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The Empty Cup

IN THIS ISSUE: The Bernard Portable—A Compact "B" Supply, by Lewis Winner—Grid Biasing Explained, by J. E. Anderson—How to Get DX, by Capt. P. V. O'Rourke—The Effect of Tubes and Speaker on Quality, by Dr. Alfred N. Goldsmith—Complete List of Stations.

Both Dials Synchronize

FIG. 3.

The panel is simplicity itself—simplicity of control and of appearance. The modulator dial is at left, the oscillator at right. The rheostat is in the middle.

LIST OF PARTS

Two Type 247-N General Radio variable condensers, C1, C2.

One Sickles coil, 3-circuit type, L1, L2, L3.

One 7x18" Bakelite panel.

Eight Klosner Model X sockets.

Two Micamold .00025 mfd. grid condensers, with 2 meg. grid leaks built in, C3R2, C4R3.

Two Type 271 General Radio Medium Frequency Transformers, MF1, MF2.

One Type 331 General Radio tuned transformer, MF3.

One 6-ohm Centralab or G.R. rheostat, R1.

Four phone tip jacks, PTJ1, PTJ2.

Two Marco 4" counterclockwise dials.

Three audio-frequency transformers (Meloformers), AF1, AF2, AF3.

The accessories will be enumerated and discussed next week.

it is isolated from the rest of the wiring. The tubes (1) and (2) take care of the frequency conversion, which is the distinguishing characteristic of the Super-Heterodyne. There are only two stages of intermediate or medium frequency amplification, instead of the usual three, because the receiver proved sensitive and selective enough in that form. Theoretically, a tube was taken from the medium frequency channel and placed in the audio channel, so that instead of three medium frequency stages of amplification there were two, and instead of two stages of audio amplification there were three. The second detector (5) and the three audio tubes (6). (7) and (8), account for the rest of the tubes in the circuit.

The Division Idea

The set was built on a plan which contemplated the use of the reboxed receiver at home when portable days had passed into memory lane, hence was placed on a baseboard in conjunction with a 7x18" panel. Instead of being in one unit, the set and equipment were in separate compartments, each of which could be independently carried. This idea proved a happy one, although it is not necessary for any one to follow it who disagrees with the division of the load. Any portable set is bound to weigh quite too much to be carried by hand for any considerable distance, especially over rough country, and as one seldom travels alone it is well to have the set so arranged that one person may carry the receiver proper and the other the compartment containing batteries, loop, etc. We used to drive to within five-eighths of a mile of our camp and park the car in a barn at Farmer Charles Clark's place. Then we would have to hike over the hill and cross two high stone fences to reach our destination. While Capt. O'Rourke never showed any great enthusiasm for the division of labors made possible by the split portable, I rather fancied the idea and used to encourage him to accept the batteries, etc., as his load, on the plea that the receiver itself, with the precious eight tubes therein, required my special care.

The Question of Weight

Any portable Super-Heterodyne, with all equipment included, even when contained in a single unit, may be expected to weigh at least 35 pounds. Of course, persons do not travel the countryside toting an object by hand, but most usually go by car, or by train or boat, so that the actual hand carrying is reduced to a minimum. But that minimum may be altogether too large to leave one comfortable after the necessary hike, unless there is an advantage in a division of the load. Besides, the split portable may be transformed into one unit by the simple expedient of strapping, and it is consoling to think that the option of division is ever available.

The wiring of the set is very simple in point of electrical work, although the necessarily crowded quarters may occasion some mechanical inconvenience to those whose experience has been along the line of sets with wide-open spaces behind the panel. But the photographs of the set will elucidate these points sufficiently to guide even the novice.

Circuit Diagnosis

On the electrical side, we see that the first tube is what looks like, and really is, a stage of tuned radio frequency amplification, at the signal frequency—the wavelength of the station that is being tuned in. This frequency gets no farther than the input into tube (1), because an oscillator hookup is operated in conjunction with this original frequency, the oscillator frequency being produced by tube (2) in conjunction with its tuned circuit, C2L2. This locally generated frequency is mixed with the frequency of the broadcasting station to produce the intermediate frequency, in this case 30 kilocycles (10,000 meters). This is the output of tube (1) and it passes through two medium frequency stages where iron-core transformers are the coupling media. These are General Radio 271 Medium Frequency Transformers. The input to the second detector (5) is achieved through a tuned medium frequency transformer of air core design (General Radio 331). This is a sharply tuned transformer, with a fixed condenser built in, neither visible on the

(*Concluded on page 22*)

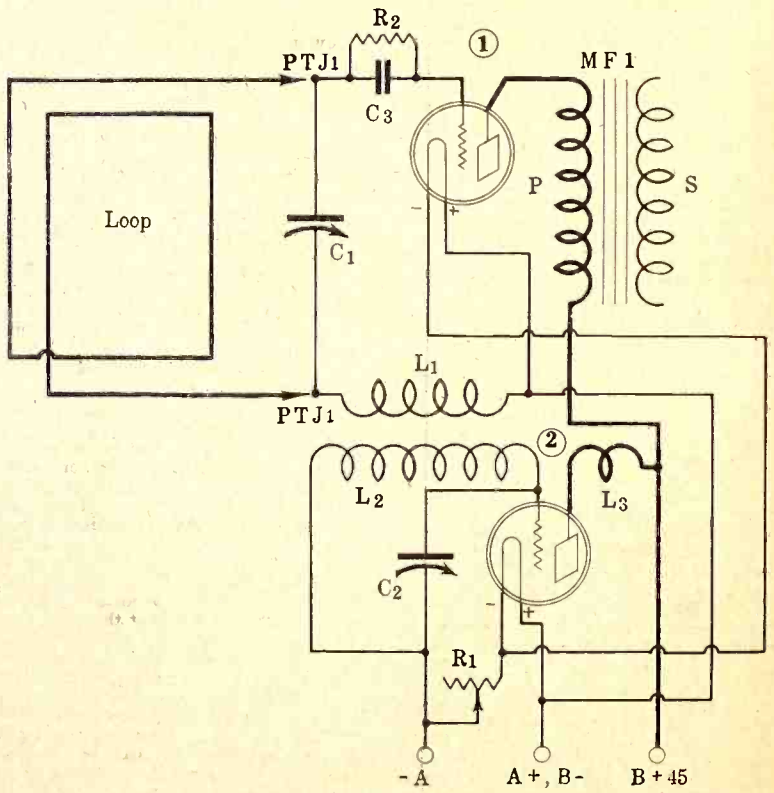


FIG. 2

The frequency converting system of the Bernard Portable, exactly coinciding with the representation in Fig. 1, but rearranged and isolated for those whose experience with Super-Heterodynes is limited.

How to Get DX

By Capt. P. V. O'Rourke

THE keenness for hearing stations thousands of miles away is numerically stronger than it ever was. While in some individual cases interest in DX may be abating, the ever increasing population of radio ranks keeps the numerical strength of the DX hounds very great indeed, hence it is premature to suppose that the lure of DX has passed away. Why, it even reposes in the bosoms of folk who do not know that DX stands for distance!

Perfect proof of the great interest in DX may be obtained from any manufacturer of radio receivers. One of the most frequent questions from prospective purchasers of sets is:

"Will this receiver bring in distance?"

If the seller says it will, and the purchaser is unable to make distant stations plainly audible, an inevitable clash takes place, and often as not the purchaser himself has stood in the way of success. Nearly all receivers commercially marketed today, as well as sets in the home-constructed class, can get DX. Some, of course, succeed better than others, but there are items to consider that will enable one to get best distance results from any particular set.

Tuning Skill Necessary

First of all, skill in tuning must be developed. This is not hard to acquire, but enough experience is necessary so that one learns to appreciate what fine tuning is necessary to bring in a far-off broadcaster. Many persons condemn a receiver because it does not bring in DX, whereas it will do so if properly tuned. Local stations are very easy to tune in, because of the power input into the receiver. Except where one suffers from shielding or

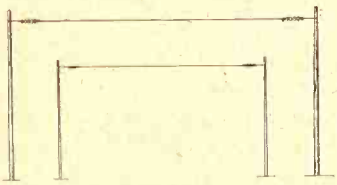


FIG. 1.

The larger and higher aerial improves the chances of receiving signals from distant stations, but within limits set forth in the text.

other forms of absorption, a local station will come pounding in, and it is hard to miss bringing it in, rather than hard to tune it in. Hence when one changes from the sphere of locals to the fascinating hunt for distance, he should remember that conditions will be entirely different. This is due to the weak power at the input, the radio wave being partly dissipated in its almost instantaneous travel from the station to the receiver. Along the route a thousand factors enter into this consideration, and one must have a receiver that is sensitive to weak signals, if he is to be fortified in his expectations of DX. This degree of sensitivity is obtained in the run of tuned radio frequency sets, in Neutrodynes, Super-Heterodynes and even in 1-tube regenerative sets. However, the 1-tube sets should not be used for DX hunting, because the only way to tune in distance is by causing a beat note—the familiar regenerative whistle that discloses location of the carrier wave. This causes radiation, a form of interference very annoying and unfair to neighbors, hence a stage of tuned radio frequency, neutralized if you like, is advisable ahead of the regenerative detector, as an alleviative.

Tips on Batteries and Tubes

Aside from tuning experience and skill, other considerations which require no structural changes are proper regard for the tubes and the sources that supply them with power. The A battery, if a storage battery, should not be allowed to go down further than a condition of half charge. The B battery voltage, while an uncertain item so far as any general rule goes, should not be maintained for a long period below 17 volts for a 22½ volts battery and 34 volts for a 45-volt battery. As we are remarking upon distance only, we must require battery conditions in excess of those which would be passable for reception of local stations. The tubes should have a good filament emission and function well as amplifiers in particular and should be changed about in the sockets until the tubes are so apportioned to the receiver that each bulb is in a socket where it works best. Those possessing regenerative sets may put tubes to a rather rough but insuring test by placing one after another in the socket where the regenerative tube is to go, and thus find out if perhaps the tube fails to respond to oscillation encouragement. If it is lacking one need not wonder that DX reception has been curtailed or prevented.

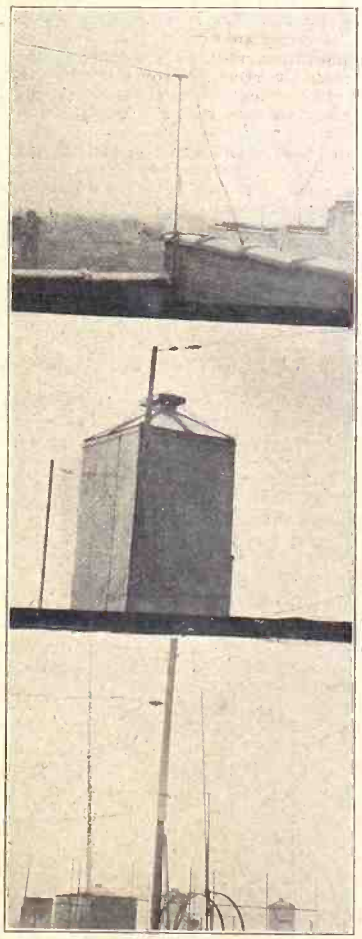
The aerial and ground connections and conditions are very important. Fig. 1 shows a method of improving DX conditions. If your aerial is short and is strung on low masts, or from chimney pot to chimney pot, particularly over a tin roof, you need not be surprised that DX holds aloof. The first requisite is to raise the antenna. That is even more important than lengthening it. Generally, the higher the aerial is from ground potential, the greater its facility for picking up DX. On the point of lengthening the antenna—and this refers to physical length—a condition soon would be approached when broad tuning would set it, and this would hinder rather than help distance reception where one had to tune through locals to get distance. The drowning effect of the locals would prevent one from "stepping out."

Physical vs. Electrical

The physical length of the aerial and its electrical length are two different things, although there exist points of interrelation. The electrical length is represented by the natural period or fundamental wavelength of the antenna. Hence, if an outdoor aerial and a ground are used, the antenna system consists of both of these and all wire used as a part thereof. A 100-foot aerial really would mean that the ground lead, aerial proper and leadin, to the very posts of the set, comprise 100 feet, not that the wire alone that stretches betwen the aerial insulators is 100 feet. For most broadcast reception 100 feet usually is recommended, and is generally satisfactory, but it is better to have a shorter serial, say 75 feet, with the antenna wire proper raised higher than it usually is. In that way you get greater pickup with lesser tendency toward broadness in tuning, while the simple extension of the antenna stretch combines the virtue with the disadvantage. The extension of wire stretched between the insulators makes the antenna proper longer both physically and electrically. Every antenna system has a wave length of its own, and that is the one to which it is most responsive, but it should be kept below the lowest broadcast wave length, as the best compromise.

