt a "power" dry cell tube like the UX-120, but he may not care to supply 135 volts of "B" battery, besides 22 1-2 volts of "C" battery for it, in order to gain results about as good as can be had with ordnary storage battery tubes.

The Connections

LET us examine Fig. 1 for the details of the circuit. Fig. 2 gives the same thing in plan view, showing the actual connections of the instruments. Hence the scheme may find interest not only on the part of those who wish to build a set but for those who already have such a set and wish to get "A" battery "juice" in simpler fashion.

So far as the radio results are concerned, the connections are exactly like the most satisfactory type of 3 tube receiving set. See the directions given for the 3 tube regenerator in the Blueprint Section of Radio Age for December for further details on this type of receiver.

At the left in Fig. 1 we have the coupler—composed of the primary, whose terminals are labelled "ANT" and "GND"; the secondary, with terminals labelled "G" and "F" and the tickler, at the top. The variable condenser is shown at C1. The grid leak and grid condenser are G. L. and C2, respectively. R-1 is the filament rheostat, and its resistance should be 6 ohms, as we are adopting a WD-12 type of tube, lighting on one dry cell, for the present circuit. The dry cell is indicated, with its polarity. C3 is a .001 or .002 mfd. fixed condenser in shunt to the primary of the first audio transformer T1, used to facilitate regeneration. Note that it need not be directly connected to point "B" on the transformer, but by running it to the C-point or filament, the condenser C3 shunts the "B" battery as well, thereby shortening the radio frequency path.

Both transformers are connected in the customary manner, their filament posts (F) being connected to the negative end of a 4 1-2 volt "C" battery. This battery is essential, to keep the grids charged negatively and keep out any voltage variations arising from the alternating current.

Filament Lighting

NEXT let us consider the filament lighting system. The detector tube is lighted on a dry cell, and the rheostat R1 serves to control its illumination as well as to turn the detector on and off. The two amplifier tubes—which are of the usual 5 volt, 1-4 ampere type like the UV 201A or the C 301A or the new equivalents—obtain their filament current from the A. C. system through a transformer. Preferably adopt a fairly large size transformer for this work. The type that is suitable is employed ordinarily for ringing door-bells and are known as "bell ringing transformers" or "bell ringers." The primary is connected to the 110 volt A. C. system and the secondary of the chosen tranfsormer should be capable of furnishng about 8 volts. Rheostat R2 must have range enough to reduce the applied voltage for the tubes to 5 or less. If R2 has about 20 to 30 ohms resistance and current-carrying capacity of at least 1-2 ampere, it will do very nicely.

Potentiometer P should be a well made instrument, capable of accurate adjustment. Its resistance should be about 400 ohms. Note that the ground is connected to the movable arm of the potentiometer, as well as the minus "B" battery and the plus side of the "C" battery. Then, by accurately setting the potentiometer so that it is at the approximate center of the resistor winding, the "hum" otherwise caused by the A. C. is balanced out.

The "B" battery is shown as a 22 1-2 volt unit and a 45 volt unit in series. Where one feels that this voltage is not great enough, it is easy to use two 45 volt units, as in Fig. 2, and use either the 22 1-2 volt or the 45 volt tap for the detector "B." In general, the 22 1-2-volt tap gives more quiet detector action and smoother control, though the 45 volt may be a little better for volume on local stations. Where the hum bothers with a 67 1-2 volt "B" battery, the use of 90 volts will stop it.

IN ORDER to avoid any interference by the alternating current—which generates fluctuating magnetic fields that may reach the audio amplifying transformers, it is a good plan to keep the bell ringing transformer and its rheostat at some distance from the set. The easiest way to do this is to mount the bell ringer and the rheostat R2 on a little board that can be placed behind the receiving cabinet. Interference by induction may occur if this board is located too close to the audio amplifier, although it can cause no induction upon the coupler. As a special precaution against this induction, transformer T1 may be a completely shielded instrument. In any case it is a good idea to connect the cores of both transformers to the "F"

(Turn to page 40)

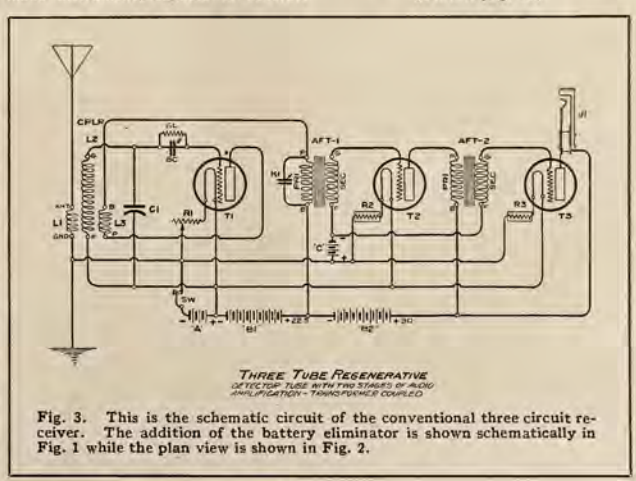
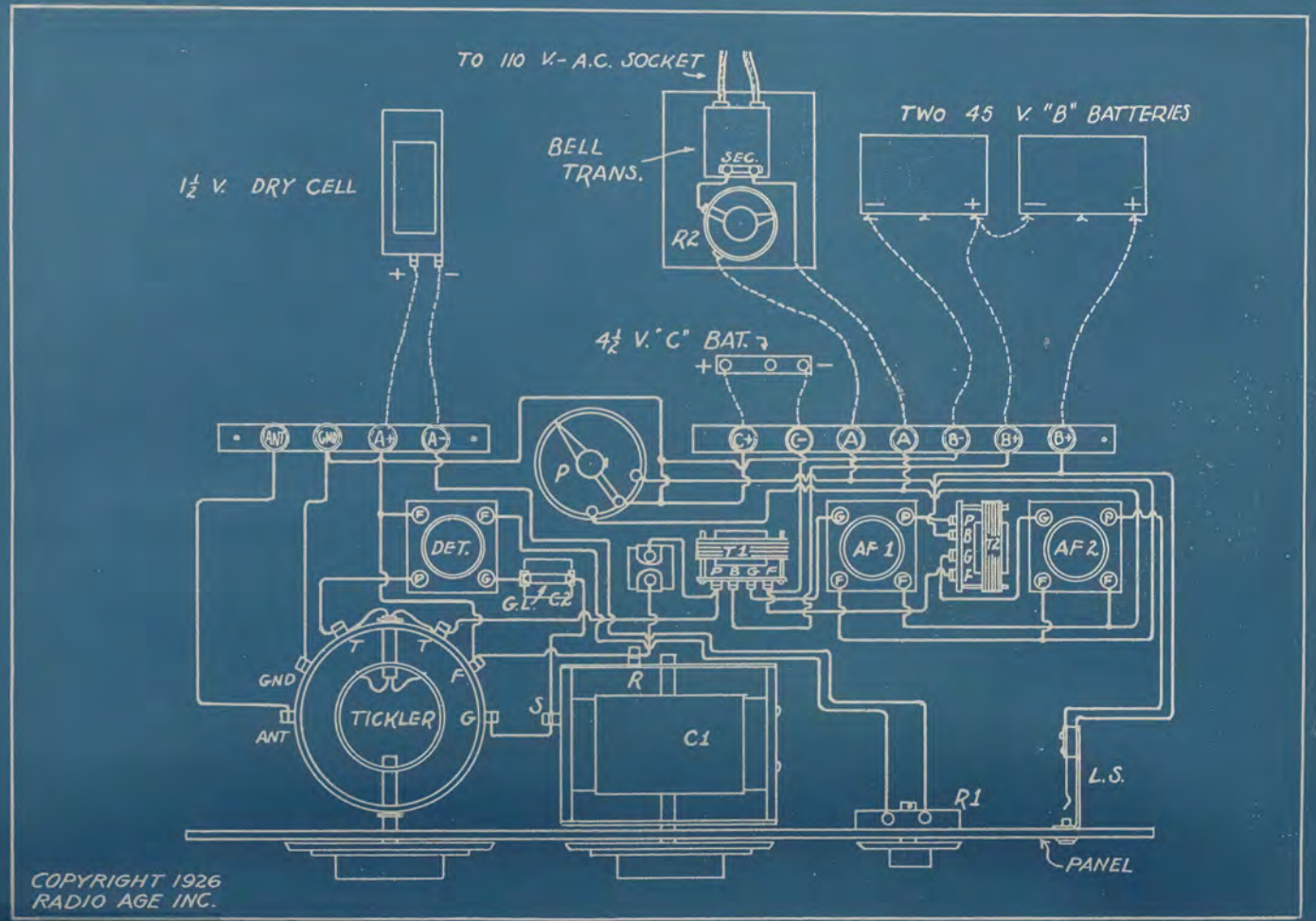


Fig. 3. This is the schematic circuit of the conventional three circuit receiver. The addition of the battery eliminator is shown schematically in Fig. 1 while the plan view is shown in Fig. 2.


TO 110 V.- A.C. SOCKET
BELL TRANS.
SEC.
R2
TWO 45 V. "B" BATTERIES
1½ V. DRY CELL
4½ V. "C" BAT.
ANT
GND
A+
A-
C+
G
A
A
B-
B+
B+
P
DET.
G.L.
C2
T1
AF 1
T2
AF 2
TICKLER
GND
ANT
R
S
C1
R1
L.S.
PANEL
COPYRIGHT 1926
RADIO AGE INC.

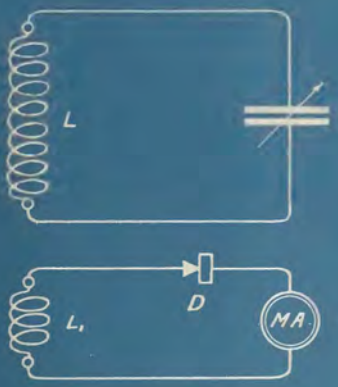


FIG. 1

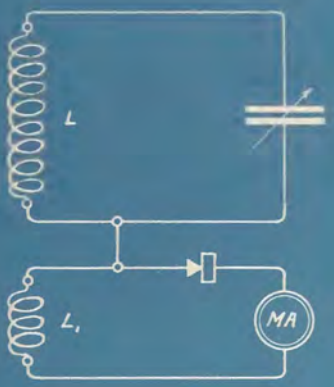


FIG. 2

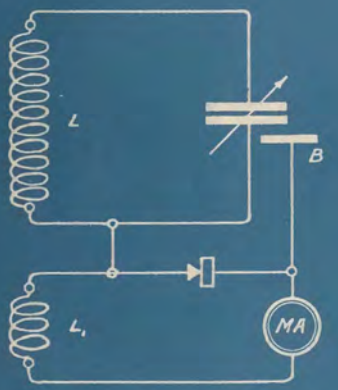


FIG. 3

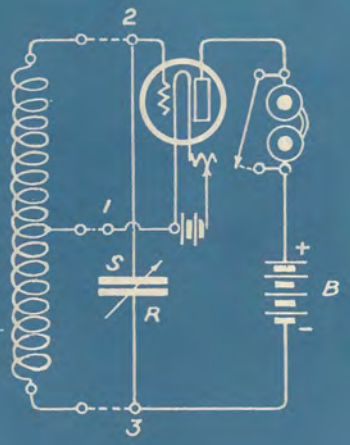


FIG. 4

W.T. GARLAND

(*Continued from page 37*)

binding posts, which is the same as "grounding" them. The writer knows of several very compact audio amplifiers of this character in which unshielded audio transformers are located within two inches of the bell ringer, without a bit of induction. However, a lot depends upon the placement, whether or not the bell ringer and T1 are at right angles magnetically, etc. T1 is the most critical, on account of the greater amplification its output undergoes, so that one does not want any A. C. to get into it by induction. It sometimes helps to ground the core of the bell ringer—which is always a shielded instrument.

The careful set builder will want to get every bit of "hum" out of it before he'll be satisfied, even though it doesn't interfere with the music when a station is tuned in. It is very easy, anyway, to adjust the set so that it is almost impossible to hear the A. C. hum, except on headphones.

Loud Speaker Only

NATURALLY the set is not intended for headphone use since it would then be necessary to have separate A. C. rheostats, potentiometers and other complications. As it stands, the receiver makes up admirably and works with the most pleasing reliability—provided, of course, that your house electric supply doesn't fail! The power consumed is negligible and will usually not be enough to register on the house meter. Theoretically, it should register and cost in the neighborhood of one cent for twenty hours of reception.

The primary of the bell ringer is connected to a length of double lamp cord and a plug. The plug can be inserted into the nearest socket—be sure you have 110 volts, 60 cycles alternating current and NOT direct current—before you hook it up. If the socket has a pull-chain switch, it will be easy to turn the tubes on and off. This may also be done, of course, by simply inserting the plug and withdrawing it. It makes no difference whether the dry cell tube is turned on first or last, but since you can not judge the detector's action with the amplifier off, it is best to turn on the 110 volts first and then gradually turn up the detector rheostat R1 to the proper unit.

Now a few remarks about the assembly of such a set and the changes necessary in converting a 3 tube storage battery set. Fig. 2 gives the plan diagram, showing in addition the "B" batteries, "C" battery, dry cell and the bell ringing transformer with its rheostat. It is best to rearrange the binding post strips as suggested in Fig. 2, placing the aerial, ground and dry cell terminals at the left and the others at the right. Dotted lines indicate wire connections to the set. The baseboard and the bell ringer should not be nearer than 6 inches to the cabinet, if possible, unless you find that moving it closer does not cause an A. C. hum.

