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Radio Age
The Magazine of the Hour

March 1926

25¢

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RADIO AGE for March, 1926

The Magazine of the Hour

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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.

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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.

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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.

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

WEAF—New York
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WIXI—Baton Rouge
WIXD—Worcester
WPIX—Philadelphia
WHO—Buffalo
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WSAA—Cleveland
WABB—Cleveland
WWJ—Detroit
WOW—Chicago
WOC—Iowa City
WOCO—Minneapolis

KSDK—St. Louis

KGO—San Francisco, 8 P. M. Pacific Coast Time
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 believe 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.
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*

Shortly after this date, the Navy in conjunction with some of the leading American manufacturers conducted a series of trans-Atlantic radio telegraph 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 to-day 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 sea-coast 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
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 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 fog, 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 this country.

Early in the century the Navy realized the importance of radio in modern naval warfare; but, the commercial demand was not large enough 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 withhold 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 remunerative 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.
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 kind of 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 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 cannot produce a whistle with the incoming wave. When you hear a whistle in your headphones having a pitch which changes according 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
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, and 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 description may be caused by the 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 bywhistles of the other two types it is best to tune away from them and try to receive 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 broadcasters 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.

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 of 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 be taking some sort of action in your community during this hour. You are in the same position as the owner of the other 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.

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.

RADIO AGE, for March, 1926
Radio Sound Ranging Device

Latest Aid to Navigation Is Described

By S. R. FALL

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)
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 three 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 fusing 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.

The Magazine of the Hour

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 "gonio-meter," 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 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 critical 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 amplifiers. 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 22 1/2 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 connected with the grid connection 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 Leakadenser 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 wiring 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 coil's, 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](image-url)

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.
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.

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 approval 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 communications, so far as such has not been included in the Interstate Commerce Act, or constitutes or affects interstate or foreign commerce.

The 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.

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 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 of the expiration outlined 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)
Recently the Browning-Drake receiver has received widespread publicity due to the fact that 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.
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 required 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 broadcasting them. This arrangement of 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 in 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 pilotron throughout, the 7.3 watt (Please turn to page 50).
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 Stygian 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. Michelson 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 the 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 predetermined altitude.

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.
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 counterpart 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.
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, 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 involved 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 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

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 sized standard

(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 connections 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 of superheterodyne 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, as a means of obtaining a true 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," by 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 "barrely" 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 result.

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 capacitive 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 broader, 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 broadened, without material increasing the resistance of the windings, 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

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.

What the Broadcasters are Doing

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 unmistakable 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.

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; WBG, Springfield, Mass., and KFXX, 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.
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)
Luigi von Kunitz who directs the Symphony Orchestra in its rendition of the twilight Symphony program given at Toronto and broadcast by CFCA.

Jessie Butt, who with Frank Oldfield are called two of CFCA's lark throated radio favorites.
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 played at the Toronto Exhibition—an annual fair which is the model for all others—has also been featured. Creator'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.

During the great blizzard of February, 1934, when telephones and telegram 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 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 their 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 they may always depend upon to keep them in its remembrance 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.
Venici Veni 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 possessing the faculties to conquer 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 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—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 WLV 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 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 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. Mr. Smith proposed 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 in advance of the first program. 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 met 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 and a total of 205,000 such announcements were asked for and a total of 205,000 such announcements were asked for and a total of 205,000 such announcements were asked for.

The “invitation” was a four-page affair. On the two inside pages were the first four programs.
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 homo-

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

The Magazine of the Hour
IF PERCHANCE, some clear, cold winter night one might broadcast the question: "Who doth 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 superheterodyne, the attitude of the average listener seems to be to disparage all the efforts of the harassed impresario who labors out our ethereal entertainment. Though holding no brief for the gentlemen in question, our sympathies have here-tofore 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 by the case in hand, 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 peaceable mood. All the worries had been straightened out and the cares that fest 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. Bruggesmith 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 of only logical demand to 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 have the necessary version 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 space, an unceasing blaze of voices rises, After a disgusted twisting of dials, they dust off the Victrola, (if 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 effort on the air. Now we measure that effort 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 unstinted 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 till the point of being frazled,—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 Anita 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 as there is room for the search for novelty 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, 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 Kam-mer Oestrow 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 Fact-orum performed upon a bicycle pump.

The Magazine of the Hour

BROADCAST SHORTCOMINGS

Beethoven and Sausages do not Sit Well With Critic

By Dorothy B. Stafford
SO TIRED has the public become of this messiness 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, and 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 sandpaper; 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 says:—

"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 métier 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. O. 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 waveling 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's O'Keeffe's Swan, without ever hearing 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 hat. 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 WSB 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 have 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 as much room for intelligence in a radio station as there is in anything else.
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.

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 6½ 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-generating. 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

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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 the usual 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 ordinary 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 "C" and "F" and the tickler, at the top. The variable condenser is shown at C1. The grid leak and grid condenser are C2 and C3, 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 light 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 transformer should be capable of furnishing 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 amperes, 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)
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 push-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. 4, 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 the 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)
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 below 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.
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.

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 homemade 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
An Index to the Best in Radio Hookups!

How long have you postponed making that favorite hookup of yours because you couldn’t find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

January, 1924
- Tuning Out Interference—Wave Traps—Eliminators
- A Junior Super-Heterodyne
- Push-Pull Amplifier

March, 1924
- An 8-Tube Super-Heterodyne
- A Tuned Frequency Amplifier
- Simple Radio Set

April, 1924
- An Efficient Super-Heterodyne (fully illustrated)
- A Ten Dollar Receiver
- Anti-Body Capacity Hookup—Radiating the Three-Circuit Tuner

May, 1924
- Construction of a Simple Portable Set
- Radio Panels
- Third Installation of Radio Age Data Sheets

June, 1924
- Important Factors in Construction of Super-Heterodyne
- A Universal Receiver
- Adding Radio and Audio to Baby Heterodyne
- Radio Age Data Sheets

July, 1924
- A Portable Tuned Impedance Receiver
- Operating Detector Tube for Grid Bias
- A Three-Tube Wizard Circuit

August, 1924
- How to Make Radio Without a Diagram
- The Single Element Tube
- A Heterodyne Audio Stages
- An Audio Amplifier without an "A" Battery

September, 1924
- How Careful Mounting Will Improve Reception
- One Tuning Control for Hair’s Breath Selectivity
- Four Places of Real Blueprints of a New Baby Heterodyne

November, 1924
- Blueprints of a Single Tube Loop Set and a Capacity Feedback Regenerator
- A 5-Tube Low Loss Receiver
- Mastering the 5-Circuit Tuner