Some Aerial Pointers

The aerial problem in cities is often a difficult one. Many radio users are content to erect merely some sort of an aerial, and depend on the set to make up any deficiencies. This is asking too much of the set. If the landlord will consent to the erection of antenna masts, these should be used, and 12-foot masts usually will suit admirably. In this way the antenna is at least 12 feet from ground potential, and in most instances considerably more. The distance of the aerial from the earth itself is not the controlling



FIGS. 2, 3 AND 4.

Do not have your leadin close to another one. Do not run your aerial parallel and close to another aerial. (Fig. 2).

A tin-encased skylight is a robber of radio energy. (Fig. 3.)

Use the full height of your mast by moving up the insulator. (Fig. 4.) (Photos by Hayden)

Signposts to DX Stations

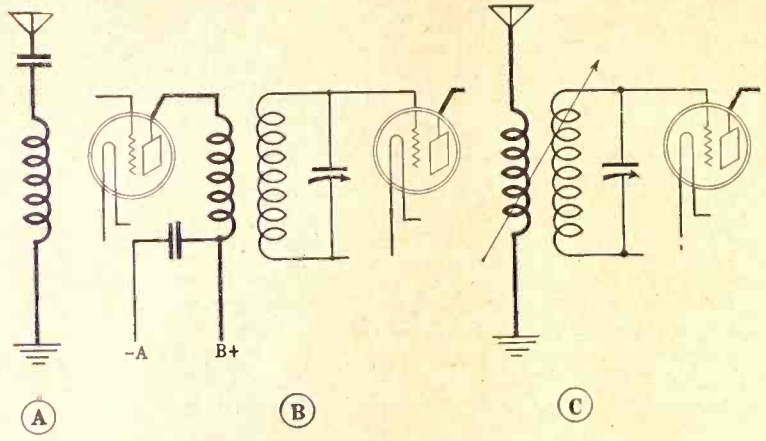


FIG. 5. A represents the antenna series condenser for improving sensitivity. B shows a bypass condenser. C illustrates a variable primary.

factor, for often tin roofs are grounded throughout gutters and outlet pipes, and the roof is the ground in every electrical sense.

In bringing the leadin to the house you should avoid having it come close to somebody else's leadin, and by all means do not have the bare wire resting on the cornice or coping (Fig. 2). Use a leadin insulator, consisting of a brace with a porcelain tip. Nor should one aerial be run parallel to another, especially where the distance between them is only a few feet, for then a condenser effect is produced, and this entails losses. Running the antenna proper near the tin casings of skylights and other objects should be avoided, too (Fig. 3). Where one has a mast he should utilize the full height of it, and not attach the insulator at some point considerably lower. (Fig. 4). That these injunctions frequently are ignored is proven by the photographs of actual aerial conditions on two roofs in New York City. At all hazards, one should comply as nearly as possible with the rules for best electrical results. Although full compliance is difficult in many instances, one should not go out of his way to avoid feasible improvements in the antenna installation. At least he can acquaint himself with the rules and apply them as circumstances permit.

The Ground Connection

The ground connection should be securely made, preferably with a ground clamp or soldered connection to the cold water pipe. Sometimes conditions are improved by using two grounds, one to the cold water pipe, the other to a radiator. Both are used at the same time. Under some conditions this will bring no improvement, due to added resistance.

Soldering to the cold water pipe is difficult, because the solder cools too quickly. Any attempt to get the proper condition of heat should be accompanied by great caution, as the pipe is lead and you might melt it. These are reasons why the ground clamp is by far the favorite method of attachment. The cold water pipe should be filed until bright, and the same should be done with that part of the ground clamp that is to make contact with it. The lead from the clamp to the set should be soldered to the clamp.

The Spring Inspection

Persons with existing aerials should inspect them now, as this is well within the purview of Spring cleaning, and it is the most attractive time of the year to do this work. Many persons in previous years have improved their antenna system in the Spring and obtained better results in April and May than they did during the Winter. This happy condition may be repeated in many instances this year, particularly as DX was somewhat more difficult to get than during the previous Winter. Scientists have different reasons for this, some ascribing the condition to a magnetic blanket over the earth, others to sun spots and still others to the coal strike, which occasioned considerable use of soft or bituminous coal, the smoke of which filled the air with absorbing particles.

As for the electrical length of the aerial, although this is increased by physically lengthening the stretch between insulators, or the ground wire, or both, the natural period or fundamental wave length may be brought down by inserting a series condenser. (Fig. 5A). This is usually placed between the leadin and the antenna post of the set. It should be of smaller capacity than the capacity of the antenna system. Few radio set users know what is the capacity of their antenna system, but a fair average is .00025 mfd., with occasional tendency toward slightly higher capacity. Hence the series condenser, under such circumstances, may be .0001 mfd. or .00015 mfd. Another plan, of course, is to use a variable condenser here, either setting it permanently at the optimum point, or putting it on the panel for variation purposes. Its setting will not be critical, except if the set has a tendency toward over-oscillation or if a distant station is being tuned in.

The greater wave length or frequency separation between the station being received and the natural period of the antenna, the lesser the transfer of energy, hence the smaller the chances of getting DX. The fixed primary, or so-called untuned or aperiodic primary, has become very popular, due to its simplicity and the elimination of a control, but as a DX feature the variable primary, by means of a movable coil (Fig. 5C), or the variable condenser in the aerial circuit, make for greater DX, within certain limits. These limits included the tendency toward free oscillation or condition of unbalance. Receiver design today includes sufficient radio frequency amplification to compensate for the fixed primary. Hence Neutrodynes might be unneutralized by the introduction of the variable primary or antenna series condenser.

A bypass condenser (Fig. 5B) often helps increase sensitivity and volume. This functions strictly as a bypass when connected as shown in the diagram, but if the right-hand side of the fixed condenser is placed instead at the plate (not at the battery end of the interstage coupling primary) a different action takes place, in that feedback is introduced. As a bypass, this fixed condenser, which is across the batteries (A minus and B plus), should be large. Something on the order of .5 or 1.0 mfd. would be suitable. But for connection direct to plate .0005 mfd. or .001 mfd. would be about right. As a bypass, across batteries, the .5 or 1.0 mfd. condenser tends to eliminate audio oscillation due to long leads and stray feed back.

Regeneration As An Aid to DX

As we have passed from the field of operation external to the receiver to a consideration of improvements in the construction of the set itself, we may well consider the advisability of introducing regeneration. This may be accomplished by having a rotary plate coil in inductive relationship to the grid coil of the same tube circuit (Fig. 6A). Regeneration increases the sensitivity of a receiver by enhancing the amplification. In fact it is a form of radio frequency amplification and its effectiveness is derived from the reduction of the resistance in the circuit. If the resistance is too greatly reduced instability results, hence there is a limit to which regeneration may be pressed, and it is impractical to use it in this form in more than one stage in any receiver. Where a rotary coil in the plate circuit is used, as shown in the diagram, the leads may be connected in either fashion—that is, either terminal of the coil to plate, the other to battery—if the tickler has a wide angle of rotation. If that angle is small, reverse the tickler connections as a test for best results. The highest effect is obtained by using the "aiding" method

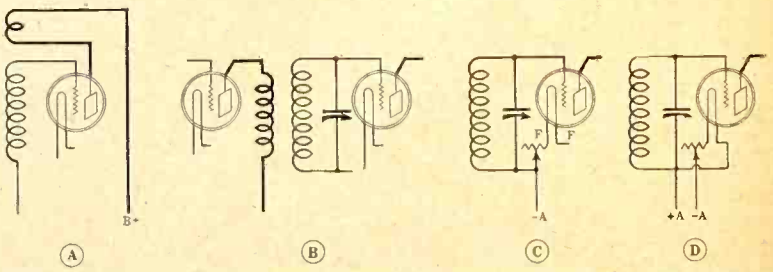


FIG. 6. A tickler coil supplying regeneration, improves sensitivity (A), while a reversal of interstage coupling primary leads (B) helps in many instances. (C) and (D) show the right and a wrong way to connect the grid return in amplifier circuits.

The Magic Key to Distance

FIG. 7. A detector circuit (A) followed by resistance audio, where the plate voltage at R1 is very important. A C battery is shown at (B).

of regeneration, where the two fields are in the same direction. If the wire is wound in the same direction, the leads should be connected in similar manner (plate and grid to beginning of respective coils). If they are connected with fields opposing, negative feedback results. Then the greater the opposition to current flow, the lesser the feedback. By the other method, the greater the coupling the greater the feedback. As simple reversal of connections will bring the solution, no detailed discussion of this is necessary. If the tickler coil rotates through more than 180 degrees, then there is no advantage in reversing connections, since exactly the same effect is gained by reversing the tickler setting, that is, the current flow is in the opposite direction to what it was before. From this it may be deduced that in any radio circuit the direction in which the wire is wound is of no importance or concern, since the correct result always can be achieved by the proper method of connection in respect to the windings as they are. In line with this idea also, reverse the primary leads of an interstage coupler (Fig. 6B) for more stability and voltage.

The Grid Return

Due consideration of the characteristics of tube operation is necessary for proper DX results. In amplifying circuits the grid return should be to negative A. This is the A minus lead of the battery, and if the rheostat is in the negative leg, as it should be, it is not the negative filament post of the socket. The connection for amplifying circuits. (Fig. 6C) takes advantage of the voltage drop across the rheostat to give the grid a negative bias equal to that drop. As the rheostat setting is changed, the bias changes. If a fixed ballast is used, the bias is steady. Granting the use of a 6-volt A battery, minus A represents minus 6, and to this point is connected the grid return side of the coil, while the negative filament is 6 volts minus the drop in the rheostat, say 5 volts, if the drop is 1 volt. As all reckoning is made from the negative filament it can be seen that the grid, due to connection to the coil, is one volt more negative than the negative filament. And that is what the bias means.

The amplifying action of the tube is almost destroyed if the grid return is to positive A (Fig. 6D).

In detector circuits the grid return is to positive A, not as shown in Fig. 6D, however, for a grid condenser and leak are inserted. If it were not for the leak there would be no conductive path from grid to filament, on account of the fixed grid condenser blocking that path. With the rheostat or ballast in the negative leg, F plus and A plus are identical leads, since no resistance is in the line to effectuate the difference.

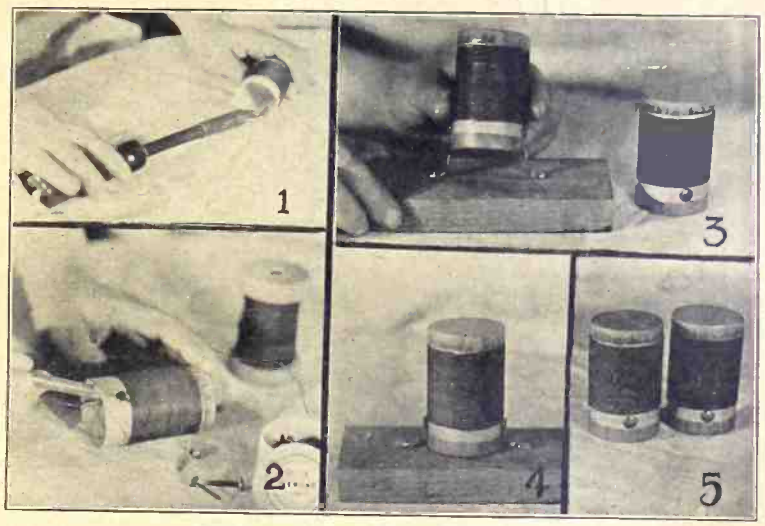
The location of the grid leak and condenser is shown in Fig. 7A, which also illustrates a resistance coupled stage of audio following the detector. On this point it is well to remember that the plate resistor is in the order of 100,000 ohms and that a higher voltage than the usual 22½ or even 45 is necessary at the battery end of the resistor to establish a sufficient actual applied voltage on the plate for best detector action. A resistance of 100,000 ohms, in many such circuits, cuts the B voltage about in half, comparing the battery post with the plate post of the tube, and allowing for the plate resistance.

A C battery, with C plus connected to minus A and with the grid return of the coil to minus C, sometimes helps to render a radio frequency amplifying tube more responsive and sensitive, and may be tried, especially in cases where tubes show signs of sluggish action. (Fig. 7B).

Perhaps the greatest obstacle to DX, so far as parts go, is the oversized primary. Take turns off the primaries (Fig. 6B) of interstage couplers and finally of the antenna coil (Fig. 5C) until that degree of selectivity is gained that makes DX possible.

[*Next week, J. E. Anderson on How to Get DX.*]

Plug-in Coils Made on Cardboard Containers



FIVE steps in making the plug-in coils.

A METHOD of making plug-in coils is shown in Figs. 1 to 5. Drug store containers, made of cardboard, are the forms.