"C" battery wires should be extremely short, and the potentiometer should be located about as indicated, if possible. Wires carrying alternating current—which are those running to the outside posts of the potentiometer and to the filament binding posts of the two amplifier sockets should be placed by themselves, especially separated from the grid leads and audio transformers. It is a good stunt to twist the filament wires together, using well insulated wires for the purpose and also to twist together the two connecting leads shown dotted from the bell ringer to the set. The current in the two wires, traveling in opposite directions, sets up conflicting magnetic fields which tend to lessen any induction. There is, however, little danger of induction or A. C. hum unless the bell ringer is too near or the ground connection omitted.

Keep Away from Grid

YOU should not get any A. C. carrying wires near the grid condenser. Remember—the only wires in the set itself carrying alternating current are the wires to the outside posts of the potentiometer and those to the filament binding posts of the audio tubes. It is best to adjust the set to eliminate the hum after having tried the set to note whether it receives broadcasting. Then tune the station out and bring up the tickler dial until the click of regeneration is heard. Then back it until the oscillation stops. Next adjust the potentiometer carefully to find the "dead spot" where the grids of the audio tubes are balanced against audio pick-up of alternating current through the grid return wires. The setting pictured in Fig. 2 is about correct, since it is supposed to balance at the center of the potentiometer winding. Be sure the audio tubes are good ones, new if possible. When the point of balance is found, vary the rheostat R2, lighting the tubes no more brightly than is consistent with good volume If no improvement in volume results from increased illumination, move it back to the minimum spot again.

It will probably be noticed that the rheostat R2 may be turned on quite far, lighting the tubes over-brightly, before

(*Turn to page 53*)

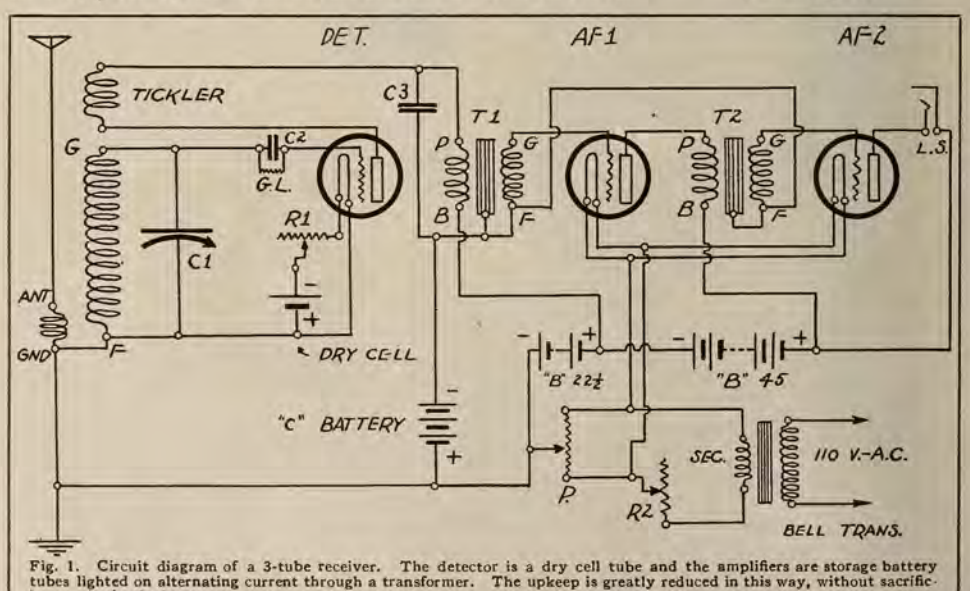


Fig. 1. Circuit diagram of a 3-tube receiver. The detector is a dry cell tube and the amplifiers are storage battery tubes lighted on alternating current through a transformer. The upkeep is greatly reduced in this way, without sacrificing results in the least.

Pick-ups and Hook-ups by our Readers

Conducted by Fred Hill

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

BY THIS time the International Radio Week tests are over; all the bloopers have gone back to their customary habits of e-e-e-e-e-owing across a wave band; the little canaries have been lost in the din of the American broadcasters and those who lost sleep and a great deal of patience during the week of trans-Atlantic tests have vowed never again to attempt the impossible. If anyone were never a believer in the non-radiating set, one night during the tests would have cured him and made him bellow vociferously for the scalp of the originator of the regenerative set. A New Year's night celebration was silent night compared to the racket put up by the regenerative sets, each owner searching diligently the air lanes for a stray European signal.

Naturally many people picked up the signals from abroad, but most of the successful ones were not in the cities. Instead the wide open spaces served a useful purpose and allowed long distance signals to be heard without the orchestral accompaniment of squeals, hisses, groans, spits, fuzzes, etc., which are more or less to be expected in congested centers.

Here's hoping by next year we will have enough good non-radiating circuits to go around so all the regenerative receivers in the cities can be traded in for teething rings.

A "TERRIBLE radio bug" who signs himself "Scotty" at Union Furnace, Ohio, writes in to make this column with a list of DX stations he has gathered. Scotty didn't do so well on his list because he forgot in making his set to ground the negative A battery and the ground connection of the set, so we presume by this time he has added a few more long distance records to his list. Scotty better send in his real name if he wants a DT button.

LEWIS DRYER, 3833 Cress Road, Cleveland, Ohio, made up the three tube inductive feedback set shown in the blueprint section of the December Radio Age and to prove what a good set it turned out to be he forwards a long list of calls heard.

DIAL Twisters who want to save time and space can make up their DX list very easily by making use of the Log-a-Wave chart which appears on the last page of each issue of Radio Age.

DIAL TWISTERS

Lewis Dryer	3833 Cress Road	Cleveland, Ohio
Baxter Miller	Box 1245	Huntington, W. Va.
Jack Reeder	622 16th St.	Huntington, W. Va.
George Pantelides	90 Court St.	Newark, N. J
Earl Whepley		Lemon Cove, Calif.
Spafford Frink	St. Luke's School	Wayne, Pa.
Robert Brown	415 M. A. C. Ave.	East Lansing, Mich.
Gerald Hahn	219 Albert St.	Pittsburgh, Pa.
A. T. Pinard	177 Beech Ave.	Toronto, Ont., Can.
Percy Donaldson	Box 292	Newell, Pa.

This convenient log has a line for each of the ninety-three wave channels, each separated 10 kilocycles from the other. There is enough room on each line for several of the broadcasting stations' call and in addition three columns for the first, second and third dial settings, in the event the reader has a three dial set. The log will take care of a single, double or triple dial set.

BAXTER MILLER, Box 1245, Huntington, West Virginia, promises to stay with Radio Age until static is eliminated, which from present accounts will be quite a while. In the same mail is a letter from Jack Reeder, 622 16th St., Huntington, West Virginia, who promises to stay with us until he gets Chili. Both of these Huntingtonians are avid readers of Radio Age and both seem to twirl a mean dial judging from the lists they send in.

GEORGE PANTELIDES, 90 Court St., Newark, N. J., makes quite a comparison when he tells us his DX list goes from one extreme to the other. The span is: WOR, a few blocks away, to 2LO which is about 3860 miles distant. In addition he logs KGO out in Oakland, which we believe is quite consistent DX work.

EARL WHEPLEY, Lemon Cove, Calif., jots down enough of the western, southern and eastern stations to entitle him to a DT button. He also wants to get into the radio game as an operator and asks for data. Take examination before the Radio Supervisor, Department of Commerce, at San Francisco; then when license is secured apply either to the Radio Corporation or the Federal Telegraph Co., at San Francisco. The Shipping Board also employs operators.

F. H. PERAU, 210 East Seventh St., Oswego, N. Y., made up the B eliminator blue-printed in our January issue of Radio Age, reports wonderful success with it, and has added it to his home-made super, telling us there is nothing on the air he cannot receive. More power to you!

SPAFFORD FRINK, St. Luke's School, Wayne, Pa., spent a good deal of his nocturnal Christmas vacation in piling up a four page, single spaced, typewritten list of the DX stations he has received during the holidays, in which list are included eight of the California broadcasters.

HOME builders of inductances will get a great deal of good information out of a technological paper just released by the Department of Commerce, Bureau of Standards, Washington, D. C. It is entitled "Radio frequency resistance and inductance of coils used in broadcast reception" by August Hund and H. B. DeGroot. It is No. 298 of the Bureau's technological papers and may be secured

for ten cents from the Superintendent of Documents, Government Printing House, Washington, D. C. In sending remittances to any government department in Washington do not use stamps—we pass this advice along because the government sells stamps but does not buy them since all its matter is franked.

USING the old ultra-audion Robert Brown, 415 M. A. C. Avenue, East Lansing, Mich., has lined up enough distant station calls to last us for a life time, all of which were pulled in on the one tuber.

A LITTLE thing like KDKA in the same town with him does not bother Gerald Hahn, 219 Albert St., Pittsburgh, Pa., who proceeds to pull in the Californians, Cubans, Canadians and a nice group of other long distance stations.

WE ARE curious if we have any readers of this column in the Republic of Mexico. If we have we would like to hear from them, even if they write their letters in Spanish. We would like to know what reception conditions are in the southern republic. If any dial twister in that country sees this paragraph, he will know it is an invitation to send us a little description of reception conditions. This also goes for Japan, although we prefer to have our Japanese correspondents write us in English—either the King's or Uncle Sam's.

GETTING a radio set for Christmas, rigging it up, and then logging 78 stations is no small achievement, but A. T. Pinard, 177 Beech Ave., Toronto 8, Ont., Canada, did it and sends us the list to prove it. He is not partial to one side of the continent but logs both of them and the middle, too.

PERCY A. DONALDSON, Box 292, Newell, Pa., liked the two tube ultra-audion in the August number of Radio Age (1925) so well he made one and then improved it a bit. His log of stations is a wow. He wound the coil on a 3 inch tube with 64 turns of single silk No. 26 wire, tapped at 45, 55 and 64 turns, low loss condensers and good quality apparatus throughout. On tap No. 3 he tuned in 209 to 461 meters; on tap No. 2 he tunes lower still, and on tap 1 into the amateur class. Altogether Mr. Donaldson is tickled with the old ultra-audion as are many readers of this magazine.

HELP! HELP!

Arthur A. Collins, amateur 9CXX, at Cedar Rapids, Iowa, who recently was written up by Armstrong Perry, has had such an avalanche of letters on amateur transmission and reception he is almost flooded.

One of his correspondents was a Japanese radio enthusiast living in Tokio, whose name and address Mr. Collins has mislaid.

If the Japanese radio fan in Tokio who wrote Mr. Collins sees this notice, please communicate again with Mr. Collins at 514 Fairview Drive, Cedar Rapids, Iowa.

This is a Test Ad

We have been told, not only by daily paper advertisers, but by many others as well, that RADIO AGE is a splendid advertising medium, and we are going to try it out with this test advertisement.

Radio World

The first nat'l. illus. radio weekly is 15c per copy, all newsdealers, $6 per year (52 nos.), $3 six months, $1.50 three months.

It is full of hookups, special articles by experts, Question and Answer Dept., and many technical and human-interest pictures. Helps you to get more out of your set. Jan. 16 issue, now on stands, full of good things. Here is the special offer to Radio Age readers: Send us $1 for trial subscription of 10 issues of Radio Wor d.

RADIO WORLD is a fine radio weekly. Have you heard about Radio World's "1926 Diamond of the Air"? Back numbers and blueprint containing full instructions sent for $1.00. This is a modest statement, but then we are modest ourselves—but we know a good radio paper when we see it.

Special Offer

Subscription Blank

Send me RADIO WORLD for 10 weeks to

Name.....

Street.....

City and State.....

Revolutionary step forward~

$9.75

For Direct Current
A. C. MODEL $12.50

Complete, nothing else to buy.
Operates at maximum efficiency at all times on either direct or alternating current, any frequency. Noiseless—no hum.

FERBEND "B" ELIMINATOR

Now you can supply plate voltage to your Radio Set at a price scarcely higher than new "B" Batteries! Your electric light socket and the new *Ferbend "B" Eliminator* furnish the permanent means of efficient "B" current supply for *any* set. No need for you to pay more than $9.75 or $12.50 for a "B" battery eliminator for Ferbend guarantees theirs to be equal or superior to any on the market *regardless of price*. Our price was fixed with the interests of the radio buying public in mind. The result is efficient and permanent "B" current now placed

Delivers unlimited current to any receiving set, regardless of number of tubes.
Delivers 100 volts to *any* set.
A. C. Model gives *Full Wave Rectification*.
Cost of operation less than 50c a year.
It lasts indefinitely.
All parts are specially designed and manufactured by us for this purpose only.

Unconditionally Guaranteed
to be equal or superior to any eliminator on the market, regardless of price.

FERBEND
Wave Trap
This company also manufactures the famous Ferbend WAVE TRAP—the instrument which has been widely imitated but never equalled. It is the only **original** and **genuine**.

Within Reach of All

The price of this remarkable new unit is spectacular in more ways than one. Besides saving you from $15 to $50 it is amazingly low considering the quality and superiority. Surely it marks a revolutionary step forward in radio. Equip you set NOW with this marvelous instrument, and be convinced.