December, 1924
- Blueprints of a New 8-Tube Super-Heterodyne
- How to Make a Receiver that Minimizes Static
- A Trans-Atlantic DX Receiver

January, 1925
- A Six Tube Super-Regen
- An Efficient Portable Set
- A Tuned Plate Regenerator
- Making a Station-Finder

February, 1925
- A Three Circuit Regenerator
- A Real Low Loss Set
- Blueprints of a Study Receiver

March, 1925
- A 6-Tube R. F. Receiver
- How to Wind Low Loss Coils
- A Home Wire Receiver
- Blueprints of a Two-Tube Ultra Audio and a Recreational Radio

April, 1925
- A 7-Tube Portable Set
- "B" Voltage from the A. C. Socket
- An Amplifier for the 3-Circuit Tuner
- Blueprints of a Five-Tube Radio Frequency Receiver

May, 1925
- A "Quiet" Regenerator
- How to Make a Tube Tester
- A Unique Super-Regen and an Improved Receiver
- A Six Tube Portable Receiver Illustrated with Blueprints

June, 1925
- Reducing Static Disturbances
- A Seven-Tube Super-Heterodyne
- A Costly Super-Regenerator
- Determining Oscillations in the Roberts Receiver
- An Ideal Set in Practical Form

July, 1925
- Learning Tube Characteristics
- How Much Current?
- Blueprints of Conventional Radio
- Symbols and a Crystal Detector Circuit

August, 1925—50c per copy
- How to Attain Smooth Tuning
- Alternating Current Tubes
- Deciding on a Portable Super
- And a big 60-page blueprint section, in which is contained blueprints of all the basic circuits from which all radio hookups have been developed since the birth of Radio.

September, 1925
- Thirty-one ways to prevent self-oscillations
- Tuned oscillators with two controls
- Ideal Audio Amplifier Circuits
- Blueprint section

October, 1925
- Auto-Transformer Coupling
- Some Facts about Heterodyning
- An Improved Slide-Wire Bridge
- Blueprints of Circuits Using Slide-Wire and Dual Controls

November, 1925
- Super without L. F. Stages
- A Good Audio Oscillator
- An Effective Short-Wave Transmitter
- Blueprints—Addict R. F. Stages

December, 1925
- Tube R. F. andoscillator
- Inductive Grid-Control Receiver
- Tuning dials for Curve Chart

January, 1926
- Radio Age Junior Model Set
- A Four-Tube Tuned Set
- Power Supply Device—Blueprint Feature
- Finished Your Radio Cabinet

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
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 newdealers, $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 World.

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:

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 $0.75 or $1.50 for an "A" 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 new placed

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 your set NOW with this marvelous instrument, and be convinced.

Special Offer
Subscription Blank

Send me RADIO WORLD for 10
weeks to

Name:

Street:

City and State:

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

RADIO AGE SUBSCRIPTION BLANK

Radio Age, Inc.
500 North Dearborn Street.
Chicago

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 . (4/36)

Please mention Radio Age when writing to advertisers.
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 cooperative efforts of 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 2 1/2 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-jipped 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 E. Bush, 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 9 1/4 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:


All stations but four in the fourth district, which is the Chicago district, are equipped with harmonic suppressors. Those four not so equipped are:—WLTS, Chicago, WGES, Oak Park, Ill., WPPG, 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.

The Magazine of the Hour

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 in 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 details 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 by an individual. To draft 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 communication are required to obtain permits in advance of the construction of the station. 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.

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

The Five Tube Set which startled the World

FRESHMAN MASTERPIECE

The Greatest Value Ever Offered in A Radio Receiving Set

At Authorized Dealers
Send for this 
1926 Catalog of 
Radio 
BARGAINS
Save \(\frac{1}{3}\) to \(\frac{1}{2}\)

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 \(\frac{1}{3}\) to \(\frac{1}{2}\).

The Biggest 5-Tube Value on the Market

Positively the world's greatest 5-tube radio bargain. Regular STS.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 Bakedite panel ofatin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, transformers and sockets. Bakedite baseboard panel and dials. Price for set only. Transportation charges extra. $29.50

This set with all Accessories, including the famous America Bell Loud Speaker with adjustable unit, 4.4 volt "B" batteries, one guaranteed 100 Amper Hour storage "A" battery, cable for battery connection, 5-201A tubes. Aerial and ground equipment, instructions complete ready to set up and operate. Nothing else to buy. Price. $59.75

Order Direct From This Page! Save \(\frac{1}{2}\) to \(\frac{1}{3}\). 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 price 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 burr walnut. Cabinet is 36 inches high. Top measures 34.5 x 17.5 inches. Equipped with high-grade built-in loud speaker with floating unit. Line, tone, and volume interior for holding all batteries, books, etc. Console Columbia 5-tube acute reporters. Price for set only. $16.95

Console Radio with built-in loud speaker and adjustable unit. Has complete sets for all aerials, storage batteries, batteries, battery charger, radio book of instructions, etc. Transportation charges extra. Shipped by freight or express.

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. Bakedite righthosts. All wire, panel, baseboard on panel and baseboard 11x18 panel - fit into any standard 7x18 cabinet. Complete instructions for setting up and operating - everything complete, nothing else to buy. $84.95

Our line is complete, includes all popular sets such as: Super-Heterodyne, Neutrodynes, Synchrodynes, etc. Radio Frequency, Ultra-Audion, BSA, Super-Heterodyne Reflex and all other latest circuits. Kits, sets and parts by well-known manufacturers such as: New, Audio-Tonics, Breite-Tully, Biddle, tidal, and Columbia.

ULTRADYNE

Complete parts for 8-tube Ultra-Heterodyne set. With complete instructions ready to wire. $45.85

NEUTRODYNE

Complete licensed Neutrodynes all specifications as in Super-Heterodyne. With complete instructions ready to wire. $29.75

COCKADAY

3-tube Cockaday kit. Complete. All parts, fully assembled on panel and panel and baseboard ready to wire. $15.85

REMLER 8-TUBE SUPER HETERODYNE

Complete parts for 8-tube Heterodyne set. With complete instructions ready to wire. 2 tubes. $18.95

HARKNESS

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

Please mention Radio Age when writing to advertisers.
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 given 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 upon application from the Bureau of Standards, Washington, D. C. Even though only a few signals are received, persons who can 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 CKAC is the official wireless station 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 H. Daundurand, 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 hurling gate receipts is the cause of the objection.