A half-pound spool of No. 22 double cotton covered wire, a board 6" square, a box of thumb tacks, cutting pliers and a soldering iron, complete the equipment to make up the coils. The diameters of these containers are usually 3" or 3¾".

Take the container and wind the desired number of turns (Fig. 1). Place a couple of thumb tacks on one of the bottoms of the containers. Solder leads, as per Fig. 2. Bring the beginning and the end of the windings to the tacks. Now take the piece of wood. Make a circle as large as the diameter of the form. Mark two dots, one directly opposite each other on the outside of the circle. Get a pair of grid leak holders. Screw a holder in on each side. Now insert the portion of the container, where the thumbtacks are placed in the grid leak holders. This is seen in Fig. 4. The coil should fit very snugly and yet be easy to take out, so that quick changes can be made. Fig. 5 shows two completed coils.

Herewith is given the coil data, when using the .00025 mfd., .00035 mfd., .0005 mfd. variable condensers, with the first stated form and wire. The wavelengths from 100 to 150 and 150 to 550 meters may be covered. The primaries always consist of 10 turns. There is a ⅜" separation between the windings.

For the 150 to 550 meter waveband, with the .00025 mfd. variable condenser, the secondary consists of 70 turns, with the .00035 mfd. variable condenser the secondary consists of 60 turns; with the .0005 mfd. variable condenser, the secondary consists of 45 turns.

If the form happens to be a bit larger, say, 3¾", the following data should be used (150 to 550 meters):

With the .00025 mfd. variable condenser, the secondary consists of 66 turns. With the .00035 mfd. variable condenser, the secondary consists of 46 turns. With the .0005 mfd. variable condenser, the secondary consists of 35 turns.

Now for the 100 to 150 meter waveband, using the 3" diameter form, with the .00025 mfd. variable condensers, the secondary consists of 25 turns, with the .00035 mfd. variable condenser, the secondary consists of 21 turns, with the .0005 mfd. variable condenser, the secondary consists of 17 turns.

Using the 3¾" form, with a .00025 mfd. variable condenser, the secondary consists of 22 turns; with the .00035 mfd. variable condenser, the secondary consists of 19 turns; with the .0005 mfd. variable condenser, the secondary consists of 13 turns. When winding the short wave coils, it is advisable to space the windings.

$50 Television Machine for Regular Receivers Is Prophesied for 1928

By Hugo Gernsback, F.R.S.
Editor of "Radio News"

I AM frequently asked this question: "What, in your opinion, will be the next great development in radio?" And to this question I always answer that, in my opinion, the next and most logical step in radio will be the establishment of "television," or the power to see objects at any distance, through the same medium by which we are now enabled to hear sounds by radio from all over the world.

Radio receiving sets have been developed to such a high degree that we need not expect any revolutionary improvements to be made in them for some years to come. The radio receiver is now at the stage of development such as the automobile reached ten years ago. The improvements made since then in the automobile have been only in the refinement of its various parts; and it will prove exactly so with radio.

The Prophecy Explained

So, when I speak of television, I do not predict a novel type of radio set per se, but rather the creation of a device which can be attached to your radio set. It will be similar, in its relation to the present radio set, to the loud speaker, which can be connected to your set, regardless of whether the latter is of the vintage of 1923, or the latest 1926 model.

This may seem to be a rash, offhand statement, but a moment's consideration will show that it is not. For instance, you can listen to a full orchestra with your radio set and (providing you have good transformers and your loud speaker will take both the upper and lower ranges) you will find no trouble in distinguishing the notes of the bass drum from those of the piccolo, even though both are playing at the same time. In other words, you hear simultaneously a number of different instruments with their interfering with each other.

Through the future application of television, it is quite logical that while a station is broadcasting a song, you will be able to see the face of the singer at the same time through a transmission on the same wave to which you are tuned in, for the following simple reason.

Narrow Audible Range

The range of acoustical frequencies is really very narrow, and does not take in a wide band; the human ear responds to no vibrations above a frequency of 23,000 per second. That is the reason why the so-called radio "carrier" is inaudible. To the non-technical listener it may be explained that the "carrier" is the fundamental wave emitted by a broadcast station, which is on the air at all times when the station is transmitting. When no one is speaking or singing at the broadcast studio, you hear nothing but a faint rushing sound in your receiving instrument. The vibrations of this carrier run into millions per second, and that is why we

If, however, television is perfected (as it almost surely will be during the next two years, or perhaps sooner) it will be possible to impress the television impulses upon this same "carrier" which brings the sound impulses to your set.

The television impulses, being of a frequency too high to be audible, will not interfere with your loud speaker; and the television picture for the same reason will not be mixed up with the speech, any more than a violin with a piano, both of which you can readily distinguish with your ear. This is an inadequate comparison, because the separation between the acoustical band or audio frequencies and the radio frequency band is enormously wider than that between any two audible notes of music; and it will therefore be practically impossible for the "sight" waves and sound waves to interfere with each other.

I have pointed this out to bring home the point that, when television is finally brought about, it is quite probable that today's radio sets will be adapted to this new purpose; and that it will be possible to connect a television attachment right to your present set and thereby see what is going on all over the country while you are enjoying the program. Not only will it be possible to see the entertainers at the broadcast station to which you tune in, but everything that is broadcast for sound only, today, will be broadcast by "remote control" for television as well.

A Hint for 1929

It may be possible to witness the inauguration of the next President from anywhere in the United States, as well as hear his address; to see a baseball game, play by play, thousands of miles from the field; to broadcast from the bottom of the ocean and give the distant audience a chance also to see what "Davy Jones' locker" looks like; or by means of a portable outfit in an airship, to look down on cities or even mountains from the clouds, while you are sitting comfortably before your radio set in your library.

Radio television, it must be said, is nearer at hand than most of us realize. The inventors of the entire world are racing frantically for the goal, because they realize that in Television they will have created a great new emancipator much greater than the telephone or radio communication itself.

In this country C. Francis Jenkins has been in the foreground in television experiments; and he has achieved success in making it possible to transmit and receive the outlines of moving objects by radio at the present time. In England, it is reported, John L. Baird, who has been on the same track, has accomplished a great deal; in France Professor Edouard Belin has also produced results, and similar work has been done in many other countries. Television is now "in the air," and I shall be very much surprised if this great new art does not step out of the laboratory into everyday use, sometime in the next two years, or less.

A Great Advance

Back in 1915, and again in 1918, I wrote a series of articles on television which were the first, I believe, published in the technical press. At that time we had only the selenium cell as a "photo-electric" or light-sensitive substance; but it is sluggish and does not follow changes of light with sufficient quickness. It has been superseded recently by some very excellent light-sensitive cells, which react to changes in less than one ten-thousandth of a second; and this improvement makes television an assured possibility today.

We should not be surprised, also, when the final apparatus is evolved, to note with what simple instruments television can be accomplished. It is my belief that the successful device will be simpler and of fewer parts than our radio receivers are today, and it is quite possible that within the next ten years $50 will purchase a complete television attachment which will perform well.

To be sure, for a long time to come, transmission will be only in black and white, giving an effect similar to that seen in motion pictures now. Color transmission will come later.

Direct Sight, Not Pictures

At this point I desire also to correct an erroneous idea about television, which is much in vogue now. Many people think of television as "radio motion pictures." Of course there will be no motion picture equipment of any kind in the radio television apparatus. Television does not concern itself with such methods at all. In reality you will see at a distance, just as if you had a telescope through which you could observe anything going on in any part of the country.

Television between broadcast stations and the broadcast public will become very popular.

(Broadcast from WRNY)

Result of Tally Shows Program Choice of Fans

THE symphony concert is the most popular feature on the air. This was determined by RADIO WORLD's national canvass. Readers balloted by the thousands. Here is the tabulated result of the first five:

	Type	For	Against
(1)	Symphony Concert	1,410	116
(2)	Organ Recital	1,213	108
(3)	Instrumental Duet	1,142	46
(4)	Classic Inst. Solo	1,076	121
(5)	Inst. Trio	1,038	26

One of the surprises for some station managers was the popularity of the organ recital.

What do you suppose happened to jazz? It was the eighth favorite. Ahead of it were the vocal quartet, 1,016 for, 110 against, and the baseball game, 976 to 204.

Band concerts are very little liked, the tally shows, only 271 favoring them, while 26 opposed them. This proved the existence of much indifference to this type of program.

The rest of the tally:

	Type	For	Against
(6)	Vocal quartet	1,016	110
(7)	Baseball game	976	204
(8)	Jazz orchestra	946	321
(9)	Waltz (inst.)	957	32
(10)	Weather reports	951	102

(11) Inst. quartet; (12) brass quartet; (13) football game; (14) vocal duet; (15) classical vocal solo; (16) sermons; (17) world topics; (18) vocal trio; (19) ringside boxing reports; (20) short play; (21) market reports; (21) radio talks, travel; (22) musical comedy; (23) grand opera; (24) musical saw; (25) hockey match; (26) old time music; (27) recitation; (28) bedtime story; (29) band concerts.

The tally clearly shows the trend toward the better class of music at the expense of ephemeral music. This confirms the musically educating influence of radio.

A point not to be overlooked is the variety of favored types of renditions.

Adjustment of Grid Bias

By the Jumping Needle Does One Determine the Right Bias, Using a Milliameter in the Plate Circuit

By J. E. Anderson
Consulting Engineer

BROADCAST listeners and home set builders are just beginning to realize the tremendous importance that the grid bias battery plays in a receiving set. They have been told innumerable times that a little C battery will almost double the life of the plate battery and at the same time make the receiver more sensitive and greatly improve the quality of the voice and music. All of this sounds too good to be true, and naturally the fans have been a little skeptical. On the face of the statement it seems contradictory and of the same variety as the manifestly absurd and contradictory claims made for many commercial radio products. Nevertheless the claims made for the C battery are fortunately true. That little C battery does just about double the life of a large B battery. It does increase the sensitivity or the volume of the set, and it does vastly improve the quality of the signal. And it does perform these functions without itself delivering any power; that is, the life of the C battery in the set is very nearly the same as its life "on the shelf." But in order that it should perform these functions well and to the fullest degree, its voltage must be adjusted very carefully for each tube and for the plate voltage on that tube. How can this voltage be adjusted conveniently?

The Easiest Way

There are several methods by which the grid bias voltage may be adjusted to the correct value, but perhaps the simplest and most convenient is by the use of a milliammeter in the plate circuit of the tube for which the grid bias is to be adjusted. In the left-hand upper corner of Fig. 1 is shown a single tube amplifier having plus B volts on the plate, and in whose plate circuit a direct current is flowing (designated Ip). This current is measured by a milliammeter M inserted in the plate circuit, preferably just below the output device, which may be a headset, a loudspeaker, the primary of a transformer, or a coupling resistance. A grid battery is inserted in the usual place, and it is the voltage E'g of this battery that is to be adjusted. The signal voltage is impressed on the amplifier between the points indicated, either by means of the secondary of a transformer or by the drop in a resistance.

Let the curve ABC in the drawing represent the grid voltage, plate current characteristic of the amplifier. In this curve the grid voltages are measured horizontally along the line AEg and the plate currents are measured vertically from this line to the curve. Thus for a zero grid voltage the plate current is OI-O, or simply I-O; and for a voltage OE-2 the plate current is I-2, etc.

The Needle's Movement

Now suppose that the grid voltage be OE-1 and that no signal voltage is impressed. The plate current as read on the meter is I-1. Now let a signal voltage with a double amplitude of EE-2 be impressed on the amplifier. The grid voltage will then alternately increase from E-1 to E, and decrease from E-1 to E-2. The current in the plate circuit will increase from I-1 to I, and decrease from I-1 to I-2. The signal will therefore cause the plate current to fluctuate between I and I-2. These fluctuations occur so rapidly that the meter, due to the inertia of its moving system, cannot follow them. The needle of the meter remains practically motionless at a position which indicates a mean value of current between I and I-2. But this mean does not coincide with the current for the mean voltage of EE-2, because I minus I-1 is very much less than I-1 minus I-2. The mean of I and I-2 will therefore be somewhat less than I-1, or it will be very nearly equal to I'-2. The signal voltage will therefore cause the meter to move down from I-1 to I'-2. The grid bias OE-1 is obviously not enough. **Hence if the grid bias is not enough, the application of a strong signal will cause a decrease in the milliammeter reading.**

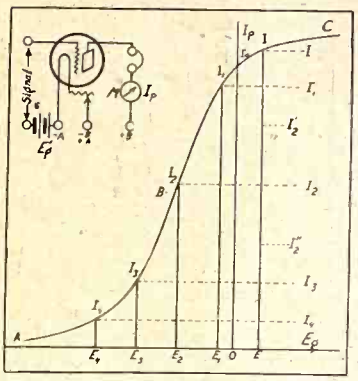


FIG. 1—The circuit diagram, showing insertion of the milliammeter, and beside it, the grid voltage-plate current curve of a vacuum tube.