Ask your dealer, or send direct

Until nation-wide distribution is completed it is possible that your dealer hasn't stocked the *Ferbend "B" Battery Eliminator* as yet. So you will not have to wait, we will make shipment direct to you upon receipt of $9.75, (A. C. Model, $12.50) or C. O. D. if desired. Remember *superior results are guaranteed* or your money back. Be one of the first to own and use the *Ferbend Maxmin "B" Battery Eliminator. Use the coupon NOW!*

FERBEND ELECTRIC CO.
431 W. Superior St. - Chicago, Ill.

FERBEND ELECTRIC CO.
431 West Superior St., Chicago
☐ Send at once. I am enclosing ☐$9.75 ☐$12.50 (Check which)
☐ Send C. O. D. ☐D. C. Model ☐A. C. Model (Check which)
☐ Send Literature.
Name.....
Address.....
City.....
State.....

RADIO AGE SUBSCRIPTION BLANK

Radio Age, Inc.
500 North Dearborn Street.
Chicago

$2.50 A YEAR

Gentlemen: Please enter my subscription for RADIO AGE, the Magazine of the Hour, for one year, beginning with the .....issue for which I enclose $2.50.

Name.....
Street and Address.....
City .....
State .....

Send cash, money order or draft (3-26)

WITH THE MANUFACTURERS

Col. Mapes Starts Radio Center

NEW YORK'S Radio Center, the newest development in the radio industry, has been established as a permanent exhibition and market for every known radio part and product. It became known with the announcement by the Bush Terminal Company that more than two entire floors in the Bush Terminal Sales Building at 130 West 42d Street and more than 20,000 square feet of space had been leased on a long basis to the Radio Center Inc. through Col. S. Herbert Mapes, President of the new company.

"The Radio Center is intended as a sort of Bourse for manufacturers of radio parts," said Col. Mapes, "and as a service market for buyers. Instead of traveling from one end of the city to another to make comparisons on purchases they intend making, buyers from this and other cities can see the products of all the manufacturers assembled in one place. We chose the Bush Building for our headquarters because, universally known as a buyers service building it is in the heart of the business district and is excellent for broadcasting conditions."

Receiving sets of all makes, all the accessories of the trade and broadcasting equipment will be on permanent display. Sound proof booths have been installed so that each exhibitor may have absolute privacy and yet avail himself of the advantages of the co-operative benefits the Radio Center will offer. A library, reception room and assembly hall are being fitted for trade gatherings and conventions.

While radio parts will be demonstrated under actual working conditions all year round, the Radio Center will be open only to accredited representatives of the wholesale trade, Colonel Mapes stated. However, a series of special invitation meetings is planned for the general public at which it is expected any innovations or new developments will be shown as they are brought forth.

Col. S. Herbert Mapes has been interested and actively engaged in the radio industry for many years. He conducted the first radio fair in New York City in 1920 and later was affiliated with the Federal Telephone and Telegraph Company of Buffalo and with the Jos. W. Jones Radio Company.

Pliers Cut, Loop and Make Square Bends

RADIO constantly sees the introduction of labor saving devices and the square bend pliers manufactured by the General Tool Co., Inc., are no exception to the rule.

In this set of pliers the radio set builder may cut busbar wire; may form its ends into loops, and in addition may make square bends with the same device. The usual procedure is to do this by hand, but the pliers referred to will greatly cut down the amount of labor involved in making a pretty wiring job.

Radiall Company Issues a S. L. F. Vernier Dial

AN ADDITION to the Radiall line has been announced by the Radiall Company, makers of the Amperites, which consists of a vernier dial which by means of two ratios of movement is intended to permit s.l.f. operation of any type of condenser.

The "tune-rite" dial as it is called is first of all a vernier. After that it has a 24 to 1 and a 2⅔ to 1 ratio, the former at the lower wave lengths and the latter ratio at the high waves.

Brackets and Lugs Made by the Keller Company

TWO new products are announced by the Keller Company, the first being soldering lugs which are pre-soldered, or solder-dipped and which will readily flux in any connections without an undue amount of heat.

A set of aluminum brackets for sub-base work on radio sets is also made by the same company. The brackets are arranged so one, two or three sub-bases may be attached, in addition to the front panel. The scheme permits a wide variation in sub-base work.

Shaw Made Chairman of General Radio Board

AT THE annual meeting of the General Radio Co., held in January, the position of Chairman of the Board of Directors was created to meet the growth of the company.

Henry S. Shaw, Treasurer of the company for the past eight years, was elected to this position.

H. B. Richmond, formerly Secretary and Assistant Treasurer, was elected to the position of Treasurer. No other change was made in the officers.

Melville Eastham, who has served as President for the past eleven years, will continue in that office and E. H. Locke enters his sixth year as Vice-President, in charge of manufacturing.

During the past year the company completed its new factory at Cambridge, Mass., which provides 50,000 square feet of ideal manufacturing space. The company will continue with the development and manufacture of scientific apparatus for the radio and telephone fields.

Storad Enlarges Its Cleveland Plant

THE Storad Manufacturing Co., formerly The Cleveland Engineering Laboratories Co., has just reorganized and increased its capital to finance expansion of its plant and business.

Heretofore the company has manufactured Storad Storage A and B batteries exclusively. The present expansion is being made to take care of production and distribution of the Storad Automatic power supply unit which is just ready to be announced to the public. This supply unit is said to be the most complete power unit yet placed on the market. It is automatic in action and is controlled entirely by the set switch. Other products will be added to the Storad line in the near future.

Handy Radio Wrench is Made by Schollhorn Co.

A HANDY device for the experimenter and home assembler of radio sets has been announced by the William Schollhorn Co., and is called a long reach adjustable radio wrench.

The wrench is 9¾ inches long and is operated by a thumb adjustment near the handle end of the barrel. The device will grip either the hex nut or the round type.

Honor Roll of the Broadcasters

Although there are 536 broadcasting stations in the United States in actual operation, only a small part of that number are equipped with harmonic suppressors to prevent radiation of harmonics of their own transmitter, according to a recent report from the Department of Commerce.

The stations so equipped are given in the following list, although it is anticipated further additions will be made to the number shown herein from time to time:

KDKA, East Pittsburgh; **KFDM**, Beaumont, Tex.; **KFJF**, Oklahoma, Okla.; **KOB**, State College, N. M.; **KPRC**, Houston, Tex.; **KTHS**, Hot Springs, Ark.; **KWWG**, Brownsville, Tex.; **WABX**, Mount Clemens, Mich.; **WAHG**, Richmond Hill, N. Y.; **WAPI**, Auburn, Ala.; **WBAL**, Baltimore, Md.; **WBAP**, Fort Worth, Tex.; **WBAX**, Wilkes-Barre, Pa.; **WBBR**, Rossville, N. Y.; **WBDC**, Grand Rapids, Mich.; **WCAE**, Pttsburgh; **WCAP**, Washington, D. C.; **WCAR**, San Antonio, Tex.; **WCAU**, Philadelphia; **WCX**, Pontiac, Mich.; **WEAF**, New York; **WEBK**, Grand Rapids, Mich.; **WFAA**, Dallas, Tex.; **WFDF**, Flint, Mich.; **WFI**, Philadelphia; **WGBS**, New York, N. Y.; **WGBU**, Fulford-by-the-Sea, Fla.; **WHAP**, New York; **WHAR**, Atlantic City; **WJAD**, Waco, Tex.; **WJR**, Pontiac, Mich.; **WKAR**, East Lansing, Mich.; **WLW**, Harrison, Ohio; **WLWL**, New York; **WOAL**, San Antonio, Tex.; **WOR**, Newark; **WPG**, Atlantic City; **WRC**, Washington, D. C.; **WRNY**, New York; **WRR**, Dallas, Tex.; **WRVA**, Richmond, Va.; **WSAI**, Mason, Ohio; **WSB**, Atlanta; **WSM**, Nashville, Tenn.; **WSMB**, New Orleans; **WTAM**, Cleveland, **WWJ**, Detroit.

All stations but four in the 9th district, which is the Chicago district, are equipped with harmonic suppressors. Those four not so equipped are:—**WLTS**, Chicago, **WGES**, Oak Park, Ill., **WPPC**, Chicago, and the station of the Edison township High School.

Use Manganin Wire in Rheostat

A rheostat with manganin wire is announced by the George W. Walker Co., in adding to its Victoreen line of products. The rheostat is shown below.

A third terminal has been added to simplify wiring. The manganin wire permits doubling the number of turns, giving a finer adjustment. Resistance sizes are six, ten, twenty and thirty ohms, taking care of all types of tubes.

Philippine Signals Heard In United States

LIEUTENANT H. P. ROBERTS, Signal Corps, stationed at Fort McKinley, Philippine Islands, is being congratulated by the Signal Corps on his accomplishments with his short-wave transmitter and receiver. He is credited with having sent the first actual message on short waves received in the United States from the Philippines, although a naval station is said to have been the first heard here.

Lieutenant Roberts, owner of station 1HR, operates a Signal Corps (SCR-109) transmitter, remodelled to operate on a forty meter wave at a cost of $17. His antenna is a small vertical cage 45 feet in length, and the counterpoise is a fan, 20 feet long. His power input on the long-distance transmission was 195 watts, very weak compared with our broadcasting stations, and his antenna current measured about 0.6 of an ampere.

No Change Contemplated in Zenith Name

STATEMENTS appearing is magazines and newspapers recently to the effect the Zenith Radio Corporation had adopted the name "Zenophonic" for its new line of instruments, were branded as absolutely incorrect, according to a statement from the Zenith organization at Chicago.

According to the Zenith statement no change is contemplated in the trade name of the sets, all advertising and sales plans being built around the "Zenith DeLuxe."

Sending Out Direct Mail Matter

The above photograph shows a staff of operators in the Allen-Bradley plant at Milwaukee, Wis., sending out direct mail matter to thirty thousand radio dealers and jobbers in the United States.

Readers who do not believe radio has grown might find interest in the statement that in the early days of broadcasting one girl in any organization could handle all the direct mail. But today it requires a whole department. This merely adds further strength to the fact that radio as an industry is outstripping all other lines as regards public interest and expenditure.

Hoover Wants Laws For Radio

(Continued from page 14)

Fourth: It recognizes that the public interest is paramount in all forms of radio activity. To that extent, the bill adopts as to this service the principle which has been found so effective in the state regulation of public utilities. It recognizes that the interest of the public as a whole supersedes the desire of any individual. This is a new and highly desirable feature in the radio law.

Fifth: It vests in the Secretary of Commerce the power to grant or refuse licenses, but this power is so limited as to obviate the possibility of its arbitrary exercise. The Secretary is required to make his determination with public benefit as the test and standard. There is a complete check upon either arbitrary, unjust or erroneous action by an appeal to the courts, by which any controverted question is determined independently and de novo. I have always taken the position that unlimited authority to control the granting of radio privileges was too great a power to be placed in the hands of any one administrative officer.

Sixth: The bill provides for a national commission of nine members to which may be referred any question upon which the Secretary of Commerce desires their judgment. There are many purely administrative questions in the detail of administrative regulation, such for instance, as the assignment of a particular wave length to a given station, which may properly be left to the judgment of a single official. But there are other broader and more important matters, such, for instance, as the determination of the persons who are to exercise radio privileges under the rule of public interest, which involve a large element of discretion and in which it is wise to have the consensus of several minds. Such decisions, especially where the questions become controversial, should properly be made by a board rather than an individual. To draw a legislative line between these two classes of functions is difficult. It seems to me the line lies at the point of controversy over privileges. The judgment of the board is made final and binding, subject only to an appeal to the courts. I consider this a highly important provision.

Seventh: Applicants desiring to engage in broadcasting or commercial communications are required to obtain permits in advance of the construction of the stations. This is a valuable provision, since it allows the applicant to know the wave length on which the station will operate and the power which it may use before he actually begins construction, and to erect his station accordingly.

Eighth: The bill authorizes the revocation of station licenses for failure to operate or for violation of law. This is another step in the recognition of the sound principle that public service is the basis for the license privilege. The exercise of this power is likewise subject to court review.

In the main, this bill accords with what I believe to be the present public necessity.

Send for this RADIO BOOK FREE

1926 Catalog of RADIO BARGAINS Save 1/3 to 1/2

The World's Largest Exclusive Radio Mail Order House Will Send You This Wonderful Book FREE!

64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. 5-tube sets as low as $29.50. Beautiful models of the very latest designs and types. Elaborate console models with loud speakers built right in cabinets of genuine mahogany and walnut. **All sets guaranteed.** Coast to coast receiving range. Also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. Guaranteed saving to you of 1/3 to 1/2.

The Biggest 5-Tube Value on the Market

Positively the world's greatest 5-tube radio bargain. **Regular $75.00 value.** Our large quantity production enables us to sell this set for **only $29.50,** fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets. Bakelite baseboard panel and dials. **Price for set only.....** **$29.50**
Transportation charges extra. Shipping weight 25 lbs.

This set with all Accessories, including the famous American Bell Loud Speaker with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. **Price.....** **$59.75**
Transportation charges extra. Shipping weight 100 lbs.

AMERICAN RADYNOLA
5 TUBE SET

Order Direct From This Page! Save 1/3 to 1/2. Sets on this page are typical examples of bargains throughout our catalog. Our guarantee protects you. Money cheerfully refunded if you are not satisfied. Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability.