ANYONE CAN MAKE BIG MONEY

Just Showing This 40 to 550 Meter Set

The most phenomenally successful radio set ever built is creating a sensation with the public in its wonderful performance. Thousands of men are making fortunes just showing this amazing New Set to their friends. Get our plan at once, while territories are open. No obligations.

TWO AMAZING NEW FEATURES

AMBU FIVE has a subpanel inlaid with copper-shot into grooves making assembly a simple matter. Connections are automatic and everlasting. 165 points of contact, yet only 4 soldered connections.

AMBU FIVE has interchangeable ALLWAVE coils. Operator can bring in stations broadcasting on wave lengths of from 40 to 550 meters. Ordinary sets do not go below 200 meters.

NO BIG INVESTMENT NEEDED

Demonstrator Set Free On Ambu Plan

Dealers of every description are getting into radio and cleaning up. Radio Dealers are doubling and trebling their sales with this AMBU FIVE.

No big investment—We carry stock for you. You buy direct from manufacturer at maximum Discount and make all the profits. By our plan you get your demonstrator set FREE.

Send For FREE Plan TODAY!

Don't wait, a 2-cent stamp brings you all facts which may mean a fortune for you. State whether interested in Radio Training for Ambu Distributor Plan or straight Sales Plan.

AMBU ENGINEERING INSTITUTE
Radio Div. 25XC
2632 Prairie Avenue
Chicago, Illinois

RAULF-RADIO CONSOLE
MFG. CO. 592 VEDDER ST.
CHICAGO. WRITE FOR CIRCULAR

RAULF-RADIO CONSOLE
MFG. CO. 592 VEDDER ST.
CHICAGO. WRITE FOR CIRCULAR

MASTERTONE $2.00
RADIO TUBES
ALL TYPES GUARANTEED
Dextron Radio Lab.
74 Stanley, Dept. R. A.
East Orange, N. J.

1926 RADIO CATALOG-OF BOOK
Our 516 Beautiful Illustrated Catalog!
Which contains all latest STANDARDS RADIO MERCHANDISE at SLASHED PRICES, and up to date Log Books.

It will pay you to buy from us. We carry one of the largest lines of Radios in the East. Don't miss the wonderful opportunity to participate in the Great Sale. Read your Letter for announcements.

To cover the cost of mailing enclose 10c
ECONOMY RADIO SALES COMPANY
2016 6th Ave., Dept. C
New York
DIRECT AND SAVE REAL MONEY
(No Dealers)

Radio Age—$2.50 a Year

Please mention Radio Age when writing to advertisers.
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 sensitivity of the audion detector, amplifier and transmitter.
1920—First permanent broadcasting station in the world established. Operated 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.

Test Your Tubes—
AT HOME

Poor reception may be the result of one bad tube in your set. Do you know the condition of your tubes?

By using a Jewell Junior Tube-Checker—at Home—You will always know whether your tubes are weak and just when to replace them.

Send for our circular No. 735

JEWELL ELECTRICAL INSTRUMENT CO.
1650 Walnut St. Chicago
"26 Years Making Good Instruments"

ORIOLE!
The Most Amazing Performer You've Ever "Tuned In"

Oriole radio receivers step right out and make astounding records on distant stations—they give exceptional volume—unqualified for clarity and sweetness of tone. The most selective sharpest, tuning set you ever played with—you'll be sold on the ORIOLE the minute you turn its dials.

Model 7—5 Tubes, with "B" battery compartment.
Model 75—5 Tubes.
Model 7C—5 Tubes—Console.
Model 8—4 Tubes.

Write for folder illustrating and describing all models.

Dealers: There is some exclusive territory open—ask for details.

W-K ELECTRIC CO.
KENOSHA, WISCONSIN

Illustration shows Model 7—
5 tubes—"B" battery compartment underneath.

HEATH CONDENSERS
For Real Radio Reception
Write for Literature
HEATH RADIO & ELECTRIC MFG. CO.,
206 First St. Newark, N. J.

A regular $25 loud speaker for $16. Loud, clear, mellow tone.
Bell 13K in. diameter, horn 22 in. high, equipped with Lakeside Adjustable Unit. Agents wanted, write for particulars.

Lakeside Supply Co.
73 W. Van Buren St., Chicago

Please mention Radio Age when writing to advertisers.
Worlds Record
SUPER 9
The receiver that brought in stations 6,000 to 8,000 miles distant with loud speaker volume night after night. All records fully verified.
Holds World’s Records For
(1) Longest distance ever received on a radio station—60,179 miles.
(2) Most consistent reception of stations 4,000 to 6,000 miles—117 programs in three months.
(3) Brought in 6 different stations in 2½ hours—all over 6,000 miles.

PRICE:
Complete Set of Parts............ $89.00
(Include all parts necessary to make an exact duplicate of this wonderful receiver, together with book of instructions and complete blue prints.)
Story of development and proofs of records sent on receipt of stamped and addressed envelope.

Scott Radio Laboratories
35 S. Dearborn St., Chicago
Dealers and Set Builders, write for discounts

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 a-c power-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 a 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.

Please mention Radio Age when writing to advertisers.
Inter coupling 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. Inter coupling 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 Isodyne 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."

Make Your Radio Set More Efficient With Allen-Bradley Radio Devices

It matters not whether you are building a receiver or own a factory-built set, in either case you can make your set more efficient by using Allen-Bradley Radio Devices in many parts of the receiver. In addition to the various devices for filament control, grid leak and potentiometer control, there also are the Bradley switch and the Bradley nier which are easily installed. The one-hole mounting makes installation quick and easy.

To bring your set up-to-date, replace your old condensers with Bradley densers and thereby enjoy the selectivity of straight-line frequency tuning. The condenser is extremely compact and will not interfere with any other parts on your panel. Don't forget the Bradley Amplifier for perfect audio amplification. This efficient amplifier is a complete unit ready for immediate use in your set. Try Allen-Bradley Devices tonight and hear the difference!

Insist on Allen-Bradley Products

Sold In Distinctive Checkered Cartons

Please mention Radio Age when writing to advertisers
Rebroadcasting Now Quite an Art

Radio listeners in England hear 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 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, Guantanambo 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.

Battery Prices SMASHED!

To Consumers Only

Here's a real battery quality, guaranteed in you at price that will assure you a unique position. Order Direct. No Retailer can offer the Large Profit you in your own package. Only you can use this quality and performance, we give you a及 The Dealer's Profit in your own package. You actually save much more than half, and if you can save responsibly and with dignity, you'll need to get a assortment.