The Needle Kicks Up

Now suppose that the grid bias be adjusted to have the value OE-3. The current in the meter will then be I-3. Now if the same signal voltage be impressed as before, in this case represented by the double amplitude E-2 E-4, the plate current will alternately decrease from I-3 to I-4 and increase from I-3 to I-2. The increase in this case is much greater than the decrease and as before the meter will indicate the mean between the two extremes rather than the current I-3 corresponding to the mean grid voltage. Now this mean is approximately I''-2, which is greater than I-3. The application of the signal voltage will therefore cause an increase in the meter reading, and this increase is the vertical distance I-3 I''-2. But the grid bias OI-3 is much too great. Hence the rule: **If the grid bias is too great, the application of a strong signal will cause an increase in the meter reading.**

Now suppose that the grid voltage be adjusted to have the value OE-2, that is, so that the operating point is where the curve is steepest. The current in the meter will be I-2. Now let a signal of the same double amplitude as before be impressed on the grid. The grid voltage will then fluctuate between OE-1 and OE-3, and the plate current will fluctuate between I-1 and I-3. In this case the increase in the plate current is exactly equal to the decrease. The mean value, and also the indication on the milliammeter, will therefore be the same as the current corresponding to the mean grid voltage, or it will be I-2. The meter will therefore show no change when the signal is applied. This is the correct grid bias, for here the amplification will be greatest and the distortion, or rectification, will be least. Hence the rule: **If the milliammeter shows no change on the application of a strong signal voltage, the grid bias is correct.**

Greater Amplitude Helps

This method of determining the correct grid bias is easier the greater the amplitude of the impressed signal voltage. On weak signals the increase or decrease is not definite or very easily seen. But if the signal is weak it is not so important to get the exact correct value, because if it is only approximately correct the distortion and the decrease in amplification will be negligible. It is better to make the grid bias just a little too great rather than too large on account of the smaller plate current and consequent smaller drain on the plate battery.

The permanent decrease or increase in the plate current on the application of a signal voltage presupposes uniform amplitude of the signal voltage, that is, uniform modulation of the radio-frequency current. In case of broadcast reception, in which the radio-frequency current is voice and music modulated the signal amplitude does not remain constant, particularly on the audio-frequency end of the receiver, where the present method of determining the grid bias is especially useful. There are moments when the amplitude is very great, and moments when it is very weak, and also moments when it is practically zero. Hence the decrease or increase as discussed above will not be definite for any length of time. The result is that the meter needle will jump around more or less, and it will always jump from that value of plate current which corresponds to the mean value of the grid potential, or that value which corresponds to the permanent grid bias. The amount of jumping will depend on the signal intensity, on the accuracy of the grid bias adjustment, and also on the type of signal. On a prolonged note it may jump down or up and stay a while, but on staccato music and on speech the movement of the needle will be very jerky and indefinite.

An Infallible Rule

But no matter what kind of **loud** signal is received, it is always possible to tell whether to increase or decrease the grid bias, by carefully observing the tendency of the needle to jump. **If it jumps down on a loud passage, the bias is not enough; if it jumps up on a loud passage, the bias is too great; if it does not jump at all, the bias is either correct or else the capacity of the tube is so great as to make a closer adjustment of little importance.**

The best meter for the purpose is a low resistance milliammeter having a range of 0-10 milliamperes, unless a power tube is employed, when a milliammeter of greater range should be employed. In case a meter of this type is not available, the next best is a low resistance, low range voltmeter, such as is used for filament voltage adjustments. A voltmeter measures the voltage across its own terminals. Hence if it is inserted in series with the plate circuit it measures the voltage drop across its terminals, and this is directly proportional to the plate current. If neither of these meters is available, then a plate voltage voltmeter might be used. This is not so good, however, on account of its high resistance. But even at that it is better to use it for adjusting the grid bias than to guess at the correct value.

A Compact B Supply

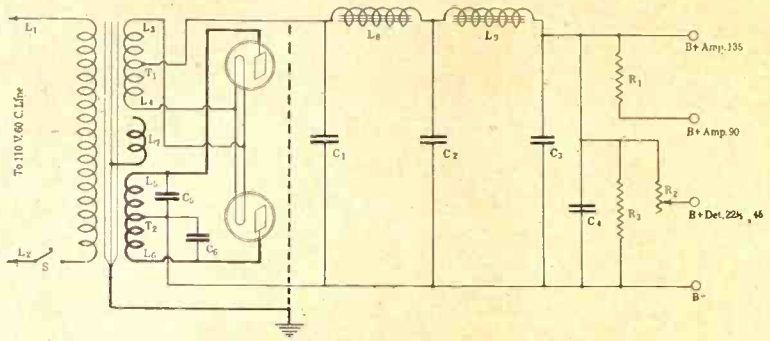


FIG. 1, showing the electrical diagram.

By Lewis Winner

Associate, Institute of Radio Engineers

WITH a few improvements in the original Tectron B battery eliminator circuit diagram and in the parts it was so designed that all the parts used to make up the eliminator could be placed in a cabinet 7¾ in. long, 4 in. wide and 5½ in. high. Heretofore, when parts for making up a B eliminator were placed close to each other, due to induction of circuits, the rectifying value of the tube and the filtering action of the coils and condensers were killed. That is, a hum always persisted, while the voltage output was poor. However, after extensive tests, a special method of placing was evolved. The circuit diagram as shown in Fig. 1 was used. The special placing of the parts is shown in Fig. 2.

Litle Change Necessary

Those who have already constructed the Tectron, and still having a little trouble in eliminating the hum, even after doing all suggested in last week's article, may follow this diagram and have a humless B eliminator. A very important change was fist made in the construction of the step-up transformer. Although the shell type core was employed, it was done only for economy of space. The change made was in the use of a static or inductance shield, placed in between the secondary high and secondary low potential windings. This is indicated by L7 in the diagram. By placing this shield in this particular place the familiar hum was eliminated. This shield keeps the high voltage off the low voltage side, acting also as a filtering by-pass condenser, shunted across the line, in the raw AC side of the line, instead of in the rectified semi-DC side of the line.

Separates Two Sides

The shield or layer of wire separates the high and the low power sides, keeping the field of one secondary from penetrating the field of the other secondary winding, thereby balancing the line and keeping the voltage from fluctuating, which causes the hum, due to the change in the inductance and capacity of the line, which necessitates the changing of the filtering medium. It is indeed a small item, but look at all the trouble avoided. The by-pass condensers shunted across the plate secondary winding tend to do the same thing, but do not fully accomplish the job. The metal shield, which is indicated by the dotted lines, prevents the fields of the AC line from penetrating those of the filtered portion, which otherwise would happen and cause a hum. The placing of the parts, so that both these portions of the circuit are so well separated, is a big step in the elimination of the hum. The core of the transformer was grounded for by-pass action, keeping the magnetic field of the AC side of line from from intervening with that of the DC side of the line. This is also the reason for grounding the core with the shield between the two circuits.

The filtering system remains the same, that is, two 30 henry choke coils, with three by-pass condensers shunt each portion of the chokes and assure a perfect filtering system. Instead of there being only two B output voltages, there are 3 output B voltages, viz., 22½ to 45 (variable through resistor R 2), 90 and 135.

Constructional Advice

Now as to the actual constructional data. eliminator. Those who have constructed the original Tectron eliminator only will have to place the special shield between the transformer windings. Those who are newcomers should use this information. The shell type core was used in both the transformers and the chokes. The choke coils consist of 5,800 turns of No. 32 enameled wire, wound over 80 shell type laminations. These are 3-8 in. in width at all ends. The mid-section is 3-4 in. The cut-in portion for the gap is ¼ in. smaller than that of the mid-section, which is ¾ in. The holes at the top and the bottom are ⅛ in. from the top

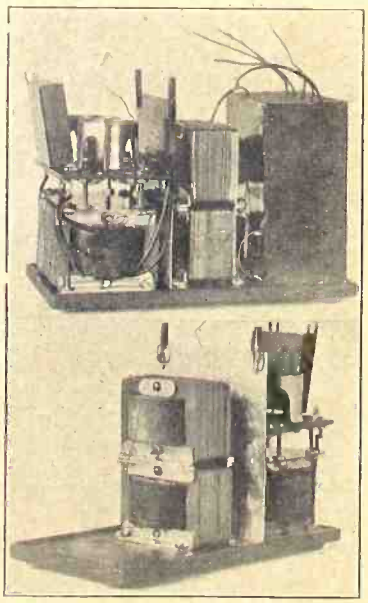


FIG. 2 (top), a side view. The layout of the parts can be clearly seen therefrom. Fig. 3 (bottom), showing the choke coils mounted one over the other. Note the metallic shield in back of the chokes.

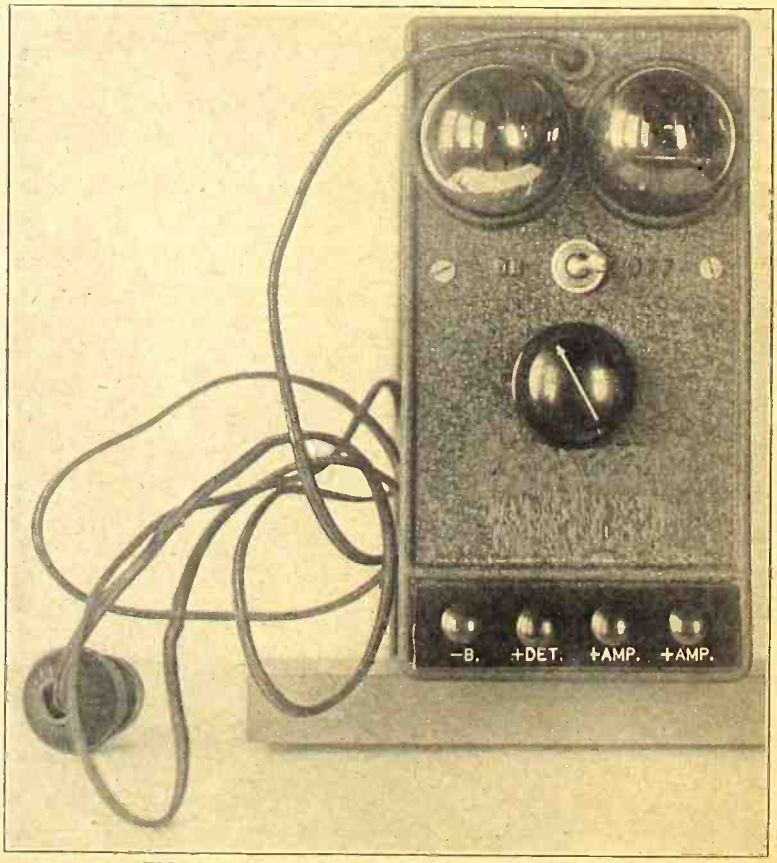


FIG. 3, the front view of the Compact Eliminator.

"No Hum," Says Author

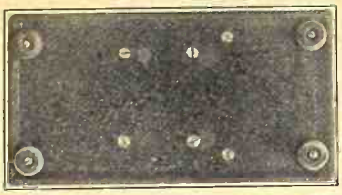


FIG. 4, the bottom plate. The screws holding the rubber feet, hold the transformer (left) and the condenser bank (right).

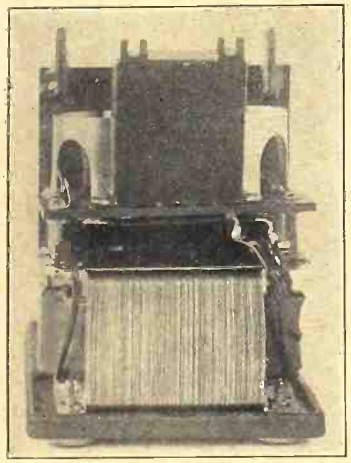


FIG. 5, showing the special step-up transformer. Note the platform with the screws holding a by-pass condenser unit and the sockets.