Columbia Grand 5-Tube Console Set

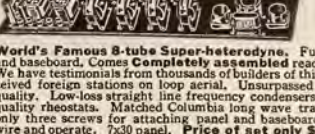
$57.95

Beautiful Walnut Cabinet in two-toned effect. Two door panels inlaid with highest grade burl walnut. Cabinet is 39 inches high. Top measures 13x37 inches. Equipped with high-grade built-in loud speaker with adjustable unit. Large, roomy interior for holding all batteries, books, etc. The Columbia Grand is a 5-tube tuned radio frequency receiver. Coast to coast receiving range. Tune in stations desired—very selective. Has latest type, low-loss condensers, coils and sockets. Bakelite baseboard panel and dial knobs. Dials are beautifully etched in gold on walnut finish bakelite panel. **Price for set only, fully built and wired—$57.95.**

Transportation charges extra. Shipped by freight or express.

This set with all accessories, which include 2-45 volt "B" batteries, one guaranteed 100 ampere hour storage "A" battery, 5-201A tubes, multicolored cable for easy battery connection, aerial and ground equipment, instructions for setting up and operating—**everything complete, nothing else to buy—$84.95**
Transportation charges extra. Shipped by freight or express.

Semi-Finished 8-Tube Super-Heterodyne



$43.75

World's Famous 8-tube Super-heterodyne. Fully mounted on panel and baseboard, Comes **Completely assembled** ready to wire and operate. We have testimonials from thousands of builders of this set. Some have received foreign stations on loop aerial. Unsurpassed in volume and tone quality. Low-loss straight line frequency condensers, vernier dials, finest quality rheostats. Matched Columbia long wave transformers. Requires only three screws for attaching panel and baseboard and set is ready to wire and operate. 7x30 panel. **Price of set only $43.75.**

Requires following accessories to complete this set: 7x30 cabinet, 8-201A tubes for storage battery operation or No. 199 tubes for dry cell operation, 100 Ampere hour storage battery, 2-45V "B" batteries, loud speaker, center tapped loop aerial. All these items are listed in our catalog, **at a tremendous saving.**

Our semi-finished sets come with all parts mounted on panel and baseboard ready for wiring. Do not fail to send for our catalog. Remember—we are the largest exclusive radio mail order dealers in the world and carry the best of everything in radio. We save you 1-3 to 1-2 on everything in radio. Detailed descriptions appear in our catalog.

Semi-Finished 5-Tube Radio Frequency Set

$18.75

This special offer is astounding the radio world. **Coast to coast reception on loud speaker.** Low-loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7x18 panel—fits into any standard 7x18 cabinet. Complete instructions for operating. **Guaranteed saving to you of $50.00. Price of set all mounted, $18.75.** Cabinet of same model as American Radynola pictured above **$5.65 extra.**

Our line is complete, includes all popular sets, such as Superheterodyne, Neutrodyne, Ultradyne, Reinartz, Regenerative, Radio Frequency, Browning-Drake, Super-Heterodyne Reflex and all other latest circuits. Kits, sets and parts by well-known manufacturers such as Frost, All-American, Thordarson, Bremer-Tully, Baldwin, Dubilier and Columbia.

ULTRADYNE
Complete parts for 8-Tube Ultradyne receiver, without cabinet, complete with blueprint, instructions and diagrams
$45.85

NEUTRODYNE
Genuine Licensed Neutrodyne kit of parts come fully assembled on the panel and baseboard with complete instructions ready to wire
$29.75

COCKADAY
3-tube Cockaday kit of parts, fully assembled on panel and baseboard ready to wire
$15.85

REMLER 8-TUBE SUPER HETERODYNE
Complete parts for Best 45 Kilocycle Super-Heterodyne Genuine Remler parts
$49.50

ULTRA-AUDION
One-tube Ultra-Audion. Wizard of radio. Fully assembled and ready to wire, with instructions
$6.35

BROWNING DRAKE
4-tube complete low-loss parts
$32.40

HARKNESS
2-tube reflex kit of parts, fully assembled on panel and baseboard, ready to wire, complete instructions
$16.95

Catalog includes list of broadcasting stations, general radio information and facts about our free service division. Write for it today.

RANDOLPH RADIO CORPORATION
159 N. Union Ave. Dept. 263 Chicago, Illinois

OUR GUARANTEE
Every article exactly as represented. Every article is tested before shipping. Complete satisfaction guaranteed.

Bureau Standards Wave Tests for February-March

THE Bureau of Standards transmits, twice a month, radio signals of definitely announced frequencies, for use by the public in standardizing frequency meters (wavemeters) and transmitting and receiving apparatus. The signals are transmitted from the Bureau Station WWV, Washington, D. C., and from Station 6XBM, Stanford University, California.

The transmissions are by unmodulated continuous-wave radio telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of the 8-minute period and continues for about 2 minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters (WWV or 6XBM) intervening. This signal continues for about 4 minutes. The "announcements" are on the same frequency as the "Standard frequency signal" just transmitted and contain a statement of the frequency. An announcement of the next frequency to be transmitted is then given. There is then a 4 minute interval while the transmitting set is adjusted for the next frequency.

The signals can be heard and utilized by stations equipped for continuous-wave reception at distances within about 500 to 1,000 miles from the transmitting stations. Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 171, which may be obtained on application from the Bureau of Standards, Washington, D. C. Even though only a few points are received, persons can obtain as complete a wavemeter calibration as desired by the method of generator harmonics, information on which is given in the Letter Circular.

The transmission runs in 8 periods from 10 p. m. to 11:32 p. m. February 20, March 5, and March 20 are the times on which readers of this issue may hear the signals.

Will Not Permit CKAC to Broadcast Hockey Games

HOCKEY fans from all over Canada and the United States, who have written to station CKAC, requesting the hockey games be broadcast from the rink, whenever American and Canadian teams cross sticks, will regret to learn that although Director Cartier, of the big Canadian station atop *La Presse* in Montreal, left no stone unturned in order to secure permit to install "mikes" in both the Forum and Montreal Arena, has not been able to give radiofans what they ask for.

Both Leo Dandurand, manager of the French team here, and H. Northey, managing director of the Forum, have refused point blank to allow any broadcasting of hockey. There were no reasons given for the refusal. It is thought that the fear of hurting gate receipts is the cause of the objection.

Audion is Now 20 Years Old

(Continued from page 20)

tities succeeded in telephoning without wires from the United States Navy station at Arlington, Va. to Honolulu and to the Eiffel Tower in Paris, utilizing the audion as transmitter, detector and amplifier at the receiver as well.

1916—*Broadcasting station established for three weeks at the DeForest Laboratories, High Bridge, N. Y. when first presidential election returns were announced by radio.*

1917—*Additional audion patents licensed to the American Telephone & Telegraph Company for the sum of $250,000.*

1917-1918—*Great success of the allied forces in maintaining radio communication between advance posts, aeroplane observers and artillery stations in European world war, dependent chiefly on the simplicity and extraordinary sensitiveness of the audion detector, amplifier and transmitter.*

1920—*First permanent broadcasting station in the world established. Opened on September 1 by the Detroit News at Detroit, Michigan; followed by the opening of the Westinghouse station at Pittsburgh a few months later.*

1920—*Value of the Audion as a contribution to human progress recognized by the Syracuse University which conferred upon Dr. DeForest the honorary degree of Doctor of Science.*

1922—*Importance of the audion in communication recognized by the Franklin Institute in Philadelphia which awarded the Elliott-Cresson Medal to Dr. DeForest.*

1922—*Invention of the audion recognized by the French Government which conferred on Dr. DeForest the Legion of Honor.*

1923—*The Phonofilm or talking moving pictures invented by DeForest through the use of the audion in all circuits.*

1924—*Transmission of photographs by telephone wire, a development by the Engineering Staff of the American Telephone & Telegraph Company, made possible by the use of a DeForest tube.*

1925—*The audion incorporated as a part of the amplifying apparatus revolutionizes the development of the phonograph.*

Harpsichord Is Used on Cincinnati Program

A FAMOUS old harpsichord, that Chopin and other celebrities played on a number of occasions was heard over the radio, on Monday night, January 18, when the Cincinnati Symphony Orchestra made its second appearance on the Cincinnati community radio programs.

Fritz Reiner, the illustrious young conductor of the Cincinnati Orchestra, who personally directs it in its community radio concert, had arranged a program of old Italian music for the occasion. The harpsichord was needed for the interpretation of two of the works, and arrangements were made to have one sent from New York, from the musical instrument museum of a leading piano manufacturing concern.

Log Your Stations—See Page 64.

Many Big Tube Sets Are Used

(Continued from page 16)

tube. This tube is operated in the receiver at 6 volts filament and 125 volts plate, while in the transmitter it is operated normally at 7.5 volts filament and 350 volts plate.

The improved patrolman's equipment weighs but slightly over 15 lb. complete (including power supply), and has given remarkable service in the field, covering distances greatly in excess of its rated range. No means is provided for emergency operation as it is designed primarily to fill the demands for a set to work with multipower sets over distances which are very conservative, as for instance, when working from a point on a line between two multipower installations.

The increasing number of carrier installations brought out numerous operating problems involving intersystem operations, gap bridging, high-frequency transmission lines, and remote control of carrier equipment over telephone wires. To answer each of these problems equipment was produced which is described briefly as follows:

By intersystem operation is meant service between dispatchers of different systems. On each system the carrier communication is normal with other sets on the same system frequency. Dispatchers who desire to communicate from two adjacent systems, however, may make provisions for doing so by the addition of an intersystem attachment which makes it possible for them automatically to communicate on an intersystem frequency which differs from either system frequency. Intersystem communication is very much simplified by the use of single-frequency duplex since a total of only three frequencies instead of six is necessary.

OPERATION requirements on some systems have made necessary the production of gap-bridging equipment for by-passing transformers, open switches, and the like. This development also has been greatly facilitated by single-frequency duplex inasmuch as it is only necessary to by-pass a single frequency instead of two.

High-frequency transmission line tuning equipment was designed for the purpose of connecting the carrier set with the high tension coupling equipment which may be a mile or so away. By this means efficient coupling may be secured even though it is necessary to locate the set at such a distance from the transmission line.

In quite a number of cases it is desired to operate the carrier equipment from a point several miles away. This point may be the dispatcher's office or perhaps that of an official. To accomplish this, remote-control apparatus gives full control by means of four wires over any distance up to ten miles.

Log Your Stations—See Page 64.

Intercoupling Is Still a Bugbear

RADIO prices have been, and in a great many cases still are, too high. The cost of an average receiving set is more than it should be. High prices have been necessary during the first few years of broadcasting to cover experimental work and hazards of this business, the future of which at that time was rather uncertain, says Frank Reichman, of the Reichman Company.

The main reason why receivers cost so much at the present time is due to the fact that very rigid inspections are necessary, and that there are many rejected and imperfect sets. If receivers are allowed to go out without careful inspection, the fans themselves will return them later on at a considerable expense both to the manufacturer and the consumer. Mistakes made in the wiring, faulty apparatus, and intercoupling of magnetic fields are responsible for most of the rejects. The first two causes are easily remedied after they are located. Intercoupling remains a bugbear to most engineers and manufacturers.

Placing the coils at critical angles partially eliminates magnetic lines of force from one coil intercoupling with the field of adjacent coils, but does not prevent spraying of the wiring of the receiver or other apparatus with the field, and thereby inducing stray currents. This intercoupling makes the receiver unstable in operation so that it oscillates readily, distorting the music or speech, and requiring an expert to maintain the tubes just below the oscillating point much the same way as a regenerative set must be operated.

Toroid inductances confine the magnetic field within the coil, so there is practically no spraying effect to interact on surrounding wiring or adjacent coils.

This makes possible the building of a receiver with only the capacity of the wiring to deal with. In the Islodyne receiver, the subpanel method of wiring is used, so it is a comparatively easy matter to balance out the slight intercoupling remaining after the main source of trouble has been stopped at its source in the design of the coils.

This means radio sets can be manufactured in quantities without fear of a large percentage of rejects by the inspectors and of sets coming back after they have been in the hands of the consumer. This advance in radio engineering will reduce the ultimate cost of the receiver to the radio fan, as well as place a much better instrument in his hands.

Here's a Definition of the Ether

SOME of us find it difficult to answer the question "What is the ether?" Here is what the British Wireless Year Book gives as a definition:

"Ether or aether: The imponderable, elastic, all-prevading medium which is assumed to exist in order to explain the transmission of energy in the form of electric magnetic waves."

The English wireless experts define radio as the American equivalent of "wireless."

Rebroadcasting Now Quite an Art

RADIO listeners in England heard music originating in the Club Ciro, London, through WGY of Schenectady, N. Y.

In California a radio fan using a short wave set, heard a program played in Los Angeles, broadcast by the 41 meter wavelength transmitter of WGY.

The London program crossed and recrossed the Atlantic before the Englishman picked it up.

Signals from KFI, bearing the song, "California here I come, right back where I started from" were picked up by WGY after a radio relay through KOA, Denver, KFKX, Hastings, Neb., and WOC, Davenport, Iowa, and rebroadcast on 41 meters. The Los Angeles fan heard KFI's program after it had traveled twice across the continent.

Both of these rebroadcast achievements are believed to be radio records. England was rebroadcast by WGY a year ago, but there was no information that the rebroadcast program had been heard at the source. Programs have been relayed from the eastern to the western coast, but there is no previous record of a relay of a western coast program to the Atlantic side of the continent and its reception again on the Pacific shore.