Free! AMBU

Send $1 Postpaid

From your examination

Here is your chance. Our battery--Free! AMBU to your examination. Nothing to add--attach in 2 minutes. It's yours. Don't miss this rare opportunity. You can use your battery--Don't let us take your battery. Order today--many tens by mail by.

Select Stations

At Will

Try this Radio Wonder at your leisure. Whatever happens, nothing to add--attach in 2 minutes. It's yours.

FREE

Select stations 1500 XH One-Tube Set 44; Crystal Set 50; Crystals 50c for $1; 5-Tube Set $25. 75.

STEINITE LABORATORIES

202 Radio Building

Auburn, Mass.

For Accurate Condenser Values Use

X-L VARIO DENSERS

The Best Semi-Fixed Condenser Made. Endorsed by all the Louderhead Decoder News.

MODEL N--Capacity range from 1.8 to 20 micro-micro-

farads, for balance in Roberts 500 tubes. NKF, Drake, McCormick, Harrows' Rameau. Neutrodyns and tuned radio frequency circuits.

Price $1.00

MODEL G--For the Cochran circuit, filter and inter-

mediate frequency circuits, with higher inter-dipole and con-

secutive grid bias in all sets. G-1 $00002 to $00004, G-2 $00005 to $00025, G-3 $00030 to $00035. Each with grid lead clips $1.25.

X-L RADIO LABORATORIES, 2428 Lincoln Ave., N. Chicago.

FREE HOOK-UPS AND

BIG RADIO GUIDE

Free, big Radio Catalog and Guide of half of new

sets, ideas, over 100 local stations and the station. You get less than 20% of sets and parts. Be sure to get this handy book before you buy. It puts money in your pocket. Shows standard radio parts, sets, all items, all reliable manufacturers. Please include name and address and postal. Send money order, OR POSTAL order.

ROLAND BROWN

21 Sanders Street

Madison, Mass.

YOU CAN GET

Greater depth or crystal set reception if you use the

BROWNLE VERNIER DETECTOR

$2.00 At your dealer or Direct.

RONALD BROWN

1711 S. 4th Street

PHENIX RADIOTRANSMITTERS

116 E. 25th Street, N.Y.C.

SELECT STATIONS AT WILL

Try this Radio Wonder at your leisure. Whatever happens, nothing to add--attach in 2 minutes. It's yours.

FREE

Select stations 1500 XH One-Tube Set 44; Crystal Set 50; Crystals 50c for $1; 5-Tube Set $25.75.

STEINITE LABORATORIES

202 Radio Building

Auburn, Mass.

For Accurate Condenser Values Use

X-L VARIO DENSERS

The Best Semi-Fixed Condenser Made. Endorsed by all the Louderhead Decoder News.

MODEL N--Capacity range from 1.8 to 20 micro-micro-

farads, for balance in Roberts 500 tubes. NKF, Drake, McCormick, Harrows' Rameau. Neutrodyns and tuned radio frequency circuits.

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FREE HOOK-UPS AND

BIG RADIO GUIDE

Free, big Radio Catalog and Guide of half of new

sets, ideas, over 100 local stations and the station. You get less than 20% of sets and parts. Be sure to get this handy book before you buy. It puts money in your pocket. Shows standard radio parts, sets, all items, all reliable manufacturers. Please include name and address and postal. Send money order, OR POSTAL order.

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Free, big Radio Catalog and Guide of half of new

sets, ideas, over 100 local stations and the station. You get less than 20% of sets and parts. Be sure to get this handy book before you buy. It puts money in your pocket. Shows standard radio parts, sets, all items, all reliable manufacturers. Please include name and address and postal. Send money order, OR POSTAL order.
New! Tone and Volume Control

The new CENTRALAB MODULATOR PLUG gives any degree of tone volume from a whisper to maximum, by the simple turn of a knob. Great for smoothing out powerful local stations, and for lessening static interference.

Centralab Modulator Plug can be attached in a moment. No tool necessary. It replaces your present phone plug.

Retail at $2.50, at your dealer's, or direct from us.

Central Radio Laboratories
24 Keefe Ave.
Milwaukee, Wis.

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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 bell ringing transformers, X-ray apparatus, power leaks and similar troubles.

Information dealing with these has 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.

APEX VERNIER DIALS
ARE BEST ON ANY SET

Ask Your Dealer or Write Us
APEX ELECTRIC MFG. COMPANY
Dept. 311 1410 W. 59th St. CHICAGO

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Correct List of Broadcast Stations

OLR Radio Electric Co. Devils Lake, N. D. 231
OLY Newhouse Hotel Salt Lake City, Utah 216
OLZ Frank E. Seifert Bakersfield, Calif. 240
OZI Electric Supply Co. Wenatchee, Wash. 360
FAB Nebraska Buick Auto Co. Lincoln, Neb. 341
FACF Arthur Bros. Mercantile Co. Phoenix, Ariz. 273
FAD F. A. Buttrey & Co. Havre, Mont. 275
FAW W. K. Azbill San Diego, Calif. 216
FKB Kimball-Upsam Co. Sacramento, Calif. 248
FLF Lee Brothers Everett, Wash. 224
FBS School District No. One Trinidad, Colo. 238
FBU Bishop N. S. Thomas Laramie, Wyo. 270
FCD Nelson 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
FEG Meier & Frank Co. Portland, Ore. 248
FEK Augsburg 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
FGD Heidbreder Radio Supply Co. Utica, Neb. 242
FGO Chickasha Radio & Electric Co. Chickasha, Okla. 248
FGQ Crairy Hardware Co. Boone, Iowa 236
FH Hotel Lassen Wichita, Kans. 268
FHA Western State College of Colo. Gunnison, Colo. 252
FHM Amrose A. McCue Neah Bay, Wash. 261
FHN 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
FIZ Daily Commonwealth Fond du Lac, Wis. 273
FB Marshall Electrical Co. Marshalltown, Iowa 248
FC R. B. Fegan (Episcopal Church) Junction City, Kans. 219
FCJ National Radio Manuf. Co. Oklahoma City, Okla. 261
FCJ Liberty Theatre (E. E. Marsh) Astoria, Ore. 246
FCJL Hardsaag Manufacturing Co. Ottumwa, Iowa 242
FCJM University of North Dakota Grand Forks, N. D. 278
FCJR Ashley C. Dixon & Son Portland, Ore. 263
FCJY Tunwall Radio Co. Fort Dodge, Iowa 246
FCJZ S. W. Baptist Theological Seminary Ft. Worth, Tex. 254
FKCA Colo. State Teachers College Greeley, Colo. 273
FKU The University of Kansas Lawrence, Kans. 275
FKZ F. M. Henry Kirkville, Mo. 226
FPL Paul E. Greenlaw Frankfort, Ky. 234
FPLP Everett M. Foster Cedar Rapids, Iowa 256
FPLR University of New Mexico Albuquerque, N. M. 254
FPLU San Benito Radio Club San Benito, Texas 236
FPLV Swedish Evangelical Church Rockford, Ill. 229
FPLX George Roy Clough Galveston, Texas 246
FLAZ Atlantic Automobile Co. Anita, Ia. 273
FMB Christian Churches Little Rock, Ark. 254
FMQ University of Arkansas Fayetteville, Ark. 300
FMRR Morningside College Sioux City, Iowa 261
FMW M. G. Sateren Houghton, Mich. 263
FMX Carleton College Northfield, Minn. 337
FMF Henry Field Seed Co. Shenandoah, Iowa 263
FMG Wonien's Radio Shop Coldwater, Miss. 254