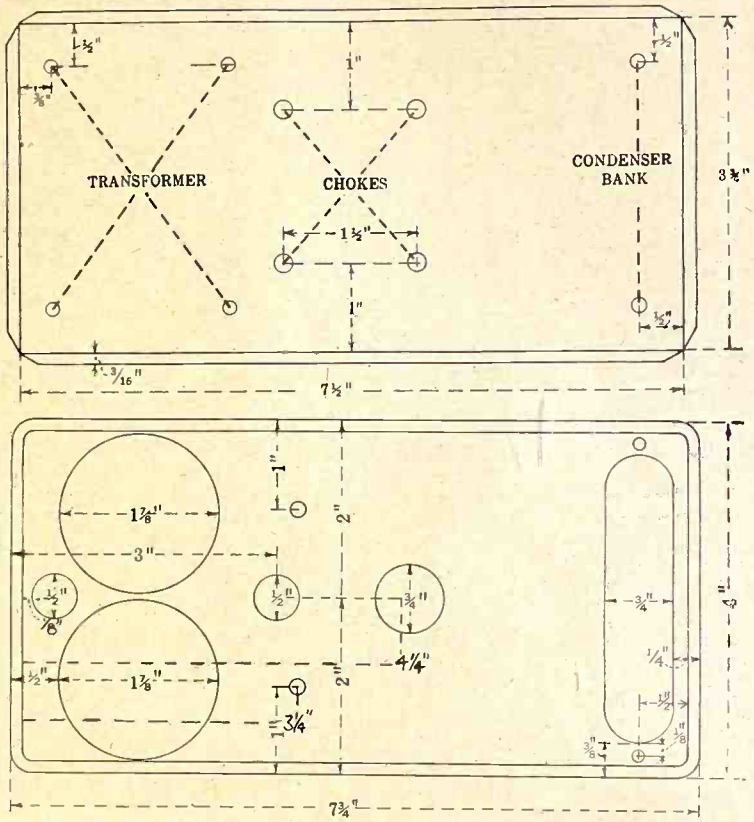


FIG. 6 (top), showing the template for the bottom plate. Fig. 7 (bottom), showing the template for the top plate. The screws holding the minus B and the plus Amp. posts on the extreme left and right positions respectively, also hold the strip to the plate.

and the bottom of the mid-section. As to the transformer, the primary L1L2, consists of 710 turns of No. 26 enameled wire. The secondary, L5L6, consists of 2,840 turns, tapped at the 1,420 turn, the half-point, using No. 31 enameled wire. This, as you will note, is the high tension secondary for supplying the voltage to the plates. The other secondary, L3L4, consists of 46 turns, tapped at the 23d turn, using No. 18 enameled wire. The core consists of 150 laminations. The special shield is made in this manner: Over the plate voltage winding, place a few layers of .014 in. thick manila paper. Obtaining some No. 18 double cotton or enameled covered wire, bring the beginning of the wire to the core. Bringing the wire ⅛ in. from the edge, wind evenly until you are ⅛ in. from the opposite edge. This terminal goes nowhere, being held intast by cutting a small slit in the heavy paper, tying the wire in this slit. Over this, the usual covering is placed and the filament secondary is wound.

The Wiring

Bring L1, the beginning of the primary, to a terminal on a socket or to a terminal of the wire going to the line. Bring L2, the end of the primary, to one point of a switch and the other terminal to the other wire of the line lead. Bring L6, the beginning of the plate secondary, to a P post on one of the sockets. Bring L5, the ending, to the P post of the other socket Bring T2, which is the tap on the high potential secondary, to the B minus post. Across one portion of the tap, shunt C5. Across the other portion, shunt C6. Connect the F plus posts of both sockets together and the F minus posts of the sockets together. Bring the beginning of the filament secondary, L4 to the F plus posts. Connect the end of the same winding, L3, to the F minus posts. T1 goes to the beginning of the choke coil, L8 and to one terminal C1. The other terminal of C1 goes to the B minus post or to T2. The other terminal of L8 goes to one terminal of C2 and to one terminal of the choke coil, L9. The other terminal of C2 goes to T2 or B minus. The other terminal of L9, goes to one terminal of C3 and to the B plus 135 Amp. volt post, to a terminal of the

(*Concluded on page* 31)

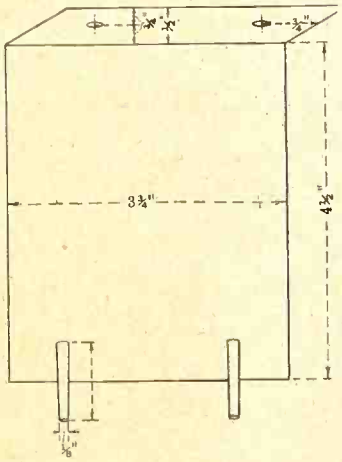


FIG. 8, showing the template for the metal shield.

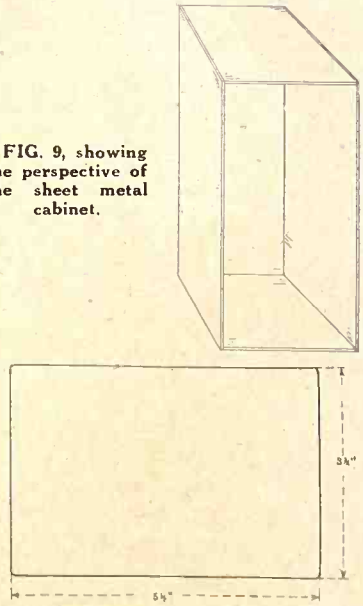


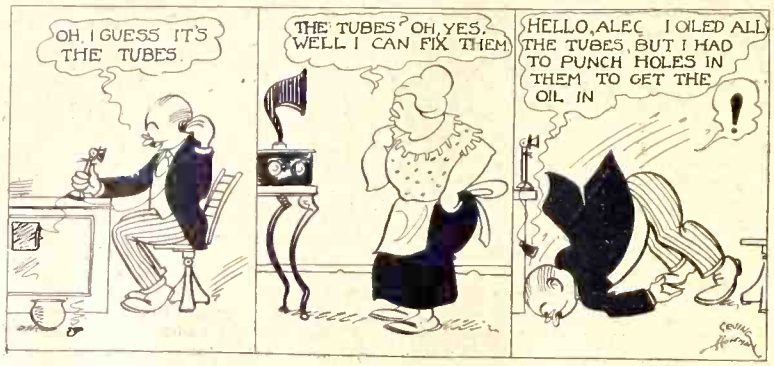
FIG. 9, showing the perspective of the sheet metal cabinet.

FIG. 10, showing the dimensions of the ends of the cabinet.

How Tubes Affect Quality

THE FATAL REMEDY

By Irving Hoffman



By Dr. A. N. Goldsmith

Chief Broadcast Engineer, Radio Corporation of America.

THE quality of reproduction of music in the home depends, as has been pointed out in earlier articles of this series, on many elements at the transmitting and receiving stations. The contributions to musical quality from the transmitting and receiving sets have already been considered and it has been pointed out how important it is that each of these, and particularly the receiving set, shall be acoustically synchronized. Acoustic synchronizing, or the accurate re-creation in the home of the sound waves produced in the studio, is the determining factor in the enjoyment of radio programs. Few people realize the very important part played by vacuum tubes in the receiving set as regards quality of musical reproduction, and the real necessity for exercising discretion in the choice of the vacuum tubes used and for maintaining them and their batteries in good operating condition.

From the view of obtaining real musical results in the home, tubes must meet a number of difficult specifications. While high-grade tubes do, as a matter of fact, meet such specifications, it is by no means uncommon to see the entire circle of broadcast transmission and reception broken and tone quality ruined by the use of unsuitable or unreliable vacuum tubes.

The Amplification Factor

Considering first some of the electrical constants of the tubes, and without going into the technical details of the matter, vacuum tubes have a certain characteristic which is known as the amplification factor. If the amplification of the tubes used in the receiver is too small, weak and unnatural-sounding signals will result. If, on the other hand, the amplification is too great in its relation to the design of the receiving set, the receiver may "oscillate" or produce squealing or howling notes which cannot be conveniently eliminated or controlled. Here then is an electrical constant of vacuum tubes which must be reasonably correct.

Another important constant is what is known as the "internal impedance" of the tube. Roughly speaking, this is a measure of the opposition of the tube to the flow of plate current through it. It is the factor which limits the current drawn from the B battery. If the internal impedance is too small there will be an excessive drain on the plate batteries without corresponding advantage, and plate battery renewals will be uncomfortably frequent. On the other hand, if the internal impedance is too high, weak signals of unsatisfactory character will be produced and tone quality on the average loud speaker will be distinctly unsatisfactory. Accordingly, internal impedance of vacuum tubes must also be held within carefully considered limits.

The Internal Capacities

The tiny filament, grid, and plate elements inside of modern vacuum tubes are close together and they, in conjunction with the wires leading from them to the contact pins in the base of the tube, constitute what are known as electrical capacities. In other words, there are miniature condensers formed by the filament, grid, and plate, the capacities of such condensers residing inside of the tube. It is a fact that in many highly efficient circuits these internal tube capacities definitely influence the electrical behavior of the set. Receivers which are "neutralized" or "balanced" against tendency toward oscillation (howling) are necessarily so balanced for a particular tube. If the internal capacity of tubes varies too far, receivers which would otherwise properly function will begin to produce uncontrollable noises, generally of a buzzing or whistling nature, whereupon the musical enjoyment by the audience is destroyed. Consequently, a watch has to be kept by the test laboratories of the tube manufacturer on the internal capacity of high quality vacuum tubes.

Inside the vacuum tube is a glowing element called the filament. It is a sort of reservoir from which streams a current of electricity in the form of a myriad of tiny electrical charges called electrons. These pass from the filament to the plate inside of the tube, and their flow is definitely controlled by the grid element between the filament and the plate which acts as a sort of electric valve turning on and off the flow of current through the tube, and presumably in accordance with the shape of the sound originally produced in the broadcast studio. This, in general terms, is the process whereby the original signal is reproduced in the home.

Electron Flow Must Be Big

It is clear that an essential portion of this process is the emission of a sufficiently copious stream of electrons from the filament. If the stream is reduced to a mere trickle, the signals will become weak and distorted. In this case, even for a low volume of sound in the home there will be rattles and distortions in tone quality. Only by a careful choice of filament material and a thoroughly correct process of manufacture and testing has it been found possible to produce filaments which not only have a sufficient electron emission when new, but which maintain their efficiency during a long useful life. It may be added that it is particularly difficult to produce such satisfactory filaments when great economy in the amount of power required to heat the filament is imperative as, for example, in the case of dry battery tubes. Filament design is accordingly a real factor in tube performance and the production of musical quality.

Vacuum tubes used as amplifiers require a high vacuum. Unusual and seemingly extravagant precautions must be taken to extract gases from the bulb and even from the metallic elements inside the tube and the very glass itself. The presence of gas in the tube shortens the life and causes it to be "noisy." Gassy tubes, instead of giving a velvety, silent background when the music stops or when a soft note is being sung, give a continual hissing or scratching sound which is most distracting and greatly detracts from the otherwise complete enjoyment of a musical program.

Microphonic Noise

This subtle factor in tube performance is difficult to measure except in the laboratory, and it is therefore of importance to be sure that highly exhausted tubes are actually being obtained by the broadcast listener—tubes which are critically tested by the laboratories of the manufacturer.

The delicate elements inside of a vacuum tube, if jarred, will vibrate. Some makes of tubes are peculiarly sensitive to mechanical disturbance and easily produce a "ringing note" if the receiving set is touched or tapped. Particularly is this the case if the tube sockets are not effectively cushioned and elastically supported. Vacuum tubes which produce a loud and prolonged ringing note when tapped will not give the same satisfaction as "non-microphonic tubes" which are free from this defect. In any case the vacuum tube mounting should be appropriate.

Radio has passed out of the stage where one sort of tube is equally desirable in every socket of the receiving set. The day of the "general utility tube" is over. We should still use the general utility tube of the older types for the amplifier portions of the receiver with the important exception of the last, or output stage. This is the tube which feeds the loud speaker and it should be a specialized "high output tube." Fortunately, there have been recently produced very useful and efficient dry-battery, storage-battery, and power-supply operated tubes which give a higher output than has hitherto been obtainable in tubes of these respective classes.

Quality Improved

By using such tubes, considerable and natural volumes of sound can be secured without distortion on appropriate loud speakers. This meets a long-felt need, because there is a vast difference between the limiting output of a tube and the undistorted output. The limiting output is merely represented by the maximum of noise which the tube can produce, which is certainly a very different thing from the undistorted output or the greatest volume of sound which can be produced while still retaining high quality.

A brief mention of the importance of suitable batteries, in good condition, in their relation to tone quality is pertinent. When the A or filament batteries of a receiver run too low, the tubes will not light up fully and the signals, besides being weak, are frequently distorted, or scratchy in quality. A run-down condi-

Loudspeaker Requisites

tion of the B or plate batteries similarly causes a noisy or weak signal with distorted quality, or may even give rise to disagreeable howling sounds. The C or grid battery also plays a great part in the production of high quality music. Exhausted C batteries, or C batteries of wrong voltage, will damage the tone quality of the received music by introducing false overtones and will also give rise to rattling. Proper C battery voltages and batteries in good condition are particularly necessary in the last two amplifier tubes of the receiving set.