Navy Is Developing Short Waves

DURING recent tests of the new 12800 KC, or about 23 meter, transmitter of NKF, the Naval Radio Laboratory station at Bellevue, D. C., her signals were picked up by the U. S. S. Galveston lying off the Pacific Coast of Panama, with a piece of lamp cord about two and half feet long for an aerial.

At first the test signals were received on the regular aerial with good signal strength; later when the short aerial was substituted, the signal strength decreased, but all messages were easily read.

These short-wave signals, it is reported, are very difficult to tune in without vernier equipped receivers, but they were also picked up by San Francisco, San Diego and San Juan.

The Navy Department at Washington is now working Balboa, San Francisco, San Diego, Guantanamo and Honolulu. Short-wave broadcast schedules are also used for London, Paris and the Fleet Flagship.

Midget Transmitter

FROM London comes a report on a "Baby" transmitter, easily handled by a single person. This set is rated at only 0.41 watts dry battery power, but is capable of adjustments to operate on wave lengths between 2 and 300 meters. It is believed a forerunner of great interest and activity on short waves among the amateurs.

Use the Log-a-Wave Chart, Page 64

Storage Battery Elimination

(Continued from page 40)

the audio hum begins to be troublesome. But, if it is turned so that the tubes are too dim, a hum starts up. Adjustment of R2 has no effect on the potentiometer setting, however. It may help to switch the two audio tubes, AF1 and AF2, around. When any change is made like grounding the core of the bell ringer, for example, always readjust the potentiometer. The balancing spot is very accurately found. Once adjusted, neither the potentiometer nor R2 have to be adjusted again until new tubes are used.

The audio tubes will last a great deal longer on A. C. than on storage battery lighting. The writer has had some tubes running daily in a set lighted on A. C. in this fashion which are apparently as good as new after four years of hard service. The reason for this is simply explained. When lighted on direct current from a battery, the filament gives off electrons chiefly from one end, whereas on alternating current the elecrtons are emitted from both ends uniformly. Amateur station owners frequently transpose the filament wires on the socket of an expensive transmitting tube to make it last longer—for the self-same reason.

A. C. supply can be carried further, although to do so involves difficulties that may interfere with the clear reception of weak stations. The method herein given involves no interference at all with DX work and the results are equal in every respect to those obtained with a storage battery, besides resulting in a more compact, economical and reliable receiver all around.

Material referred to in the article above, may be secured from any reliable radio dealer. Bell ringing transformers are made by the Thordarson Electric Co., or the Jefferson Electric Co., while potentiometers are made by Yaxley Mfg. Co., Centralab and Allen-Bradley.

Radio Vigilance Committee Finds Town Clear

VANCOUVER'S radio vigilance committee, sponsored by the American Radio Relay League to trace radio interference in that city, reports this difficulty has been practically eliminated in-so-far as it falls within the province of the committee. The only interference known to exist now is caused by violet ray machines, X-ray apparatus, power leaks and similar troubles.

Information dealing with these have been turned over to the proper governmental authority and it is expected suitable action will be taken upon the complaints. The record in Vancouver duplicates to a large extent that made by vigilance committees in other cities of the Dominion and of the United States. Most of the interference has been definitely located in sources outside the control of the radio-using public.

Correct List of Broadcast Stations

OKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
OLR	Radio Electric Co.	Devils Lake, N. D.	231
OYL	Newhouse Hotel	Salt Lake City, Utah	216
OZB	Frank E. Seifert	Bakersfield, Calif.	240
OZI	Electric Supply Co.	Wenatchee, Wash.	360
FAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
FAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
FAF	A. E. Fowler	San Jose, Calif.	217
FAJ	University of Colorado	Boulder, Colo.	261
FAU	Independent School Dist.	Boise, Idaho	280
FBB	F. A. Buttrey & Co.	Havre, Mont.	275
FBC	W. K. Azbill	San Diego, Calif.	216
FBK	Kimball-Upson Co.	Sacramento, Calif.	248
FBL	Leese Bros.	Everett, Wash.	224
FBS	School District No. One	Trinidad, Colo.	238
FBU	Bishop N. S. Thomas	Laramie, Wyo.	270
FCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
FCF	Frank A. Moore	Walla Walla, Wash.	256
FDD	St. Michaels Cathedral	Boise, Idaho	278
FDM	Magnolia Petroleum Co.	Beaumont, Texas	316
FDX	First Baptist Church	Shreveport, La.	250
FDY	South Dakota State College	Brookings, S. D.	273
FDZ	Harry O. Iverson	Minneapolis, Minn.	231
FEC	Meier & Frank Co.	Portland, Ore.	248
FEK	Augsbury Seminary	Minneapolis, Minn.	261
FEL	Winner Radio Corp.	Denver, Colo.	254
FEQ	J. L. Scroggin	Oak, Neb.	268
FFP	First Baptist Church	Moberly, Mo.	242
FEY	Bunker Hill & Sullivan Min. & Con. Co.	Kellogg, Idaho	235
FGB	Heidbreder Radio Supply Co.	Utica, Neb.	224
FGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
FGQ	Crary Hardware Co.	Boone, Iowa	226
FH	Hotel Lassen	Wichita, Kans.	268
FHA	Western State College of Colo.	Gunnison, Colo.	252
FHH	Ambrose A. McCue	Neah Bay, Wash.	261
FHL	Penn. College	Oskaloosa, Iowa	240
FI	E. C. Anthony, Inc.	Los Angeles, Calif.	469
FIF	Benson Polytechnic Institute	Portland, Ore.	248
FIO	North Central High School	Spokane, Wash.	266
FIQ	First Methodist Church	Yakima, Wash.	256
FIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
FIZ	Daily Commonwealth	Fond du Lac, Wis.	273
FJB	Marshall Electrical Co.	Marshalltown, Iowa	248
FJC	R. B. Fegan (Episcopal Church)	Junction City, Kans.	219
FJF	National Radio Manf. Co.	Oklahoma City, Okla.	261
FJI	Liberty Theatre (E. E. Marsh)	Astoria, Ore.	246
FJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
FJM	University of North Dakota	Grand Forks, N. D.	278
FJR	Ashley C. Dixon & Son	Portland, Ore.	263
FJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
FJZ	S. W. Baptist Theological Seminary	Ft. Worth, Tex.	254
FKA	Colo. State Teachers College	Greeley, Colo.	273
FKU	The University of Kansas	Lawrence, Kans.	275
FKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
FKZ	F. M. Henry	Kirkville, Mo.	226
FLD	Paul E. Greenlaw	Franklinton, La.	234
FLP	Everett M. Foster	Cedar Rapids, Iowa	256
FLR	University of New Mexico	Albuquerque, N. M.	254
FLU	San Benito Radio Club	San Benito, Texas	236
FLV	Swedish Evangelical Church	Rockford, Ill.	229
FLX	George Roy Clough	Galveston, Texas	240
FLZ	Atlantic Automobile Co.	Anita, Ia.	273
FMB	Christian Churches	Little Rock, Ark.	254
FMQ	University of Arkansas	Fayetteville, Ark.	300
FMR	Morningside College	Sioux City, Iowa	261
FMW	M. G. Sateren	Houghton, Mich.	263
FMX	Carleton College	Northfield, Minn.	337
FNF	Henry Field Seed Co.	Shenandoah, Iowa	263
FNG	Wooten's Radio Shop	Coldwater, Miss	254
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	Chamber of Commerce	Burlingame, Calif.	226
KFON	Echophone Radio Shop	Long Beach, Calif.	233
KFOO	Latter Day Saints' University	Salt Lake City, Utah	236
KFOP	Rohrer Elec. Co.	Marshfield, Ore.	240
KFOR	David City Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Board of Education, Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul. Minn.	252
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPL	C. C. Baxter	Dublin, Texas.	252
KFPM	The New Furniture Co.	Greenville, Texas.	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cape & Johnson	Salt Lake City, Utah	286
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	266
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	263
KFQH	Radio Service Co.	Burlingame, Calif.	213
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. Riker	Holy City, Calif.	217
KFQW	C. F. Knierim	North Bend, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFRW	United Churches of Olympia	Olympia, Wash.	219
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros. Music Co.	Galveston, Texas	258
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver ,Colo.	234
KFUQ	Julius Brunton and Sons Co.	San Francisco, Calif.	234
KFUR	Peery Bldg. Co.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	261
KFUU	Colburn Radio Labs.	San Leandro, Calif.	224
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	205
KFVE	Film Corporation of America	St. Louis, Mo.	240
KFVF	Clarence B. Juneau	Hollywood, Calif.	208
KFVG	First M. E. Church	Independence, Kans.	236
KFVH	Whan Radio Shop	Manhattan, Kans.	219
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVO	F. M. Henry	Kirksville, Mo.	226
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	244
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVW	Airfan Radio Corp.	San Diego, Calif.	246
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWA	Browning Bros. Co.	Ogden, Utah.	261
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	211
KFWF	St. Louis Truth Center	St. Louis, Mo.	215
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	245
KFWI	Radio Entertainments, Inc.	South San Franciso, Calif.	226
KFWM	Oakland Educational Society	Oakland, Calif.	207
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	Wilbur Jerman	Portland, Oreg.	213
KFXB	Bertram O. Heller	Big Bear Lake, Calif.	203
KFXC	Santa Maria Valley Railroad Co.	Santa Maria, Calif.	210
KFXD	L. H. Strong	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Colorado Springs, Colo.	250
KFXH	Bledsoe Radio Comapny	El Paso, Texas	242
KFXJ	Mt. States Radio Dist. Inc. (Port. sta.)	Denver, Colo.	216
KFXM	Neches Electric Co.	Beaumont, Texas	227
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Mary M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	205
KFYJ	Chronicle Publishing Co.	Houston, Texas	238

A Simple Frequency Meter

(Continued from page 36)

great care so that the error in setting will be small. The observer should place himself in such a position that the body capacity will not effect the adjustments of the frequency meter and generator. An extremely precise adjustment of the generator may be obtained by tapping the pointer attached to the knob of the condenser. The frequency meter is now carefully tuned until the resonance indicator shows a maximum deflection. As it is tuned near the point of resonance, the reactive effect may cause a slight variation in the frequency of the generator, with the result that the beat note will again be heard. This change may be measurable on the frequency meter and, therefore, adjustments should be made to attain again the condition of zero beat. This may require decreased coupling between the frequency meter and the generator in addition to the slight readjustment of the generator. These measurements should be made with consideration for other listeners-in since the beat notes produced may be radiated from the receiving antenna."

The use of harmonics produced in the local generator as a means of obtaining additional points over the range of the frequency meter; a description of the various methods of frequency measurements; and the necessary care and calibration of a frequency meter, are outlined in detail by Uncle Sam. The necessary limitation of an article of this kind, however, will not permit of a discussion of these factors. A request for Letter Circular No. 171, if addressed to the Bureau of Standards, Department of Commerce, Washington, D. C., will bring complete information on the subject of "Methods and Apparatus for Measurement of the Frequencies of Distant Radio Transmitting Stations." Meanwhile, if you are experimentally inclined and regardless of whether your "laboratory" consists of a portion of the basement in your home or whether you operate a bona-fide transmitting and receiving radio station the outline contained in this story should offer the basis for fruitful experimentation.

To eliminate body capacity a condenser should be used which either has a metal dial which may be shielded, or one whose rotors are separate from the shaft. In the case of the Remler condensers, these may be used with effectiveness on account of both of the stators being movable and not connected directly to the shaft, but through a set of bakelite gears. The dial which comes with these condensers is a metal one, reads up to 200 degrees (almost a complete circle) and in addition the dial may be grounded.