KFOA Rhodes Department Store Seattle, Wash. 454
KFOB Chamber of Commerce Burlingame, Calif. 226
KOFN Electophone Radio Shop Long Beach, Calif. 233
KFOO Latter Day Saints University Salt Lake City, Utah 236
KFOP Rohrer Elec. Co. Marshallfield, Ore. 240
KFOV David City Tire & Electric Co. David City, Neb. 226
KFTC College Hill Radio Club Whita, Kans. 231
KFOX Board of Education, Tech. High School Omaha, Nebr. 248
KFOY Beacon Radio Service St. Paul, Minn. 252
KFG Garretson and Dennis Los Angeles, Calif. 238
KFFP C. C. Baxter Dallas, Texas 252
KFFM The New Furniture Co. Greenville, Texas 242
KFFP Los Angeles County Forestry Dept Los Angeles, Calif. 251
KFTP Cape & Johnson Salt Lake City, Utah 286
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KFYY The Searchlight Publishing Co. Fort Worth, Texas 263
KFOH Radio Service Co. Burlington, Calif. 213
KFOJ G. S. Carson, Jr. Iowa City, Ia. 224
KFRU W. Riker Holy City, Calif. 217
KFMW C. F. Knierim North Bend, Wash. 216
KFOZ Taft Products Co. Hollywood, Calif. 226
KFBR Hall Bros. Beverly, Texas 248
KFGC City of Paris Dry Goods Co. San Francisco, Calif. 268
KFRU Stephens College Columbia, Mo. 500
KFW United Churches of Olympia Olympia, Wash. 219
KFGS Echo Park Evan. Assn. Los Angeles, Calif. 275
KFUS Thomas Groggan & Bros. Music Co. Galveston, Texas 258
KFUO Concordia Seminary St. Louis, Mo. 545
KFUP Fitzsimmons General Hospital Denver, Colo. 234
KFUO Julius Brunton and Sons Co. San Francisco, Calif. 234
KFUN Peery Bldg. Co. Ogden, Utah 256
KFUS Louis L. Sherman Portland, Ore. 256
KFUT University of Utah Salt Lake City, Utah 261
KFVD Colburn Radio Labs. San Leandro, Calif. 224
KFUV 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
KFVI Whan Radio Shop Manhattan, Kans. 219
KFVL Headquarters Troop, 56th Cavalry Houston, Texas 240
KFVN Carl E. Bagley Welcome, Minn. 227
KFVO F. M. Henry Kirkville, Mo. 226
KFVR Moonlight Ranch Route 6, Denver, Colo. 244
KFVS Cape Girardeau Battery Station Cape Girardeau, Mo. 224
KFVW Airian Radio Corp. San Diego, Calif. 246
KFVY Radio Supply Co. Albuquerque, N. M. 250
KFWA Browning Bros. Co. Ogden, Utah 261
KFWB Warner Brothers Hollywood, Calif. 252
KFWC L. E. Wall San Bernardino, Calif. 211
KWFH St. Louis Truth Center St. Louis, Mo. 215
KWFH F. Wellington Morse, Jr. Chico, Calif. 245
KWFJ Radiote Telecommunications Inc. South San Francisco, Calif. 226
KFWM Oakland Educational Society Oakland, Calif. 207
KFWO Lawrence Mott Avalon, Calif. 211
KFWW Louisiana College Pineville, La. 238
KFWL Wilbur Jerman Portland, Ore. 213
KFXA Bertram O. Heller Big Bear Lake, Calif. 224
KFXC Santa Maria Valley Railroad Co. Santa Maria, Calif. 210
KFXD L. H. Strong Logan, Utah 258
KFXF Pike's Peak Broadcasting Co. Colorado Springs, Colo. 210
KFXH Bledsoe Radio Company El Paso, Texas 242
KFXI Mt. States Radio Dist. Inc. (Port. Sta.) Denver, Colo. 240
KFXM Neches Electric Co. Beaumont, Texas 227
KFXR Classen Film Finishing Co. Oklahoma City, Okla. 214
KFXY Mary M. Costigan Flagstaff, Ariz. 205
KFFY Carl's Radio Den. Oxnard, Calif. 205
KFFY Chronicle Publishing Co. Houston, Texas 238
Just Hear A
QUAM SPEAKER
With the Silver Drumhead Diaphragm

It is far superior to any other loudspeaker in tone quality, volume and enunciation, due to an entirely new principle of diaphragmatic construction—the Silver Drumhead.

This Silver Diaphragm is only three one-thousandths of an inch in thickness, stretched tightly over a brass ring and adjusted to a sensitivity that responds to the slightest impulse. A small silicon steel disc is welded to its center to receive the impulses from the magnets. The extreme thinness of the silver, coupled with its well known musical qualities and tuning to the proper pitch, permits it to vibrate so fast that its reproduction of speech and music is perfect and sets an entirely new standard in radio reproduction.

Non-vibrating, semi-hard rubber horn, finished in mahogany and cast aluminum tone throat in russet crackle, make for a beautiful appearance as well as perfect reproduction of sound.

Manufacturers—Write us for our special proposition on Quam Units. They will improve your receiving sets 100%.

QUAM RADIO CORPORATION
1925 So. Western Ave., Chicago, Ill.