The best rule is to select reliable tubes, each suited for the particular purpose to which it is to be put in the receiver, and then not to overwork these tubes nor to neglect the upkeep of the batteries feeding the tubes.

The remaining piece of apparatus to be considered, namely, the loudspeaker, is certainly one of the most important factors in acoustic synchronizing and one which, in many instances, falls lamentably short of the needs of the situation. There is more imitation science quoted in relation to loudspeakers than in almost any other portion of the radio receiver field. The most extravagant claims are made even on an amazingly slim foundation.

The loudspeaker is, in fact, the "neck of the bottle," so far as sound reproduction is concerned. Even if everything else at the transmitter and receiver is acoustically synchronized but the loudspeaker is not, the results will be spoiled. It is just as if an opera with inspired music, a fitting libretto, and striking stage settings, were nevertheless to be sung by incompetent performers. The effect would be ruined despite the perfection of all factors save the vocal rendition.

The Three Major Points

There are three definite things which must be accomplished by the perfect loudspeaker. The first of these is that it shall give omnitonal reproduction. In other words, it must reproduce every tone from the lowest to the highest—from the gravest, deep note to the highest, shrill note. In the second place, it must be equitonal. It must not select any tone or group of tones and either unduly emphasize or arbitrarily suppress them. And, thirdly, it must have what may be termed sonority. This is the quality of giving full volume without distortion of tone quality. Naturalness of reproduction depends on normal volume without distortion.

Considering first the omnitonal requirement, if low notes are missing from the loudspeaker, a thin, metallic, and unnatural effect will be produced and music will sound as if it were coming from the older types of cheap phonograph, now happily obsolescent.

If high notes are omitted, a booming quality will be given to speech, the higher pitched musical instruments will be lost, speech intelligibility will suffer, and everything will sound as if it were being produced in a large echoing vault. Should the medium register of tones be omitted, the effect is of course fatal, and speech will be practically unintelligible and music without merit.

Choppy Flow of Music

A failure to meet the even more difficult equitonal condition causes a series of somewhat similar faults, though not in so extreme a measure. A loudspeaker which is not equitonal spoils the smooth flow of music. Some notes, which are exaggerated, fairly "pop out" at the listener in a distracting and inartistic way. Other notes, which are relatively slighted, are practically lost and this also produces a distracting and unnatural effect. The different notes in a chord may not be reproduced with equal or appropriate volume, and the chord will sound strange and even unpleasant. A scale played on an instrument will not hold constant quality from note to note. Some notes will sound sharp, and others flat. The delicate intonations of the speaking voice will be lost, and the human quality of speech impaired or absent. In summary, natural and faithful reproduction definitely requires equitonal loudspeakers.

The influence of volume or sonority is not quite so pronounced but is, nevertheless, very noticeable. If the volume is reduced, the lower musical notes seem to drop out first, the balance between the various instruments in the orchestra is destroyed, noises in the room interrupt the enjoyment of the music, and a decidedly inferior effect is produced. If, on the other hand, too great a volume is employed (and even if there is no distortion of tone quality such as generally occurs in this case since most loudspeakers overload on high volumes), the effect is oppressive and deafening. Neighbors are annoyed, and rattling and disagreeable notes seem to be present. The happy medium of natural volume is definitely required to meet the third condition of proper sonority. If sonority is too low, the attention of the audience will wander and the concert will be spoiled by interruptions. If the volume is too high, the owner of the receiving set will be forced to apologize continually for peculiar and unnatural tone effects. Only full, natural volume is rich and true in its effects.

Big Advance Made

Fortunately, we have available today types of loudspeakers which meet the three primary requirements of a perfect loudspeaker to a close degree of approximation, and are capable of giving great enjoyment to the listener. This was not the case for the earlier types of loudspeakers which were crude. The important feature of the development is that the result has actually been obtained, and that the high quality loudspeaker has become available. Fortunately these devices can be used either separately or as a part of an assembled radio receiver. Each method of use has its advantages and disadvantages. Putting the loudspeaker into the radio receiver makes a convenient, compact, and self-contained unit of the entire receiving equipment. It is, however, difficult to tune such a receiver right in front of it and at the same time to be sure that the best results are being obtained across the room where the listeners generally are located.

The Other Side

On the other hand, the separate loudspeaker across the room from the listeners, with the receiver itself placed among the listeners, has the disadvantage of requiring a wire connection from receiver to loudspeaker and of putting two pieces of furniture into the room. But it has the marked operating advantage of furnishing the possibility of tuning the set from the location of the listeners with the loudspeaker at a distance so that the best effect, as experienced by the audience, will actually be obtained. No doubt each method of operation always will be preferred by some.

The result of the development of the relatively perfected loudspeaker is that radio broadcasting has become a branch of music. The greatest artists in the world no longer hesitate to send their performances by radio to the homes of the listeners, and leading musical organizations are giving broadcasting their enthusiastic backing and support. The high quality loudspeaker has made it possible to convince musicians that they will lose nothing of their artistic reputations through radio.

3 STATIONS INCREASE POWER

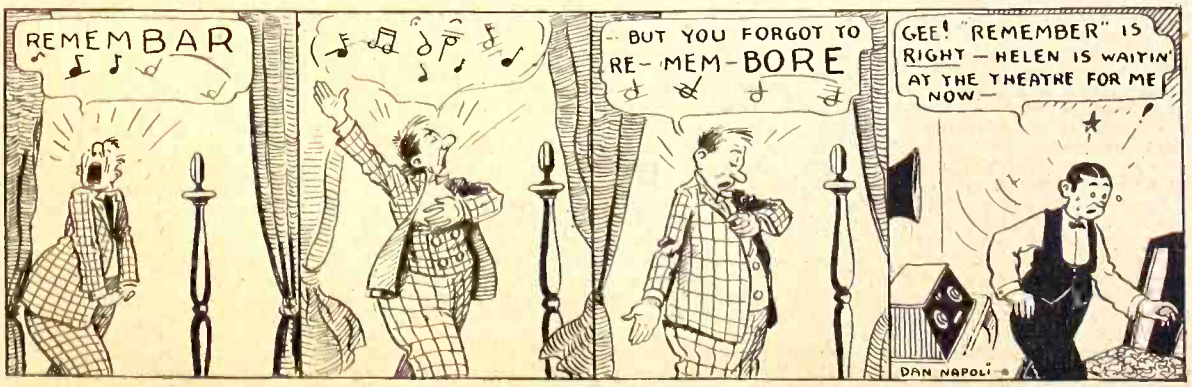
KFNF, Shenendoah, Iowa, has been transferred to class B and has increased its power from 500 to 1,000 watts.

The power of WEBH, Chicago, has been increased from 1,500 to 2,000 watts.

The power of WLWL, New York, has been increased from 1,500 to 3,500 watts.

BETTER LATE THAN NEVER

By Dan Napoli



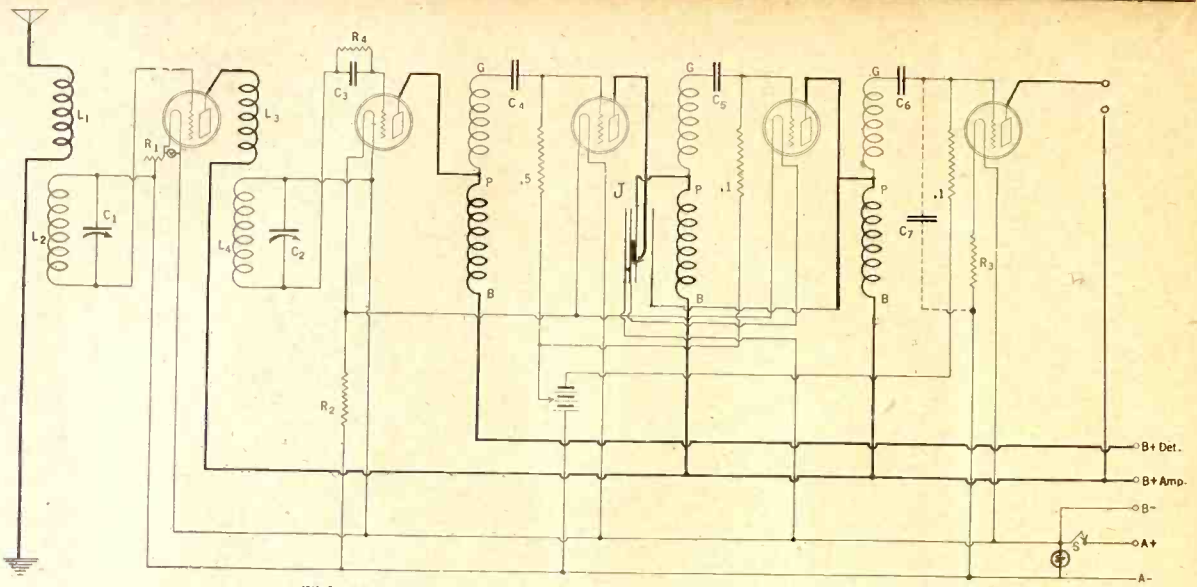


FIG. 285, showing the receiver requested by Philip Draughn

Radio University

A FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th St., N. Y. City.

I WOULD be very pleased to have a diagram of a 5-tube receiver, employing a stage of non-regenerative tuned radio frequency amplification, a non-regenerative detector and three stages of auto-transformer AF coupling. A voltmeter should be shunted across the filament leads, in shunt to which is a lamp and a switch. A filament jack should be inserted in the output of the first AF tube, so that when the switch is turned to the "off" position, the second audio tube is automatically unlighted, the plate of the first tube being connected to the P post of the final autotransformer. When the switch jack is at the "on" position, the filament circuit of the second audio tube is closed, which lights that tube up. The object of this switch is to have a volume control on local stations, where if it is so tremendous, only two stages of AF can be employed (middle stage being cut out). A rheostat should be inserted in series with negative leg of the RF tube. Ballast resistors should control the filaments of the detector and the last audio tubes. I wish to use a C battery also. Please state the constants of the coils, condensers, etc.—Philip Draughn, Hillsborough, N. J.

Fig. 285, shows the diagram, that you request. The RFT are wound on tubings 3¼" in diameter and 4" high. The primaries, L1 and L3 consist of 10 turns. The secondaries, which are wound on the same tubings, as the respective primaries, consist of 45 turns. There is a ⅜" separation, between the two windings. No. 22 double cotton covered wire is used for winding. Condensers, C1 and C2, are of the .0005 mfd. variable type. C3 is a .00025 mfd. fixed condenser, while the grid leak, R4 which shunts it, has a resistance of 2 megohms. C7 is a .002 mfd. fixed condenser. The voltmeter is designated by the small V in the circle, in shunt to the filament, leads of the first or RF tube. The lamp is designated by the capital E in a circle, between the A plus and the A minus leads, in the lower right hand corner. S is the filament switch. C4, C5 and C6 are .25 or 1 mfd. fixed condensers of the mica dielectric type. R1 is a 6 to 10 ohm, ¼ ampere rheostat. R2 is a ¼ ampere ballast resistor. R3 is a ¼ ampere ballast resistor. The —01A type tubes, should be used in this receiver to obtain the greatest efficiency.

* * *

I WOULD like to have the electrical circuit diagrams, for an A and B battery eliminator, for use with the 110 volt, 60 cycle line, A. C. If such diagrams appeared in RADIO WORLD, I would like to know the dates of their appearance.—Russell Zimmerman, News Depot, 116 Poplar St., Two Harbors, Minn.

Diagrams for the construction of B battery eliminators have appeared in the Dec. 12, 26, Jan. 2, 16, March 13 and 27 issues of RADIO WORLD. There is also one in this issue. The complete constructional data were given in each one of these issues. A circuit diagram of an A battery eliminator will be described soon by Lewis Winner.

* * *

HOW MANY turns should be placed on a form, 2 feet square, using No. 18 double cotton covered or annunciator wire as the conductor, to make a loop, to be used in conjunction with the Diamond of the Air? The same method of winding, etc., as was described by Herbert C. Hayden in the Oct. 31 issue of RADIO WORLD, is to be used. (2)—Can a 10-ohm rheostat be used to control the filament of a —01A type tube, to be used as a detector as well as a 20-ohm rheostat, with the proper carrying capacity of amperes in this set? (3)—Can a 20-ohm, ¾ ampere rheostat be used to control the filaments of the two AF and one RF tubes in the 1925 Model Diamond of the Air? (4)—As I am confined to a very small space, I find it necessary to use a short antenna. I use the regulation tuner and RFT with 45 turns on the secondary. In this manner, I am unable to receive stations, above 455 meters. What can I do to receive stations above this wave-length, without increasing the length of the antenna?—D. P. Norman, 1812 Montrose St., Philadelphia, Pa.