For the direct current milliammeter the builder may secure either a Jewell, Weston or Westinghouse meter, preferably with a full scale deflection of 2 milliamperes. A resistance can be placed across the meter to dampen the swing of the needle as is explained in the article. *(Continued on page 57)*

FYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
FYR	Hoskens-Meyers, Inc.	Bismarck, N. Dak.	248
GO	General Electric Co.	Oakland, Calif.	361
GTT	Glad Tidings Tabernacle	San Francisco, Calif.	234
GU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	270
GW	Portland Morning Oregonian	Portland, Oreg.	491
GY	St. Martins College	Lacy, Wash.	246
HJ	Times-Mirror Co.	Los Angeles, Calif.	405
HQ	Louis Wasmer	Seattle, Wash.	273
JBS	J. Brunton & Sons	San Francisco, Calif.	220
JR	Northwest Radio Service Co.	Seattle, Wash.	384
JS	Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	293
LDS	Reorganized Church	Independence, Mo.	441
LS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	250
LX	Tribune Publishing Co.	Oakland, Calif.	508
LZ	Reynolds Radio Co.	Denver, Colo.	266
MA	May Seed & Nursery Co.	Shenandoah, Iowa	252
MJ	Fresno Bee	Fresno, Calif.	234
MMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
MO	Love Electric Co.	Tacoma, Wash.	250
MOX	Voice of St. Louis	St. Louis, Mo.	280
NRC	C. B. Juneau	Los Angeles, Calif.	208
NX	Los Angeles Evening Express	Los Angeles, Calif.	337
OA	General Electric Co.	Denver, Colo.	322
OAC	Oregon Agricultural College	Corvallis, Oreg.	280
OB	N. Mex. College Ag. & Me. Arts	State College, N. Mex.	349
OCH	Central High School	Omaha, Neb.	258
OCW	Oklahoma College for Women	Chickasha, Okla.	252
OIL	Monarch Manufacturing Co.	Council Bluffs, Iowa	278
PO	Hale Bros.	San Francisco, Calif.	428
PPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
PRC	Houston Post Dispatch	Houston, Texas	297
PSN	Star-News Publishing Co.	Pasadena, Calif.	316
QP	H. B. Read	Portland, Oreg.	213
QV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
QW	Charles D. Herrold	San Jose, Calif.	231
RE	Berkeley Daily Gazette	Berkeley, Calif.	256
SAC	Kansas State Agricultural College	Manhattan, Kans.	341
SD	Pulitzer Printing Co.	St. Louis, Mo.	545
SL	Radio Service Corp. of Utah	Salt Lake City, Utah	300
SO	A. A. Berry Seed Co.	Clarinda, Iowa	242
TAB	Tenth Ave. Baptist Church	Oakland, Calif.	333
TBI	Bible Institute	Los Angeles, Calif.	294
TBR	Brown's Radio Shop	Portland, Ore.	263
TCL	American Radio Telephone Co. Inc.	Seattle, Wash.	306
THS	New Arlington Hotel Co.	Hot Springs, Ark.	275
TNT	N. Baker	Muscatine, Iowa	256
TW	First Presbyterian Church	Seattle, Wash.	454
UO	Examiner Printing Co.	San Francisco, Calif.	250
UOM	State University of Montana	Missoula, Mont.	244
USD	University of South Dakota	Vermillion, S. D.	278
UT	University of Texas	Austin, Texas	231
VOO	The Voice of Oklahoma	Bristow, Okla.	375
WG	Portable Wireless Telephone Co.	Stockton, Calif.	248
WKC	Wilson Duncan Studios	Kansas City, Mo.	236
WKH	W. G. Patterson	Kennonwood, La.	261
WSC	State College	Pullman, Wash.	349
WWG	City of Brownsville	Brownsville, Texas	278
YO	Electric Shop	Honolulu, Hawaii	270
YW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
ZM	Preston D. Allen	Oakland, Calif.	240
WJBO	Valdemar Jensen	New Orleans, La.	268
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WEPT	I. R. Nelson Co.	Newark, N. J.	263
WAAW	Omaha Grain Exchange	Omaha, Nebr.	278
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	1st Universalist Church	Bangor, Me.	240
WABL	Connecticut Agricultural College	Sorrs, Conn.	283
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	278
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	238
WAFD	Albert B. Parfet Co.	Port Huron, Mich.	275
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	316
WAIT	A. H. White Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Hubbard & Co.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	248
WARC	American Radio & Research Corp.	Medford, Mass.	261
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	Clemson Agric. College	Clemson College, S. C.	331
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAO	James Millikan University	Decatur, Ill.	270
WBAL	Consolidated Gas & Elec. Co.	Baltimore, Md.	246
WBAP	Wortham-Carter Pub. (Star Telegram)	Ft. Worth, Texas	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	292
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Plymouth Congregational Church	Newark, Ohio	226
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBX	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf. Co. "B" 118th inf.	Charleston, S.C.	268
WBCN	Foster & McDonnell	Chicago, Ill.	266
WBDC	Baxter Laundry Co.	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBGA	Jones Elec. & Radio Mfg. Co.	Baltimore, Md.	254
WBNY	Shirley Katz	New York, N. Y.	210
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBR	Pennsylvania State Police	Butler, Pa.	286
WBRC	Bell Radio Corporation	Birmingham, Ala	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Elect. & Mfg. Co.	Boston, Mass.	242
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufmann & Baer Co. & The Pitts. Pr.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAO	A. A. and A. S. Brager	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Tel. Co.	Washington, D. C.	468
WCAR	Southern Radio Corp. of Texas	San Antonio, Texas	263
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur C. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburg, Pa.	236
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Mester	Providence, R. I.	205
WCBX	Radio Shop of Newark (H. Lubinsky)	Newark, N. J.	233
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCEE	Liberty Weekly	Elgin, Ill.	275
WCLO	C. E. Whitmore	Camp Lake, Wisc.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCSH	Henry P. Rines	Portland, Maine	256
WCSO	Wittenberg College	Springfield, Ohio	248
WCWS	Chas. W. Selene (Portable)	Providence, R. I.	210
WCX	Free Press and Jewett R. & P. Co.	Detroit, Mich.	517

A Simple Frequency Wave Meter

(Continued from page 55)

IN THE blueprint diagram on page 39 the reader will find the three steps in the development of the final circuit of the resonance type wave meter. The first is Fig. 1 in which the coupling is an inductive one between the two circuits. In Fig. 2 the coupling has been made magnetic, though only to one side of the tuning circuit. In the third diagram, Fig. 3, the final circuit as adopted at the Bureau of Standards is shown in which provision is made by means of the plate B for a method of eliminating body capacity, assuring all measurements being standard and not subject to variation due to presence of absorptive structures.

In Fig. 4 is shown the schematic of the Hartley oscillator used as the driver. Items 1, 2 and 3 show the points at which the inductance is hooked into the circuit. The constructional features of the inductance are shown in the article itself, while views of the driver and of the wavemeter are also shown in blueprint form.

Further data on the use of wavemeter and driver may be secured by studying the picture at the bottom of page 36.

DAD	Dad's Auto Accessories, Inc	Nashville, Tenn.	226
DAE	Tampa Daily Times	Tampa, Fla.	273
DAF	Kansas City Star	Kansas City, Mo.	366
DAG	J. Laurence Martin	Amarillo, Texas	263
DAH	Trinity Methodist Church	El Paso, Texas	268
DAR	Lit Brothers	Philadelphia, Pa.	393
DAY	Radio Equipment Corp.	Fargo, N. Dak.	261
DBA	Plymouth Cong. Church	Newark, Ohio	226
DBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
DBD	Herman Edwin Burns	Martinsburg, W. Va.	268
DBE	Gilham-Schoen Elec. Co.	Atlanta, Ga.	270
DBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
DBK	M. F. Broz	Cleveland, Ohio.	227
DBN	Electric Light & Power Co.	Bangor, Me.	252
DBO	Rollins College, Inc.	Winter Park, Fla.	240
DBR	Tremont Temple Baptist Church	Boston, Mass.	261
DBV	The Strand Theatre	Fort Wayne, Ind.	258
DBZ	Boy Scouts, City Hall	Kingston, N. Y.	233
DOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
DRC	Doolittle Radio Corp.	New Haven, Conn.	268
DWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
DZ	J. L. Bush	Tuscola, Ill.	278
EAF	American Telephone & Telegraph Co.	New York, N. Y.	491
EAI	Cornell University	Ithaca, N. Y.	254
EAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
EAN	Shepard Co.	Providence, R. I.	270
EAO	Ohio State University	Columbus, Ohio	294
EAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
EAU	Davidson Bros. Co.	Sioux City, Iowa	275
EB	Benwood Co.	St. Louis, Mo.	273
EBC	Walter Cecil Bridges	Superior, Wisc	242
EBD	Electrical Equip. & Service Co.	Anderson, Ind.	246
EBE	Roy W. Waller	Cambridge, Ohio	234
EBH	Edgewater B. H. & Herald Examiner	Chicago, Ill.	370
EBJ	Third Avenue Railway Co.	New York, N. Y.	273
EBK	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
EBL	Radio Corp. of America (Portable)	New York, N. Y.	226
EBM	Radio Corp. of America (Portable)	New York, N. Y.	226
EBP	E. B. Pedicord	New Orelans, La.	280
EBQ	Tate Radio Corp.	Harrisburg, Ill.	226
EBR	H. H. Howell	Buffalo, N. Y.	244
EBW	Beloit College	Beloit, Wisc.	268
EBZ	Savannah Radio Corp.	Savannah, Ga.	263
EEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349
EHS	Robert E. Hughes	Evanston, Ill.	203
EMC	Emanuel Missionary College	Berrien Springs, Mich.	285
ENR	All-American Radio Corp.	Chicago, Ill.	266
EW	St. Louis University	St. Louis, Mo.	248
FAA	Dallas News & Dallas Journal	Dallas, Tex.	476
FAM	Times Publishing Co.	St. Cloud, Minn.	273
FAV	University of Nebraska	Lincoln, Neb.	275
FBC	First Baptist Church	Knoxville, Tenn.	250
FBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
FBE	John Van De Walle	Seymour, Ind.	226
FBG	The Wm. F. Gable Co.	Altoona, Pa.	278
FBH	Concourse Radio Corporation	New York, N. Y.	273
FBI	Galvin Radio Supply Co.	Camden, N. J.	236
FBJ	St. John's University	Collegeville, Minn.	236
FBL	Onondaga Hotel Co.	Syracuse, N. Y.	252
FBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
FBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	254
FBZ	Knox College	Galesburg, Ill.	254
FDF	F. D. Fallain	Flint, Mich.	234
FI	Strawbridge and Clothier	Philadelphia, Pa.	394
FKB	F. K. Bridgman	Chicago, Ill.	217
FRL	Robert Morrison Lacey	Brooklyn, N. Y.	205
FUV	G. Pearson Ward	Springfield, Mo.	252
FUW	Earl William Lewis	Moberly, Mo.	233
GAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248
GAQ	Youree Hotel	Shreveport, La.	252
GBB	Harry H. Carman	Freeport, N. Y.	244
GBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBI	Frank S. Megargee	Scranton, Pa.	240
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBR	George S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	252
WGCP	D. W. May, Inc.	Newark, N. J.	252
WGHB	G. H. Bowles Developments	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGI	American R. & R. Co.	Medford Hillside, Mass.	261
WGMU	A. H. Grebe & Co. Inc., (Portable)	Richmond Hill, N. Y.	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School Technology	Atlanta, Ga.	270
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquett Univ. & Milw. Journal	Milwaukee, Wis.	275
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAM	Univ. of Rochester (Eastman S. of M.)	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAT	Dr. George W. Young	Minneapolis, Minn.	263
WHAV	Wilmington Elec. Specialty Co.	Wilmington, Del.	263
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBB	The Copps Co.	Stevens Point, Wis.	240
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Me.	231
WHBL	James H. Slusser	Logansport, Ind.	216
WHBM	C. L. Carrell, Portable Station	Chicago, Ill.	233
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBQ	St. John's M. E. Church South	Memphis Tenn.	233
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHDI	W. H. Dunwoody Ind. Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHK	The Radio Air Service Corp	Clevelnad, Ohio	273
WHN	George Schubert	New York, N. Y.	361
WHO	Banker's Life Co.	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WHT	Radiophone Broadcasting Corp.	Deerfieled, Ill.	400
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAO	Chronicle Publishing Co.	Marion, Ind	26
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zitteli, Jr.	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Werton, W. Va.	246
WIBS	New Jersey Nat'l Guard Hdqs. Co.	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak, Inc.	Utica, N. Y.	205
WIBZ	A. D. Trum	Montgomery, Ala.	231
WIL	Benson Radio & The Star	St. Louis, Mo.	273
WIOD	Wonderful Isle of Dreams	Miami, Fla.	*
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAB	American Electric Co.	Lincoln, Neb.	229

*Wave not definitely assigned.

Radio Interference Is Still Bad

DESPITE the fact that there are about twenty less stations on the air than at the close of the Fourth National Radio Conference, interference is almost as bad, according to reports reaching Secretary Hoover. This is probably due to the fact that most of the stations deleted from the lists were small or inactive stations with low power and short ranges. Practically none of the larger or high-powered stations has shut down in the past few months, with the result that interference between stations is about the same as it has been.

The situation can only be remedied, it is Mr. Hoover's belief, when legislation is passed authorizing the Department of Commerce to eliminate some of the stations now on the air or to refuse to license new stations for which there is no public necessity.

The radio inspectors of the Department have to concern themselves with radio interference only, as neither the 1912 laws nor the proposed bill for radio regulation provides for investigating or testing any other form of interference.

If fans are a little patient, it is pointed out, interference between stations should decrease, and today ought to be less than it was a few months ago, on account of the remedial measures taken by the broadcasters to reduce interference between themselves.

A number of stations have secured piezo crystals to keep their emissions on the assigned frequencies.

Bulletin Board For Artists

PAYING the artist in recorded recognition, by means of a bulletin board score of requests, is the novel idea of "Dynamo Dave" Edelson, director-announcer of World Battery Station WSBC.

Dave has long been partial to the artist himself, thruout his radio career. He feels the inadequacy, in most cases the absence of remuneration to the entertainers who build up the station's reputation, and seeks to pay them in some way. A record of their popularity is this way.

A voice goes out on the air. If it pleases, the audience reacts by letter, telephone, or wire. The artist who has pleased should know this, and knowing, be spurred on to greater effort. The comparison of scores on the bulletin board of the studio, furthermore, makes for competition—the very life of business.

Interesting Paper on Fading by Prof. C. M. Jansky, Jr.

A STATISTICAL study of the conditions affecting the distance range of radio telephone broadcasting stations, which study was completed during last October, is now available from the Superintendent of Documents, at Washington, D. C.

The paper is written by Prof. C. M. Jansky, Jr., consulting radio engineer of the Bureau of Standards and details the tests made on the signals of KDKA and WLB. The work was directed by Prof. Jansky and participated in by a large number of amateurs and radiophone listeners.