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 affect 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 since the beat notes produced may be radiated from the receiver 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)
<table>
<thead>
<tr>
<th>Call Letters</th>
<th>Company/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>WABW</td>
<td>College of Wooster, Wooster, Ohio</td>
</tr>
<tr>
<td>WABZ</td>
<td>Coliseum Place Baptist Church, New Orleans, La.</td>
</tr>
<tr>
<td>WADC</td>
<td>Allen T. Simmons (Allen Theatre), Akron, Ohio</td>
</tr>
<tr>
<td>WAFD</td>
<td>Albert B. Parot, Port Huron, Mich.</td>
</tr>
<tr>
<td>WAHG</td>
<td>A. H. Grebe &amp; Co., Richmond Hill, N. Y.</td>
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<tr>
<td>WAIU</td>
<td>American Insurance Union, Columbus, Ohio</td>
</tr>
<tr>
<td>WAMD</td>
<td>Hubbard &amp; Co., Minneapolis, Minn.</td>
</tr>
<tr>
<td>WAPI</td>
<td>Alabama Polytechnic Institute, Auburn, Ala.</td>
</tr>
<tr>
<td>WBAA</td>
<td>Purdue University, Lafayette, Ind.</td>
</tr>
<tr>
<td>WCBC</td>
<td>Clemson Agric. College, Clemson College, S. C.</td>
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<tr>
<td>WBCN</td>
<td>The Dayton Co., Minneapolis, Minn.</td>
</tr>
<tr>
<td>WBKK</td>
<td>Pennsylvannia State Police, Harrisburg, Pa.</td>
</tr>
<tr>
<td>WBAA</td>
<td>James Millikan University, Decatur, Ill.</td>
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<tr>
<td>WBAL</td>
<td>Consolidated Gas &amp; Elec. Co., Baltimore, Md.</td>
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<tr>
<td>WBAS</td>
<td>Workam-Carter Pub. (Star Telegram), Ft. Worth, Texas</td>
</tr>
<tr>
<td>WBAY</td>
<td>Erner &amp; Hopkins Co., Columbus, Ohio</td>
</tr>
<tr>
<td>WBAX</td>
<td>John H. Stenger, Jr., Wilkes-Barre, Pa.</td>
</tr>
<tr>
<td>WBAX</td>
<td>Western Electric Co., New York, N. Y.</td>
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<tr>
<td>WBX</td>
<td>Plymouth Congregational Church, Newark, Ohio</td>
</tr>
<tr>
<td>WBBL</td>
<td>Grace Covenant Presbyterian Church, Richmond, Va.</td>
</tr>
<tr>
<td>WBBM</td>
<td>Atlass Investment Co., Chicago, Ill.</td>
</tr>
<tr>
<td>WBBN</td>
<td>Blake, A. B., Wilmington, N. C.</td>
</tr>
<tr>
<td>WBBP</td>
<td>Petoskey High School, Petoskey, Mich.</td>
</tr>
<tr>
<td>WBBBB</td>
<td>People's Pulpit Assoc., Rossville, N. Y.</td>
</tr>
<tr>
<td>WBBR</td>
<td>First Baptist Church, New Orleans, La.</td>
</tr>
<tr>
<td>WBBX</td>
<td>Ruffner Junior High School, Norfolk, Va.</td>
</tr>
<tr>
<td>WBCN</td>
<td>Foster &amp; McDonnell, Chicago, Ill.</td>
</tr>
<tr>
<td>WBEA</td>
<td>Bliss Electrical School, Tacoma Park, Md.</td>
</tr>
<tr>
<td>WBKY</td>
<td>Shirley Katz, New York, N. Y.</td>
</tr>
<tr>
<td>WBOQ</td>
<td>A. H. Grebe &amp; Co., Inc., Richmond Hill, N. Y.</td>
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<tr>
<td>WBR</td>
<td>Pennsylvania State Police, Butler, Pa.</td>
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<tr>
<td>WBCR</td>
<td>Bell Radio Corporation, Birmingham, Ala.</td>
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<tr>
<td>WBCT</td>
<td>Charlotte Chamber of Commerce, Charlotte, N. C.</td>
</tr>
<tr>
<td>WOAG</td>
<td>Connecticut Agricultural College, Mansfield, Conn.</td>
</tr>
<tr>
<td>WCG</td>
<td>St. Lawrence University, Canton, N. Y.</td>
</tr>
<tr>
<td>WCA</td>
<td>Kaufmann &amp; Beier Co. &amp; The Flits, Pittsburgh, Pa.</td>
</tr>
<tr>
<td>WCGE</td>
<td>Nebraska Wesleyan University-University Press, Lincoln, Neb.</td>
</tr>
<tr>
<td>WCAJ</td>
<td>St. Olaf College, Northfield, Minn.</td>
</tr>
<tr>
<td>WCAO</td>
<td>A. A. and A. S. Brager, Baltimore, Md.</td>
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<tr>
<td>WCAP</td>
<td>Chesapeake &amp; Potomac Tel. Co., Washington, D. C.</td>
</tr>
<tr>
<td>WCAR</td>
<td>Southern Radio Corp. of Texas, San Antonio, Texas</td>
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<tr>
<td>WCAT</td>
<td>State College of Mines, Rapid City, S. Dak.</td>
</tr>
<tr>
<td>WCAE</td>
<td>University of Vermont, Burlington, Vt.</td>
</tr>
<tr>
<td>WBCEA</td>
<td>Harvard, Mass.</td>
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<tr>
<td>WCBE</td>
<td>Wilbur C. Vol. Va., Zionsville, Ind.</td>
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<tr>
<td>WBCH</td>
<td>Marlton, N. J.</td>
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<tr>
<td>WCBH</td>
<td>University of Virginia, Oxford, Mo.</td>
</tr>
<tr>
<td>WCBM</td>
<td>Charles Swarts, Baltimore, Md.</td>
</tr>
<tr>
<td>WCBQ</td>
<td>First Baptist Church, Nashville, Tenn.</td>
</tr>
<tr>
<td>WCBX</td>
<td>Department of Commerce, Providence, R. I.</td>
</tr>
<tr>
<td>WCBY</td>
<td>Radio Shop of New York (H. Lubinsky), Newark, N. J.</td>
</tr>
<tr>
<td>WCCO</td>
<td>Washburn-Crosby Co., Anoka, Minn.</td>
</tr>
<tr>
<td>WCEE</td>
<td>Liberty Weekly, Elgin, Ill.</td>
</tr>
<tr>
<td>WCLK</td>
<td>C. E. Whitmore, Camp Lake, Wis.</td>
</tr>
<tr>
<td>WCLC</td>
<td>H. M. Couch, Joliet, Ill.</td>
</tr>
<tr>
<td>WCLR</td>
<td>Henry P. Rines, Portland, Me.</td>
</tr>
<tr>
<td>WCSO</td>
<td>Wittenberg College, Springfield, Ohio</td>
</tr>
<tr>
<td>WCO</td>
<td>W. C. Selene (Portable), Providence, R. I.</td>
</tr>
</tbody>
</table>
A Simple Frequency Wave Meter