(1)—You will have to wind 16 turns. (2)—Yes. (3)—Yes. (4)—Either insert a .0005 mfd. fixed condenser in shunt to the antenna and the ground or add 6 turns to the secondaries of both the tuner and the RFT.

I AM rebuilding The Set That Thrilled Jack, described by Lewis Winner in the Oct. 10 and 17 issues of RADIO WORLD, and wish to have the following straightened out: (1)—Should there be a space left between the primary and the secondary windings of the two radio frequency transformers, or should they be wound together? (2)—On my first set I had trouble in controlling the oscillations with the potentiometer. Is it advisable to take it out altogether, running the grid returns of the radio frequency tubes to the negative side of the filament and the grid return of the detector to the positive side of the filament? (3)—In the first receiver, I connected a 500,000 ohm potentiometer in the last stage of AF amplification thus: the arm to the G post of socket 5, while the resistance posts went to one terminal of C4 and C minus respectively. As soon as this was done a loud howl developed. However, when the arm of the potentiometer was placed between the center and the resistance terminal, which went to the fixed condenser, C4, the howl ceased. The volume decreased. How could this howl be killed and the volume kept?—H. R. Halbfass, LaPorte, Ia.

(1)—It is immaterial as to whether a space is left between the primary and the secondary windings. (2)—Yes. Do not overload RF and detector tubes with plate voltage. Be sure that the RFT are all properly spaced apart or at right angles to each other. (3)—According to your description, it seems as if you had a potentiometer with a portion of the resistance burned out, or probably disconnected. No howl should occur when the resistance is connected as you state. Test the C battery for correct voltage. Be sure and place the correct C voltage with the proper B voltage, e.g., 90, 4.5., etc. These data are given on the carton of each tube purchased. See that the stopping condensers make a complete circuit.

* * *

I AM very much interested in the 1926 Model Diamond of the Air, which I am going to build. However before doing so I would like to have the following queries answered. (1)—What is the best size wire to use to wind the tuner and the radio frequency transformer, using a 3" diameter basket weave form, with the under two and over two method of winding? (2)—When winding these coils, is it all right to wind the primary in with the secondary as is done with all basket

weave windings? (3)—How many turns should the primaries and the secondaries consist of, using the wire first specified. The tickler is to be wound on a tubing 2" in diameter. Basket weave method of winding is to be employed here also.—Charles Tucker, North Windham, Conn.

(1)—Use No. 22 double cotton covered. (2)—Yes. (3)—The primaries consist of 10 turns. The secondaries consist of 50 turns. The tickler consists of 36 turns of No. 26 single silk covered wire. Of course .0005 mfd. variable condensers shunt the secondaries. In winding the coils, 20 turns of the secondary are first put on. Then 10 turns of the primary along and 10 turns of the secondary are wound side by side, together. The rest of the secondary winding is then put on. viz., 20 turns.

* * *

I WOULD be pleased to have complete data as to the construction of a tuned radio-frequency transformer, the windings being supported on strips and well spaced. The secondary is to be shunted by a .0005 mfd. variable condenser.—H. Ruffins, Houston, Tex.

Fig. 286, shows the diagrams, which illustrate the various steps as to the construction of such an RFT. Fig. 1, in this group, shows the dimensions for one of the circular heads, used to mount the strips. Fig. 2, shows the length of the strips, which may be of hard rubber or wood and also that of the width of the head, with manner of mounting. Fig. 3, shows how the primary and the secondary are placed. Now, since you are going to use the .0005 mfd. variable condenser, the secondary will consist of 45 turns. The method of making the notches to fit the windings is shown in Fig. 4. You will note, however, that when making these notches, by following the diagrams, you will have 67 notches, or 22 to spare. However, you do not have to use a form 4⅛" long. Use one which is only 3¾" long. Then you will find that there will be just enough room for the placing of these turns of wire. The primary consist of 10 turns and may be wound on top of the beginning of the secondary winding or alongside of the secondary winding. Fig. 5, shows how to mount the coil on angle brackets. The last Fig. (6), shows how the strips are fitted into the slots of the circular head. No. 22 double cotton covered wire is used to wind the coil. Do not place any shellac or varnish on these coils. Collodion may be applied, but very sparingly. If the notches are deep enough and the windings tight enough, you should have little trouble in making the windings stay securely.

* * *

I HAVE a Daven Super Amplifier, which consists of three stages of resistance coupled amplification. Will this amplifier give as good results when used after the detector tube in the 1926 Model Diamond of the Air, as the stage of transformer coupled and two stages of resistance coupled AF amplification, now used?—A. J. Pushwal, Box 382, Wilmerding, Pa.

Yes.

* * *

I AM building the 5-tube Low-Loss Neutrodyne, described in the June 13 issue of Radio World, by Neal Fitzalan. Now I find it very difficult to connect the coils. That is, I do not know, where the beginnings and the ends of the RFT go to, etc. (2)—How many turns do the secondaries consist of? I am using .0005 mfd. variable condensers.—George W. Berry, 65 Duane St., N. Y. City.

The beginning of the primary winding, L1, goes to the antenna. The ending of this same winding goes to the ground. The beginning of the secondary winding, L2, goes to the F minus post. The ending of this winding goes to the G post. The stationary plates of the variable condenser C, are also connected to this point, while the variable plates are connected to the beginning of the winding. The beginning of the primary, L3, of the second RFT goes to the plate post of the first socket. The end of this winding goes to the B plus 67½ volts post. The beginning of the secondary winding, L4, goes to the F minus post and to the rotary plates of the variable condenser, C3. Now the tapped portion of this coil, which is near the beginning of this winding, goes to the rotary plates of the midget or neutralizing condenser, C2. The stationary plates of this condenser go to the end of the secondary winding of the first RFT. The end of the secondary winding, L4, goes to the stationary plates of the neutralizing condenser, C6, to the stationary plates of the variable condenser, C3, and to the G post. The beginning of the primary, L5, of the third and last RFT goes to the P post on the second socket. The ending of this coil goes to the B plus 67½ volt post. The beginning of the secondary winding, L6, goes to the rotary plates of the variable condenser, C4, to one terminal of a variable grid leak, R1 and to the F plus post. The tapped portion of this coil goes to the rotary plates of the neutralizing condenser, C6. The ending of this winding goes to the stationary plates of the variable condenser, C4 and to one terminal of a fixed grid condenser, C5. Note that all the high and the low potentials of the coils, F with B plus and grid with plate terminals, are kept together. (2)—The secondaries consist of 50 turns.

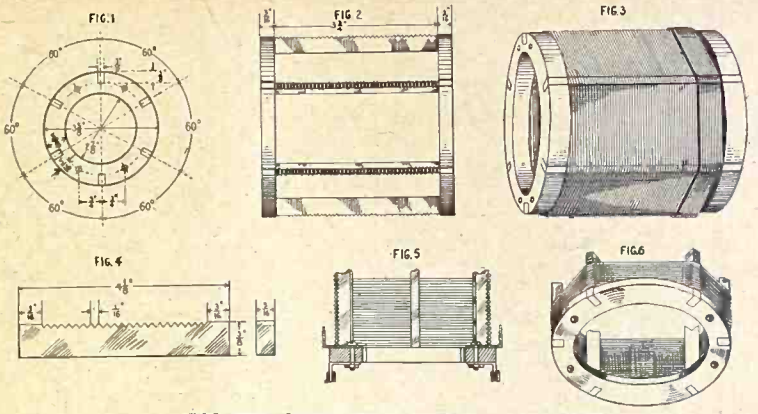


FIG. 286, showing how to make a tuned RFT

* * *

ARE ALL single circuit 1-tube receivers regenerative?—A. H. Hewitt, 1406 Garfield Ave., Laramie, Wyo.

No, but if they are not they may not suit the needs of the day regarding selectivity.

IN REFERENCE to the Super-Heterodyne described by J. E. Anderson in the March 20 issue of Radio World and built by Paul Hollingshead. (1)—Can the —01A type tubes be employed successfully. (2)—Could ballast resistors be used to control the filaments of the AF and the RF tubes? (3)—Will the —01A type tubes give louder signals than the —99 type tubes? (4)—Is it advisable to use only the General Radio IFT in this set, or can any IFT be employed?—J. B. Blund, Jersey City, N. J.

(1)—Yes. (2)—Yes. (3)—This circuit was designed around the use of the GR. medium frequency transformers.

* * *

IS IT not possible to use a hand drill as a coil winder? (2)—If so, please show how this can be done and explain the operations.—J. Kahn, Morris Plains, N. J.

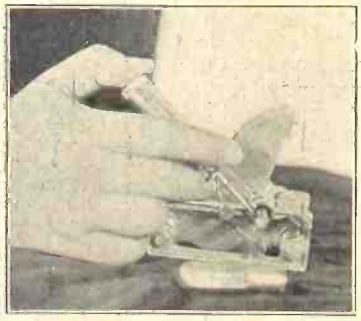
Fig. 287, shows the method of employing a hand drill as a coil winder. Place a piece of dowel stick in the chuck, instead of the drill. Place the tubing on which the coil is to be wound over the dowel stick. The diameter of the dowel stick should be about 1/16" less all around than that of the tubing itself.

FIG. 287, illustrating the method of using a hand drill as a coil winder.
(Hayden)

Broadcasts in Costume

ANGE SORENSON, who appears during the Norwegian half hour by the Vikings, broadcast through stations WEAF, WJAR, WGR, WTAG, WCAE, WOC, WWJ, KSD, WEAR and WCAP, every Friday from 9:30 to 10 P. M. (Foto Topics).

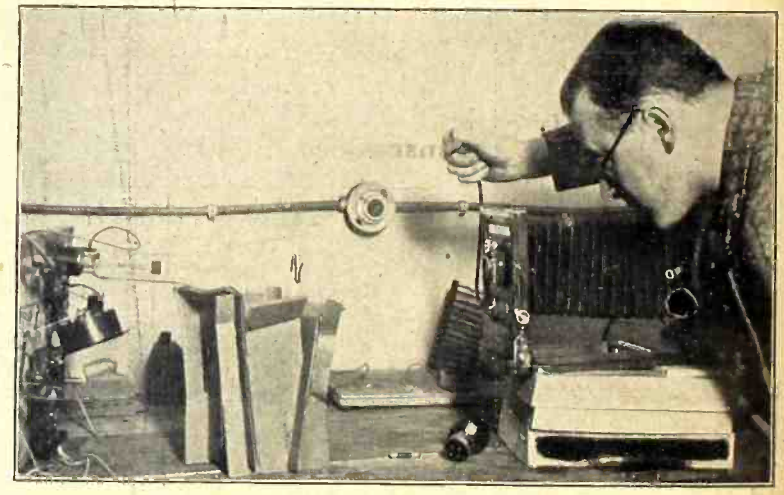
A Funny "Remedy"



DON'T pour oil on troubled variable condensers, even if the shaft happens to be a little tight. The oil will insulate the bearings and then the real trouble starts. If the condenser action is too stiff you may loosen up on the bearings. (Hayden)

English Language First in Japan!

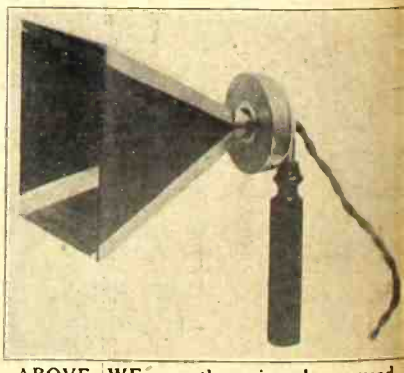
WHEN it comes to enjoining artists by the bulletin board method, the English language tops the native tongue in Japan. The Shochiku Girl Opera Company broadcasters are shown at the Tokio studio. The girl at right is not the dramatic soprano. (Underwood & Underwood)



HOW audio waves are photographed. Note the wave form being photographed by John F. Rider. (Foto Topics)

ALEXANDER BRAILOWSKY, Russian pianist, Atwater Kent artist.