JAD	Jackson's Radio Eng. Laboratories	Waco, Texas	353
JAG	Norfolk Daily News	Norfolk, Nebr.	270
JAK	Clifford L. White	Greentown, Iowa	254
JAM	D. M. Perham	Cedar Rapids, Iowa	268
JAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
JAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
JAX	City of Jacksonville	Jacksonville, Fla.	337
JAZ	Zenith Radio Co.	Mt. Prospect, Ill.	322
JBA	D. H. Lentz, Jr.	Joliet, Ill.	207
JBB	L. W. McClung	St. Petersburg, Fla.	254
JBC	Hummer Furniture Co.	LaSalle, Ill.	234
JBG	Interstate Radio, Inc.	Charlotte, N. C.	224
JBI	Robert S. Johnson	Red Bank, N. J.	219
JBK	E. F. Goodwin	Ypsilanti, Mich.	233
JBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
JBS	Seneca Vocational School	Buffalo, N. Y.	218
JBU	Bucknell University	Lewisburg, Pa.	218
JJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
JR	Jewett Radio & Phon. Co. & D. F. P.	Pontiac, Mich.	517
JY	Radio Corp. of America	New York, N. Y.	405
JZ	Radio Corp. of America	New York, N. Y.	454
KAA	H. F. Paar	Cedar Rapids, Iowa	278
KAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
KAF	WKAF Broadcasting Co.	Milwakuee, Wis.	261
KAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
KAR	Michigan State College	East Lansing, Mich.	285
KAV	Laconia Radio Club	Laconia, N. H.	224
KBB	Sanders Bros.	Joliet, Ill.	214
KBE	K. & B. Electric Co.	Webster, Mass.	231
KBG	C. L. Carrell (Portable)	Chicago, Ill.	216
KRC	Kodel Radio Corp.	Cincinnati, Ohio	326
KRC	Kodel Radio Corp.	Cincinnati, Ohio	422
KY	WKY Radio Shop	Oklahoma City, Okla.	275
LAL	First Christian Church	Tulsa, Okla.	250
LAP	Wm. V. Jordan	Louisville, Ky	75
LAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
LIB	Liberty Magazine	Chicago, Ill.	303
LIT	Lit Bros.	Philadelphia, Pa.	394
LS	Sears Roebuck & Co.	Crete, Ill.	345
LTS	Lane Technical High School	Chicago, Ill.	258
LW	Crosley Mfg. Co.	Cincinnati, Ohio	422
LWL	Miss. Society of St. Paul the Apostle	New York, N. Y.	288
MAC	C. B. Meredith	Casenovia, N. Y.	275
MAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
MAK	Norton Laboratories	Lockport, N. Y.	266
MAL	M. A. Lesse Optical Co.	Washington, D. C.	213
MAN	First Baptist Church	Columbus, Ohio	278
MAQ	Chicago Daily News	Chicago, Ill.	447
MAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
MAZ	Mercer University	Macon, Ga.	261
MBB	American Bond & Mortgage Co.	Chicago, Ill.	250
MBC	Michigan Broadcasting Co.	Detroit, Mich.	256
MBF	Miami Beach Hotel	Miami Beach, Fla.	384
MC	Commercial Appeal	Memphis, Tenn.	500
MCA	Hotel McAlpin (Greenley Sq. Hotel Co.)	New York, N.Y.	341
NAB	Shepard Stores	Boston, Mass.	250
NAC	Shepard Stores	Boston, Mass.	280
NAD	University of Oklahoma	Norman, Okla.	254
NAL	Omaha Central High School	Omaha, Nebr.	258
NAT	Lenning Bros. Co. (Frederick Lenning)	Philadelphia, Pa.	250
NAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
NBH	New Bedford Hotel	New Bedford, Mass.	248
NJ	Radio Shop	Newark, N. J.	252
NOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
NYC	Dept. of Plant & Structures	New York, N. Y.	526
OAE	Midland College	Fremont, Nebr.	280
OAG	Apollo Theatre (Belvidere Amuse. Co.)	Belvidere, Ill.	274
OAI	Southern Equipment Co.	San Antonio, Texas	394
OAN	Vaughn Con. of Music (J. D. Vaughn)	Lawrenceburg, Ten.	283
OAO	Lyradion Mfg. Co.	Mishawaka, Ind.	369
OAR	Lundskow, Henry P.	Kenosha, Wis.	225
OAT	Boyd M. Hamp	Wilmington, Del	360
WOAV	Penn. Nat'l Guard, 2nd Bat., 112th Inf.	Erie, Pa.	242
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, N. Y.	224
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Otto Baur	New York, N. Y.	233
WOO	John Wanamaker	Philadelphia, Pa.	508
WOQ	Unity School of Christianity	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAL	Superior Radio & Tel. Equip. Co.	Columbus, Ohio	285
WPCC	North Shore Cong. Church	Chicago, Ill.	256
WPDQ	H. L. Turner	Buffalo, N. Y.	258
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	263
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	New York, N. Y.	361
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAQ	St. Louis Radio Service Co.	St. Louis, Mo.	263
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Horace D. Good	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wynne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio & Electric Co.	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRHF	Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneaoplis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRL	Union College	Schenectady, N. Y.	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., M. Y. "MU-1"	NewYork, N. Y.	236
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publisher Co.	Allentown, Pa.	229
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	210
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	275
WSDA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wisc.	246
WSRO	Radio Company	Hamilton, Ohio	252
WSTA	Camp Marien	Chesham, N. H.	229
WSUI	State University of Iowa	Iowa City, Iowa	484
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	266

Veni, Vidi, Vici—By Radio

(Continued from page 27)

announcement monthly, containing the programs for the succeeding month. Requests for the second edition exceeded 300,000; and for the February announcements they reached a total of 325,000. This is cited merely to illustrate the growth of interest within Cincinnati itself in this "campaign of conquest."

Mr. Smith developed the Cincinnati Community Concert Orchestra in connection with the programs to provide the orchestral background for many of the special features introduced at each concert. This orchestra is made up of leading players from each choir of the Cincinnati Symphony Orchestra, with Ary Van Leeuwen, principal flutist, and a musician of international distinction, as the conductor.

THIS orchestra has been particularly valuable in the working out of continuity, or thematic programs, to which Mr. Smith is very partial. More than two years ago Mr. Smith demonstrated the possibilities of thematic programs by presenting a radio play, written by himself. It was the first play ever presented by radio. Mr. Smith has followed the plan in subtilty and entertainingly advertising Cincinnati. He presented a musical sketch, for example, to tell of the beauties and charm of Eden Park, one of Cincinnati's beauty spots; and musical numbers by Chaminade fitted admirably into the picture. On another night he presented "Romanita, a Legend of Mt. Storm," to describe another of Cincinnati's delightful parks; and again it was the excuse for introducing musical numbers appropriate to his story. For the program of Feb. 22 he wrote a musical romance, "Louise Rameau," for which Mr. Van Leeuwen wrote the incidental music, and the title role of which was sung by Jeanette Vreeland, the famous soprano.

Mr. Smith has also adapted the thematic idea in other ways in connection with the community programs. For example, the second concert given through the microphone by the Cincinnati Symphony Orchestra was made up entirely of old Italian music. The "History of the Dance," on the opening program, carried out this idea. Still another example was the Dream Concert presented Feb. 1, a program made up of some of the best compositions about dreams in musical literature. Still another, and perhaps one of the most unique programs ever arranged in radio history, was "Governors' Night," on Feb. 15. To arrange this concert, the Community Broadcasting Committee wrote to the Governor of every State in the union, asking him—or her—to state his favorite selection, with the announcement that it would be played at one of the community concerts.

Mr. Smith succeeded in enlisting a remarkable galaxy of musical stars for the various Cincinnati community programs. Among those already heard were Grace Kerns, soprano; Ethel Jones, contralto; Fred Patton, baritone; Jane Upperman, soprano; Alma Beck, contralto; Dan Beddoe, Cincinnati's famous Welsh tenor; Jan Van Bommel, Dutch tenor; Theodore Ritch, Russian tenor; Mme. Marguerite Melville Liszniewska, pianiste; Mieczyslaw Munz, Polish pianist; Emil Heermann, violinist; Karl Kirksmith, 'cellist; Joseph Vito, harpist, and a number of others. Mme. Liszniewska is to appear again on one of the March programs. A bassoon trio—Hans Meuser, Richard Savolini and Fred Jacky—was presented for the first time to radio listeners. A bassoon trio is so rare that there is very little music written for it, and the trio had to prepare its own arrangements.

STARS of the first magnitude are being booked for the future programs, Mr. Smith announces. "There will be no deviation in the policy of making the two hours between 10 and 12 o'clock Central Standard time, every Monday night, from WSAI, two of the most delightful hours of the week," he promises.

The present series of Cincinnati community radio concerts will come to a close on April 12, although many Cincinnatians are urging that they be continued indefinitely.

Have these community concerts accomplished their mission? Have they contributed to the happiness of the world? Have they brought Cincinnati any return?

The answer is in the thousands of letters and telegrams on file at the Cincinnati Chamber of Commerce from all parts of the American continent, expressing gratitude for the happy hours provided. They are an acknowledgement of the good will created. And it is the history of economics that commercial advantage usually follows in the wake of good will. Cincinnati set out, on the wings of the air, to conquer America; and the letters are testimony that it has at least partly succeeded.

WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAG	Telegram Pub. Co.	Worcester, Mass.	268
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Williard Storage Battery Co.	Cleveland, Ohio	389
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wisc.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas	College Sta., Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTX	H. G. Saal Co.	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	250
WWAE	Electric Park	Plainfield, Ill.	242
WWAO	Michigan College of Mines	Houghton, Mich.	263
WWGL	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WWI	Ford Motor Co.	Dearborn, Mich.	266
WWJ	Detroit News	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg Co., (Ltd.) Can.	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Oht.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	321
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co. (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	291
CNRC	Canadian National Railways	Calgary, Alta.	436
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

CYB	Mexico City	380	CYL	Mexico City	400	CZE	Mexico City 350

Republic of Cuba

PWX	Cuban Telephone Co.	Habana	400
2BY	Frederick W. Borton	Habana	315
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2HC	Heraldo de Cuba	Habana	275
2HS	Julio Power	Habana	180
2JD	Raul Parez Falcon	Habana	105
2K	Alvara Daza	Habana	200
2KD	E. Sanchez de Fuentes	Habana	350
2LC	Luis Casas	Habana	250
2MG	Manuel G. Salas	Habana	280
2MN	Fausto Simon	Habana	270
20L	Oscar Collado	Habana	300
2TW	Roberto E. Ramires	Habana	230
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo E. Figueroa	Colon	360
6BY	Jose Ganduxe	Cienflegos	300
6CX	Antonio T. Figueroa	Cienflegos	170
6DW	Eduardo Terry	Cienflegos	225
6XJ	Frank H. Jones	Tuinucu	275
6KW	Frank H. Jones	Tuinucu	340
8BY	Alberto Ravelo	Stgo. de Cuba	250
8DW	Pedro C. Anduz	Stgo. de Cuba	275
8FU	Andres Vinnet	Stgo. de Cuba	225
12AB	Alberto S. de Bustamante	Habana	240
16AZ	Valentin Ullivarri	Cienfuegos	200
20K	Mario Garcia Velez	Habana	360

Great Britain

2LO	London	365	6BM	Bournemouth	385	5SC	Glascow 422
5IT	Birmingham	479	2ZY	Manchester	378	2BD	Aberdeen 495
5WA	Cardiff	353	5NO	Newcastle	408	6FL	Sheffield (relay station) 301

France

YN	Lyons	550	8AJ	Paris	1,780
FL	Paris (Eiffel Tower)	2,650	ESP	Paris	458

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, of five, fifteen and thirty per cent respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less than ten words will be accepted.

All classified ads for the April issue must be sent in by March 1.

ADVERTISING SERVICE

QUEX Sales Letters Get More Business. Write him today. Quex, 4418 Michigan Ave., Chicago.

AGENTS WANTED

Sell Five Tube Radio Sets. Thirty days free trial. Three sales weekly pays $90 profit. Experience unnecessary. DIRECT RADIO, 197-FF Fourteenth St., Milwaukee, Wisconsin.

AGENTS—Quick sales, big profits, outfit free. Cash or credit. Sales in every home for our high class line of Pure Food Products, Soaps, Perfumes, Toilet Articles, etc. Write today for money-making plans. American Products Co., 5795 American Bldg., Cincinnati, Ohio.

Agents Make $60.00 weekly. Distribute quality food and toilet preparations among friends and neighbors. No money or experience necessary. Free automobile. Desk BG3. Healthe Products Co., Cincinnati, Ohio.

Agents Wanted VANCY Guaranteed Radio Tubes with imported filament all sizes BUY BY TEST also transmitters. Sample tubes $1.50 each Post Paid. Send cash or money order. Van Cleef-Deforest Radio Company, Great Kills, S. I., N. Y.

FORDS. 60 miles on one gallon of Gas. It has been proven such mileage can be made. AIRLOCK guarantees to increase gas mileage; also prevents radiator boiling in summer or freezing in winter. Cools, Fuels, Decarbonizes the Ford motor. Splendid territory open. AIRLOCK PRODUCTS, Box 703G, Willow Street, Long Beach, Calif.

RADIO—Join our sales organization and make big money. We want a man in every county to sell well advertised sets and parts made by the leading manufacturers. Widener of Kansas City makes $150.00 weekly. You can do as well or better. Write today for catalog, and discounts. Name your county. Waveland Radio Company, Div. 52, 1027 No. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electrical Jobbers, Chicago and Vicinity, has opening for 3 additional lines carrying volume business, as we cater to large jobbers. Edelstein, 1804 McCormick Bld., Chicago.