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.
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
WGBY  D. W. May, Inc.  Newark, N. J.  252
WGHG  B. Holmes Developments  Clearwater, Fla.  268
WGHG  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  Central 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  Marquette Univ. & Milw. Journal  Milwaukee, Wis.  275
WHAF  Haier Supply Co.  Joplin, Mo.  263
WHAP  Univ of Rochester (Eastman S. M.)  Rochester, N. Y.  278
WHAR  W. H. Taylor Finance Corp.  Brooklyn, N. Y.  240
WHAR  College House  Atlantic City, N. J.  275
WHAS  Courier-Journal & Louisville Times  Louisville, Ky.  400
WHAT  Dr. George W. Young  Minneapolis, Minn.  263
WHAT  Wilkinson Radio Specialty Co.  Wilmington, Del.  268
WHAZ  Rensselaer Polytechnic Institute  Troy, N. Y.  379
WHB  Sweeney School Co.  Kansas City, Mo.  366
WHBC  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  Belleville, Ohio  222
WHBF  Bedfords Speciality Company  Rock Island, Ill.  222
WHBG  John S. Skane  Harrisburg, Pa.  313
WHBJ  Culver Military Academy  Culver, Ind.  222
WHBJ  Lauer Auto Co.  Ft. Wayne, Ind.  234
WHBK  Franklin St. Garage, Inc.  Ellsworth, Me.  225
WHBL  James H. Slusser  Logansport, Ind.  216
WHBM  C. L. Carrell, Portable Station  Chicago, Ill.  223
WHBN  First Ave. Methodist Church  St. Petersburg, Fla.  240
WHBQ  St. John's M. E. Church South  Memphis, Tenn.  268
WHBP  Johnstown Automobile Co.  Johnstown, Pa.  256
WHBU  Riviera Theatre & Bing's Clothing  Anderson, Ind.  219
WHBW  D. R. Kienzel  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  Cleveland, Ohio  273
WHN  George Schubert  New York, N. Y.  361
WHO  Banker's Life Co.  Des Moines, la.  526
WHT  Radiophone Broadcasting Corp  Deerfield, Ill.  238
WHT  Radiophone Broadcasting Corp  Deerfield, Ind.  400
WIAF  Howard R. Miller  Philadelphia, Pa.  250
WIAO  Chronicle Publishing Co.  Marion, Ind.  26
WIAE  Home Electric Co.  Burlington, Iowa  254
WIBA  The Capital-Times Station  Madison, Wis.  238
WIBG  St. Paul's Protestant E. Church  Elizabeth, N. Y.  222
WIBH  Elite-Radio Stores  New Bedford, Mass.  210
WIBR  Frederick B. Zittel, 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, Va.  246
WIBS  New Jersey Nat'l Guard Hqs. Co.  Elizabeth, N. J.  203
WIBU  The Electric Farm  Poyette, Wis.  222
WIBW  Dr. L. L. Dill  Logansport, Ind.  220
WIBX  Grid-Lake, Inc.  Utica, N. Y.  205
WIBZ  A. D. Trumbull  Montgomery, Ala.  231
WIL  Benson Radio & The Star  St. Louis, Mo.  273
WIOD  Wonderful Island 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-two 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 used from the lists were small or inactive stations with low power and short ranges. Practically none of the larger or high-powered stations have shut down in the past few months, with the result that interference between stations is about the same as before.

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 1921 laws nor the proposed bill for radio regulations provides for investigations or testing any other form of interference.

If fans are a little patient, it is pointed out, interference between stations will 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-an- nouncer of World Battery Station WSB.

Dave has long been partial to the artist himself, through 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 explains 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.

THE BIG LITTLE THINGS OF RADIO

As an owner of a radio set you should demand two things: (1) Volume on the weakest signal, (2) Tone quality that makes criticism impossible and excuses or qualifications unnecessary. Why sacrifice one for the other? Demand both. Today it is a simple matter to have both.

It is easy to get volume but there is only one way to get quality and volume. Use Resistance-Coupled Amplification in the audio end of your set. We have made this very simple by developing the Daven Super-Amplifier. Or, if you prefer self-assembly, couple up Daven precision-built resistances and mountings as contained in the 3-K Kit. Then you will hear radio at its best.

Three new Daven Products were announced this Fall. The Daven Leakdendenser is a Daven grid leak of permanent and constant value, combined with a grid condenser of fixed capacitance, correct for all makes of detector tubes. Precision-built, simple, effective, uniform and very handsome. A pair of mounting clips included.

The new Daven High Mu Tube Type MU-20, used with the Daven Super-Amplifier, is designed to give 50% more volume—6 volt, 1/2 ampere. The Daven Power Tube Type MU-6 is for use in the last or output stage of any set regardless of the method of amplification used—6 volt, 1/2 ampere.

The new Daven Special Type "A" Condensers are the latest development of Daven Engineers. Their use in Resistance Coupled Amplifiers gives you 50% more volume than ordinary condensers.

The Resistor Manual is the "A. B. C." of Resistance Coupled Amplification—a complete handbook for designers and builders. Send for it.

Daven PRODUCTS ARE SOLD ONLY BY GOOD DEALERS

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Please send me the following on Resistance Coupled Amplification:

[ ] Resistor Manual. 30c is enclosed. (Check One) [ ] Complete Catalog (free)

Name

Address

To Dealers: May we have our nearest distributor communicate with you?

FLINT AUDIO TRANSFORMER $3.50

1. CLEARNESS 2. VOLUME 3. DISTANCE 4. APPEARANCE 5. PRICE

Circular Upon Request FLINT RADIO CO. 1842 Wilson Ave., Chicago

$1.50 FOR YOUR OLD RADIO TUBES regardless make or condition, toward purchase of each new standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. AGENTS WANTED.

SUPER-SERVICE LABORATORIES, Dept. 52 Room 36, 39 W. Adams St. CHICAGO, ILL.

FREE Send No Money

Pay postage after stamps and FREE album arrive. We pay postage if you prefer to pay with order. Money refunded if not DELIGHTED.

DEALERS WANTED. Field order today—Now. Postal will do.

IDEAL CO., Dept. 2323, 366 Wrigley Bldg., Chicago

Please mention Radio Age when writing to advertisers.
Chicago Battery Co., Peoria St., Chicago

FAMOUS for unsurpassed quality, guaranteed long-lived service and unvarying dependability, Chicago Batteries offer the Radio fan the "Peace that comes from years of experience and mastery correlated with the finest materials available. Enforced and approved by leading Radio and Automobile authorities, Chicago Batteries in their new non-leak, solid rubber case represent an amazing value at lowest cost.