Man wanted for this territory to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today Tanners Mfg. Co., 1334C. St., Boston, Mass.

$50 WEEKLY EVENINGS. DEMONSTRATING A super selective 6-tube radio set. Selectodyne Radio Co., Dept. M-325 West State, Rockford, Illinois.

RADIO SALESMEN and SET BUILDERS in every county write Grenzer Radio, 1479 Hodiamont, St. Louis, Mo.

"B" BATTERIES

100 VOLT EDISON TYPE "B" BATTERY, knocked down. Parts and plans—complete, $12.50. Lans Mfg. 2937 W. Lake, Chicago.

BOOKS AND MAGAZINES

Free booklet "Interesting Radio Magazine—Monthly payment subscriptions." Two-thirds publishers prices. Spencershield Agencies, West Los Angeles, Calif.

EXPERIMENTAL RADIO by R. R. Ramsey, Professor of Physics Indiana University. "The only scientific experimental manual. Enthusiastically endorsed by the American Radio Relay League for amateur use. Used in colleges, universities and Government schools. Measure, adjust, and perfect your set. 85 experiments. Price $2.00 post paid. Hugh Ramsey, Bloomington, Indiana.

ELECTRICAL MEN LOCATE TROUBLE OR ELECTRICAL APPARATUS. PRACTICAL EXPLANATION WITH BLUE PRINT DIAGRAMS OF MOTOR & CONTROLER CONNECTIONS. GREAT HELP & GUIDE TO MEN IN THE TRADE. COMPLETE BOOK FORM PRICE $2.00 POST-PAID. U. S. SALES & TRADING COMPANY, 1457 BROADWAY, NEW YORK, N. Y.

BUSINESS OPPORTUNITIES

Peach-Orange-Fig Groves "On the Gulf." Guaranteed care. Monthly payments. Big quick returns. Suburban Orchards, Dept. K, Biloxi, Mississippi.

$100 weekly up. We want experienced Radio men to operate branch assembling plants. Part or whole time. Barfield Radio Co., 13 Tillery Street, Dept. A R, Brooklyn, New York.

CRYSTALS

Supersensitive Galena Crystals: Pound 75c prepaid. ALKEMITE, All sensitive Crystals 50c. Buskett, Geologist, Joplin, Missouri.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldogs, 501 Rockwood, Dallas, Texas.

HELP WANTED

RADIO SALESMEN and SET BUILDERS—We need you and you need us. If you are reliable and well known in your community, we will appoint you our representative and furnish you with standard well advertised sets and parts at prices that will enable you to sell at a handsome profit. Write at once for catalog and sales plan. Waveland Radio Co., Div. 53, 1027 N. State St., Chicago, Ill.

MEN wanting forest ranger, railway clerk and other government positions, write for free particulars of exams. Mokane, Dept. B-33, Denver, Colo.

MEN WISHING TO ENTER DINING, SLEEPING CAR SERVICE AS CONDUCTORS, PORTERS, WAITERS. WRITE 123 RAILWAY EXCHANGE, KANSAS CITY.

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and salable. Address: Mr. R. F. Darina, Room 1101, 116 West 32nd St., New York, N. Y.

MUSIC

SONG Poem Writers—If you have your words put to music let a gifted Melody Writer do it. Write Francis Conover, (Composer) AVON, New Jersey.

"MUSIC COMPOSED" TO WORDS. BAUER BROS., (formerly of Sousa's Band), Oshkosh, Wisconsin.

PATENTS

FOR SALE: U. S. and Canadian Patent on an Attachment for Phonographs; is the most beautiful invention of the age. Address Chas. F. Smith, Huff, N. Dak.

RADIO

"$1.00 For Your Old Tubes regardless of make or condition towards the purchase of each new Standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 6229 Broadway, Chicago, Ill. Paste this ad in your set."

B BATTERY ELIMINATORS—BUILD YOUR OWN cheap; no hum; acid or anything to get out of order; blueprint and instructions; 50 cents, money order or cash. Web Radio Co., Dept. A, 5823 Calumet Ave., Chicago, Illinois.

Standard solderless radio Jacks. Binding post attachments. Double circuit. One dollar bill. Postpaid. Clinton Seward, Jr., New Paltz, New York, N. Y.

Three Cosmopolitan Phusiformers, each $5.50, book of instructions included. F. A. Mall, Triopli, Iowa.

15 to 25 per cent discount on nationally advertised sets and parts. Every item guaranteed. Tell us your needs. IMPERIAL RADIO COMPANY, Delaware, Ohio.

RADIO SETS. Our prices save you money. Lists free. The Radio Shoppe, Box 645, East Liverpool, Ohio.

RADIO

AT LAST! The Radco Static Eliminator. Eliminates 50 to 90% Static. Many satisfied users. Write for particulars. Radio Specialties Company, Sioux Falls, South Dakota.

RADIO DEALERS

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Rossiter-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

HAVE YOU SEEN THE NEW DIALITE, THE UNIQUE lamp that lights up your panel and adds a decorative touch to any radio set? Retails at $2.75, complete. Send for folder and dealer's proposition on this fast moving article. Also, we are distributors for the famous Knurled Walnut Cabinets, the most beautiful cabinets made. American-Universal Radio Co., 6255 Broadway, Chicago, Ill., Box 11.

SALESMEN WANTED

Make $100 WEEKLY in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. UZARKA, INC., 126 F Austin Ave., Chicago.

66 MILES ON 1 GALLON—SCIENTIFIC GAS SAVER. All autos. 10 free to introduce. Critchlow, A-90, Wheaton, Illinois.

MANUFACTURERS OF NEW AND IMPROVED STATION finder and vernier tuning-dial want live salesmen to call on radio trade. Excellent side-line; good commissions; exclusive territories. Westerland Corporation, Dobbs Ferry, New York.

STAMPS

69 stamps, 4 cents. Book Stamp Company, 642 Meredith Street, Dayton, Ohio.

STAMPS, 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5950 Cote Brilliante, St. Louis, Missouri.

WIRELESS

Want to Memorize the Wireless Code? The Coryden Snyder Code Method. Patented is quickest. Send 25c coin, or M. O. to C. C. Snyder, 1423 Elmdale Ave., Chicago, Ill.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Govt. and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co. 13 F Hudson St., New York.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 905, Jacksonville, Florida. Enclose stamp.

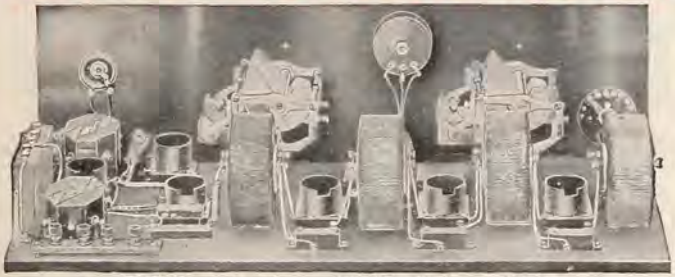
Radio Age Classified Ads Brings Results

Tell them you read it in Radio Age

KC	Meters	STATIONS	DIALS 1	2	3
1480	202.6				
1470	204.0				
1460	205.4				
1450	206.8				
1440	208.2				
1430	209.7				
1420	211.1				
1410	212.6				
1400	214.2				
1390	215.7				
1380	217.3				
1370	218.8				
1360	220.4				
1350	222.1				
1340	223.7				
1330	225.4				
1320	227.1				
1310	228.9				
1300	230.6				
1290	232.4				
1280	234.2				
1270	236.1				
1260	238.0				
1250	239.9				
1240	241.8				
1230	243.8				
1220	245.8				
1210	247.8				
1200	249.9				
1190	252.0				
1180	254.1				
1170	256.3				
1160	258.5				
1150	260.7				
1140	263.0				
1130	265.3				
1120	267.7				
1110	270.1				
1100	272.6				
1090	275.1				
1080	277.6				
1070	280.2				
1060	282.8				
1050	285.5				
1040	288.3				
1030	291.1				
1020	293.9				

KC	Meters	STATIONS	DIALS 1	2	3
1010	296.9				
1000	299.8				
990	302.8				
980	303.9				
970	309.1				
960	312.3				
950	315.6				
940	319.0				
930	322.4				
920	325.9				
910	329.5				
900	333.1				
890	336.9				
880	340.7				
870	344.6				
860	348.6				
850	352.7				
840	356.9				
830	361.2				
820	365.6				
810	370.2				
800	374.8				
790	379.5				
780	384.4				
770	389.4				
760	394.5				
750	399.8				
740	405.2				
730	410.7				
720	416.4				
710	422.3				
700	428.3				
690	434.5				
680	440.9				
670	447.5				
660	454.3				
650	461.3				
640	468.5				
630	475.9				
620	483.6				
610	491.5				
600	499.7				
590	508.2				
580	516.9				
570	526.0				
560	535.4				
550	545.1				

LOOK NO FURTHER



B-T Counterphase Six (Built from Kit)

The Counterphase is the only new and noteworthy development in radio this year. It's the season's leader and it promises to maintain its position for many seasons to come.

The essential parts used in this set are available in kit form. Each kit contains a nine-color full size wiring diagram and a set of wires cut to length and colored like the diagram. Wiring the set is a simple matter and it's easy to build.

The No. 6 Kit contains the following:

2—B-T Types LD-17 Tandem Condensers
1—TA Torostyle Inductance
3—TC Torostyle Transformers
3—Mikro-Mike Condensers
1—B-T Dual Resistance
1—4 ohm resistance
1—Set of wires cut to length
1—Blue print and instruction sheet.

Price, ... $38.00

The No. 5 Kit contains the following:

1—B-T Type L-17 Condenser
1—B-T Type LD-17 Tandem Condenser
1—TA Torostyle Inductance
2—TC Torostyle Transformers
2—Mikro-Mike Condensers
1—B-T Dual Resistance
1—4 ohm resistance
1—Set of wires cut to length
1—Blue print and instruction sheet.

Price, ... $28.50

FOR BEST RESULTS USE B-T PARTS THRUOUT

2.2 to 1, $5.00
4.7 to 1, 5.75

AUDIO TRANSFORMERS

For true tone use B-T Euphonic Audio transformers. Reproduces high and low notes with equal clarity and tone quality. Designed by the inventor of the Counterphase and Nameless circuits. The mechanical design permits mounting in various positions for easy wiring.

SOCKETS

A small article but an important one. Faulty contacts are impossible with the B-T Universal socket. It accommodates the old and new style UX base tubes. A compact efficient socket made of genuine bakelite. Insure your set against socket trouble by using B-T sockets throughout.

Price, 75c Each

The 9th edition of "Better Tuning" contains valuable information for the radio fan. Read about the Counterphase and other hook-ups in this interesting 68 page booklet. Sent postpaid on receipt of 10 cents in stamps or coin.

BREMER-TULLY MFG. CO.

532 SO. CANAL ST., CHICAGO, ILL.

ZENITH
—LONG DISTANCE— RADIO

Zenith Ideals Make Zenith Values

Prices Gravitate to Their True Levels

It is one of life's little ironies that the thing which is second-rate at $200 is no less second-rate at $98.75

Be Wary of "Bargains" in Radio!

The true artist would gladly pay $10,000 or more for the violin that Paganini played. Yet other violins weigh as much—in wood and strings. They only lack one priceless thing—*master-craftsmanship.*

The Zenith ideal, in the building of fine radio sets, is the ideal of the master craftsman. Zenith is not satisfied with tone quality short of the finest in artistic values—with cabinet work short of the really beautiful—with performance short of the superlative. Its aim is to build the best in radio that can be built—then and then only to affix a price.

By virtue of its steadfast adherence to this ideal, Zenith radio instruments are constantly increasing in value.

Today Zenith factories are employing more craftsmen, building more radio instruments, than ever before in Zenith's history. Yet Zenith is still unable to keep pace with the public's demand for radio instruments built to the Zenith ideal.

Whatever else you do—see Zenith—listen to Zenith—in your own home. Remember, you do not need the full purchase price to start your ownership. You can place in your home the finest Zenith made on a down-payment of only $80.

Your nearest Zenith dealer will gladly demonstrate the model that appeals to you—in your own home—whatever evening suits you best. No obligation. Write us for his name and complete descriptive literature.

Chinese
Art Model
De Luxe

Zenith is made in Chicago to operate in a territory where 27 broadcasting stations are located—the most difficult conditions for radio reception in the world. Excellent results in Chicago mean unmatched performance elsewhere.

The complete Zenith line includes ten models, each in its class an outstanding value. The price range is from $100 to $2,500.

(All Prices F. O. B. Chicago)

Zenith Broadcasting Station W J A Z Schedule: **Dance Orchestras on Wednesday and Saturday Nights from 9:00 P. M. until 2:00 A. M. ¶ Musical Program from the Zenith Spanish Garden Studio 10:00 until 12:00 o'clock Thursday Nights and Special Programs 7:00 until 9:00 Sunday Nights. ¶ Central Standard Time. ¶ Authorized Wave Length, 322.4 Meters.**

Zenith Radio Corporation

Straus Building, Chicago

They Cost More—But They Do More!

Scanned from the collections of
The Library of Congress

Packard Campus
for Audio Visual Conservation
www.loc.gov/avconservation

Motion Picture and Television Reading Room
www.loc.gov/rr/mopic

Recorded Sound Reference Center
www.loc.gov/rr/record