PRICES
Solid Rubber Case Radio Batteries
6 volts, 100 Amperes...$8.79 4 volts, 120 Amperes...$10.79
6 volts, 140 Amperes...$12.50
GUARANTEED 2 YEARS
Solid Rubber Case Auto Batteries
6 volts, 11 plate...$9.79 6 volts, 12 plates...$10.79
11 volt, 7 plate, A. M. $12.50
S A V E M O N E Y— O R D E R D I R E C T
Buy Chicago Batteries direct from the manufacturer. Batteries are order will be shipped the same day. Expense of mailing is 25c.

CHICAGO BATTERY CO., 1204 Peoria St., Chicago

RADIO CABINETS—
We have a large stock of cabinet material, semifinished, available for quick shipment during the present season. Panel sizes adaptable, range from 5 1/2 to 8 inch width and 18 to 24 inch in length. Prices reasonable. Write or wire inquiry for your requirements.

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Indianapolis, Ind.

Bakelite Sockets
Aid clear reception. Write for Booklet 31
BAKELITE CORPORATION
147 Ave. New York, N. Y.
Chicago Office: 636 West 22nd Street

The 1926 Annual is Out.
Get Your Copy Now

Venl lVidi Vici—By Radio
(Continued from page 27)
announcement monthly, containing the programs for the succeeding month. 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 A. Y. Van Leeuwen, principal flutist, and a musician of international distinction, as the conductor.

This orchestra has been particularly valuable in the working out of containing 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 subtility 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 to a part on "Eden Park." 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 form. Again another, and perhaps one of the most unique programs ever arranged in radio history, was "Governor's 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 are: Grace Krens, soprano; Ethel Jones, contralto; Fred Patton, baritone; Jane Upperman, soprano; Alma Beck, contralto; Dan Beddoo, Cincinnati's famous Welsh tenor; Jan Van Bommel, Dutch tenor; Theodore Ritch, Russian tenor; Mr. Smith, organist for the Cincinnati Symphony Orchestra; Frederic Monisch, pianist; Melville Liszniewska, 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 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, and some from far quarters. Never have more happy hours provided. They are an acknowledgment 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 a record for the most unique programs ever arranged in radio; and the letters are testimony that it has at least partly succeeded.
### Dominion of Canada

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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 one single insertion. Liberal discounts are allowed on three, six, and twelve-insertion groups. Five, fifteen, and thirty percent respectively are allowed when 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.

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Sell Five Tube Radio Sets. Thirty days free trial. Three years' experience necessary. DAILY RATES, 157-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 Phonographs, Radios, Perfumes, Toilet Articles, etc. Write today for money-making plans. American Products Co., 3535 American Bldg., Cincinnati, Ohio.

Agents make $90.00 weekly. Distribute quality food and toilet preparations among friends and neighbors. No previous experience necessary. Five minutes for actual work. DRAK BGS. Health Products Co., Cincinnati, Ohio. Agents Wanted VANCY Guaranteed Radio Tubes with insurance protection on all types BEST BETS are available. Sample tube $1.00 each Post Paid. Send cash or money order. Van Chief-Deforest Radio Co., Great Kills, S. I., N. Y.

FORDS. 60 miles on one gallon of Gas. It has been proven with miles tests. It is made. A RADIO puts hundreds of competitors out of business. You can do as well or better. Write today for catalog and discounts. Name your own. Westland Radio Co., 1657 N. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electric Installations-Makes more money than he has ever made on any other commission calls. Additional lines carrying volume business, as we cater to Bell Telephone. Edsallton, 1504 McCormick Bld., Chicago.

MAN wanted for this territory to sell wonderful radios. Name is famous. You will do better than you ever did before. Write today. Tanners Mfg. Co., 1354C St., Boston, Mass.


RADIO SALES-AGENTS IN every county write. Grenner Radio, 1479 Haddonla, St. Louis, Mo.

"B" BATTERIES


BOOKS AND MAGAZINES


EXPERIMENTAL RADIO by R. R. Ramsey, Professor of Physics Indiana University. The only scientific experimental manual. Enthusiastically endorsed by the principal scientific papers of the world. Used in colleges, universities and government schools. For use, education, and profit. Price $2.00 post paid. Hugh Ramsey, Bloomington, Indiana.

ELECTRICAL MEN, LOCATE TROUBLE OR ELECTRICAL APPARATUS. PRACTICAL EXPLANATION WITH ILLUSTRATIONS. GREAT HELP TO GUIDE MEN IN THE TRADE. Complete text 30c. Address W. S. Sales & Trading Company, 1445 Broadway, New York, N.Y.

BUSINESS OPPORTUNITIES


$100 weekly. We want experienced Radio men to operate branch establishment plants. Part of our staff will go at same time. Barist Radio Co., 73 Tilly Street, Dept. A N, Brooklyn, N. Y.

CRYSTALS

Supersensitive Galena Crystals. Bound 75c prepaid. AKEMITE. All conditions Crystals 50c. Baskett, Groveland, Jolin, Missouri.

DOGS

BEAUTIFUL REGISTERED PUPPIES. Bulls, 501 Rockwood, Dallas, Texas.

HELP WANTED

RADIO SALES-AGENTS AND SET BUILDERS. We need you and you need us. If you are reliable and well known in your community, we will make you our representative and furnish you with standard well represented and furnished. You will be enabled to sell at a handsome profit. Write us for details and sales plan. Westland Radio Co., 1657 N. State St., Chicago, Ill.

MEN want forest ranger, railway clerk and other government positions, write for free particulars of work. Mokana, Dept. B-32, 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 is looking for people whose products are nationally advertised and who are always wants new Radio devices to sell. Will pay a liberal price for invention which is sound and saleable. Address Mr. R. F. DeVine, Room 1022, 116 West 52nd 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 Conner, (Composer) A.M.N., New Jersey.

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

PATENTS

FOR SALE: U. S. and Canadian Patents on an Attachment for Phonograph which is very useful and profitable in sale of phonographs. Address Cha's, F. Smith, Huff, N. Dak.

Radio Age Classified Ads Brings Results

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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**

**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.

Price, 2 to 1, $5.00
4 to 1, 5.75

**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, 75¢ 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 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.

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.  G. 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.  G. Central Standard Time.  G. Authorized Wave Length, 322.4 Meters.

Zenith Radio Corporation
Straus Building, Chicago

They Cost More—But They Do More!