The First Microphone

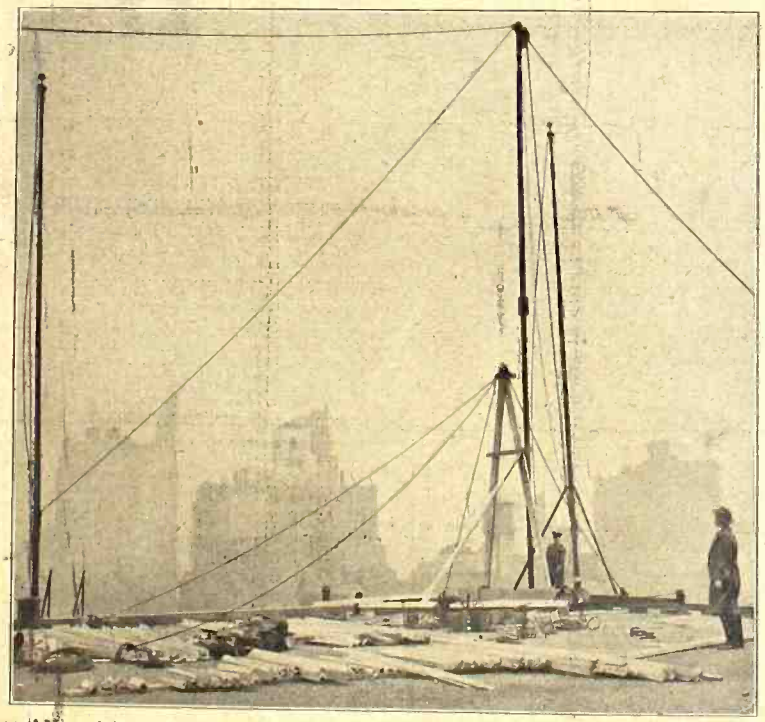


ABOVE WE see the microphone used by Nellie Melba, diva, in the first important concert broadcast, through a station at Chelmsford, England, on June 15, 1920. (Kadel & Herbert)

Shakespearean Players Heard Weekly

THE WEAF Shakespearean Players, heard every Saturday at 8:15 P. M. in tabloid Shakespearian presentations. Standing (left to right): Gerald Stopp, Katherine Emmet, Lawrence Cecil. Sitting (left to right): Alfred Shirley, Margot Lester and Charles Webster. (Foto Topics).

Remote Transmission Gains Way



AN aerial erected by a station just outside the tall buildings of Manhattan.

Difficulty in "getting out" has prompted several stations, with studios in congested Manhattan Island, to use aerials far enough away from the mass of steel buildings to avoid absorption. WOR, WBPI, WJZ, WMCA, WGCP and WGBS have such remote transmission. The photo shows the WGBS antenna at Astoria, L. I., just after its recent erection. The broadcasts are carried by land wire from the respective studios, at which are located speech amplifiers, also. The radio part of the work takes place at the transmission plant.

Radio Under the Sea

WORKMAN ON the naval laboratory sound barge, lowering a sound transmitter into the Potomac River, where experiments are being carried on in the development of the undersea radio telephone. (Wide World).

The Official List of Stations

Corrected and Revised Up to March 24

Station	Owner and Location	Meters
KDKA	Westinghouse E. & M. Co., Pittsburgh, Pa.	309
KDLR	Radio Elec. Co., Devils Lake, N. D.	231
KDYL	Newhouse Hotel, Salt Lake City, Utah	246
KDZB	F. E. Seifert, Bakersfield, Cal.	210
KFAB	Nebraska Buick Auto Co., Lincoln Neb.	340
KFAD	Electrical Equipment Co., Phoenix Ariz.	273
KFAE	State College, Pullman, Wash.	349
KFAF	A. E. Fowler, San Jose, Calif.	217
KFAJ	University of Colorado, Boulder, Colo.	261
KFAU	Boise High School, Boise, Idaho.	283
KFBB	F. A. Buttry Co., Havre, Mont.	275
KFBG	1st Presbyterian Church, Tacoma, Wash.	250
KFBK	Kimball, Upson Co., Sacramento, Cal.	248
KFBL	Leese Bros., Everett, Wash.	224
KFBS	School District No. 1, Trinidad, Col.	238
KFBU	Bishop N. S. Thomas, Laramie, Wyo.	270
KFCB	Nielson Radio Co., Phoenix, Ariz.	238
KFCF	F. A. Moore, Walla Walla, Wash.	256
KFDD	St. Michael's Cathedral, Boise, Idaho.	278
KFDM	Magnolia Petroleum Co., Beaumont, Texas	316
KFDX	1st Baptist Church, Shreveport, La.	250
KFDY	State College of Agriculture, Brookings, S. D.	273
KFDZ	H. O. Iberson, Minneapolis, Minn.	231
KFEC	Meier & Frank Co., Portland, Ore.	248
KFEL	Winner Radio Corp., Denver, Colo.	254
KFEQ	J. L. Scroggin, Oak, Neb.	268
KFEY	Bunker Hill & Sullivan, Kellog, Idaho	233
KFFP	1st Baptist Church, Moberly, Mo.	242
KFGQ	Crary Co., Boone, Iowa	226
KFHA	Western State College, Gunnison, Colo.	252
KFHL	Penn College, Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc., Los Angeles, Cal.	469
KFIF	Benson Institute, Portland, Ore.	248
KFIQ	1st Methodist Church, Yakima, Wash.	256
KFIU	Alaska Elec. Co., Juneau, Alaska	226
KFIZ	Daily Commonwealth, Fond du Lac, Wis.	273
KFJB	Marshall Elec Co., Marshalltown, Ia.	248
KFJC	R. B. Fegan, Junction City, Kan.	219
KFJF	National Radio Co., Oklahoma City, Okla.	261
KFJI	Liberty Theatre, Astoria, Ore.	246
KFJM	University of N. D., Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son, Portland, Ore.	263
KFJY	Tunwall Radio Co., Ft. Dodge, Iowa.	246
KFJZ	Southwestern Baptist Theo. Seminary, Ft. Worth, Tex.	254
KFKA	State Teachers College, Greeley, Colo.	273
KFKU	University of Kansas, Lawrence, Kans.	275
KFKX	Westinghouse E. & M. Co., Hastings, Neb.	288
KFKZ	F. M. Henry, Kirksville, Mo.	226
KFLP	Everett M. Foster, Cedar Rapids, Ia.	256
KFLR	University of N. M., Albuquerque, N. M.	254
KFLU	San Benito Radio Club, San Benito, Tex.	236
KFLV	Swedish Evangelist Church, Rockford, Ill.	229
KFLX	George R. Clough, Galveston, Texas.	240
KFLZ	Atlantic Auto Co., Atlantic, Iowa	273
KFMR	Morningside College, Sioux City, Iowa	261
KFMW	M. G. Sataren, Houghton, Mich.	263
KFMX	Carleton College, Northfield, Minn.	337
KFNF	Henry Field Seed Co., Shenandoah, Iowa	266
KFOA	Rhodes Company, Seattle, Wash.	454
KFOB	Chamber of Commerce, Burlingame, Cal.	226
KOFJ–KFOS	Moberly High School, Moberly, Mo.	242
KFON	Nichols and Warriner Co., Long Beach, Cal.	233
KFOO	Latter Day Saints University, Salt Lake City, Utah	236
KFOR	David City Tire & Elec. Co., David City, Neb.	226
KFOT	College Hill Radio Club, Wichita, Kan.	231
KFOX	Technical High School, Omaha, Neb.	248
KFOY	Beacon Radio Service, St. Paul, Minn.	252
KFPL	C. C. Baxter, Dublin, Texas	252
KFPM	New Furniture Co., Greenville, Texas.	242
KFPR	Forestry Department, Los Angeles, Cal.	231
KFPW	St. John's Church, Carterville, Mo.	258
KFPY	Symonds Investment Co., Spokane, Wash.	266
KFQA	The Principia, St. Louis, Mo.	261
KFQB	Searchlight Publishing Co., Ft. Worth, Texas	263
KFQC	Kidd Bros., Taft, Cal.	231
KFCH	Radio Service Co., Burlingame, Col.	220
KFQP	G. S. Carson, Jr., Iowa City, Ia.	224
KFQU	W. Riker, Holy City, Cal.	217
KFQW	F. C. Knierim, North Bend, Wash.	216
KFQZ	Taft Radio Co., Hollywood, Cal.	226
KFRB	Hall Bros., Beeville, Texas.	248
KFRC	Paris Dry Goods Co., San Francisco.	268
KFRU	Stephens College, Columbia, Mo.	500
KFRW	United Churches, Olympia, Wash.	220
KFSG	Echo Park Evangelistic Ass'n., Los Angeles, Cal.	275
KFUJ	Hoppert P. and H. Co., Breckenridge, Minn.	242
KFUL	T. Goggan & Bro., Galveston, Tex.	258
KFUM	W. D. Corley, Colorado Springs, Col.	240
KFUO	Concordia Theo. Seminary, St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital, Denver, Colo.	234
KFUR	H. W. Peery and R. Redfield, Ogden, Utah	224
KFUS	Louis L. Sherman, Oakland, Cal.	256
KFUT	University of Utah, Salt Lake City, Utah	261
KFUU	Coburn Radio Laboratories, San Leandro, Cal.	220
KFUV	G. P. Ward, Springfield, Mo.	252
KFVD	Chas. & W. J. McWhinnie, San Pedro, Cal.	205
KFVE	Film Corp., St. Louis, Mo.	240
KFVF	Clarence B. Juneau, Hollywood, Cal.	208
KFVG	1st Meth-Epis. Church, Independence, Kan.	236
KFVH	Herbert Whan, Manhattan, Kans.	219
KFVI	56th Cav. Brigade, Houston, Tex.	240
KFVN	C. E. Bagley, Welcome, Minn.	227
KFVO	F. M. Henry, Kirksville, Mo.	226
KFVR	Moonlight Ranch, Denver, Col.	246
KFVS	Cape Girardeau Battery Station, Cape Girardeau, Mo.	224
KFVW	Airfan Radio Corp., San Diego, Cal.	246
KFVY	Radio Supply Co., Albuquerque, N. M.	250
KFWA	Browning Bros. Co., Ogden, Utah.	261
KFWB	Warner Bros. Pictures, Inc., Hollywood, Cal.	252
KFWC	L. E. Wall & C. S. Myers, Upland, Cal.	211
KFWF	St. Louis Truth Center, St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr., Chico, Cal.	254
KFWO	Lawrence Mott, Avalon, Cal.	211
KFWI	Radio Entertainers, Inc., South San Francisco, Cal.	220
KFWM	Oakland Educational Soc., Oakland, Cal.	207
KFWU	Louisiana College, Pineville, La.	238
KFWV	Wilbur Jerman, Portland, Ore.	213
KFYF	Carl's Radio Den, Oxnard, Cal.	205
KFXB	B. O. Heller, Big Bear Lake, Cal.	203
KFXC	Santa Maria Valley R. R. Co., Santa Maria, Cal.	210
KFXD	L. H. Strong, Logan, Utah.	205
KFXH	Bledsoe Radio Co., El Paso, Texas.	242
KFXJ	Mt. States Radio District, Inc., (Portable), Col.	216
KFXF	Pikes Peak Broadcasting Station Co., Colo. Springs, Colo.	250
KFXM	Neches Electric Co., Beaumont, Tex.	227
KFXR	Classen Film Finishing Co., Okla. City, Okla.	214
KFXY	Mary M. Costigan, Flagstaff, Ariz.	205
KFYJ	Houston Chronicle, Houston, Tex., (Portable)	238
KFYR	Hoskins Meyers, Inc., Bismarck, N. D.	248
KGO	General Electric Company, Oakland, Cal.	361
KGTT	Glad Tidings Tabernacle, San Francisco, Cal.	207
KGU	M. A. Mulrony, Honolulu, Hawaii.	270
KGW	The Oregonian, Portland, Ore.	492
KGY	St. Martin's College, Lacey, Wash.	246
KHJ	The Times, Los Angeles, Cal.	405
KHQ	Louis Wasmer, Seattle, Wash.	273
KJBS	J. Brunton & Sons Co., San Francisco, Cal.	220
KJR	Northwest Radio Co., Seattle, Wash.	384
KLDS	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	441
KLS	Warner Bros., Radio Co., Oakland, Cal.	252
KLX	Tribune, Oakland, Cal.	508
KLZ	Reynolds Radio Co., Denver, Colo.	266
KMA	May Seed & Nursery Co., Shenandoah, Ia.	252
KMJ	San Joaquin Corp., Fresno, Cal.	234
KMO	Love Elec. Co., Tacoma, Wash.	250
KMOX	St. Louis Globe-Democrat, St. Louis, Mo.	280-233
KMMJ	M. M. Johnson Co., Clay Center, Nebr.	229
KNRC	J. B. Juneau, Hollywood, Cal.	208
KNTR	D. S. Garretson & R. M. Turner, Los Angeles, Cal.	238
KNX	Express, Hollywood, Cal.	337
KOA	General Electric Co., Denver, Col.	322
KOAC	Oregon Agricultural College, Corvalis, Ore.	283
KOB	College of Agri., State College, N. M.	349
KOCH	Omaha Central High School, Omaha, Neb.	258
KOCW	Okla. College for Women, Chickashia, Okla.	252
KOIL	Monarch Manufacturing Co., Council Bluffs, Ia.	278
KPO	Hale Brothers, San Francisco, Cal.	429
KPPC	Pasadena Presbyterian Church, Pasadena, Cal.	229
KPRC	Houston Print Co., Houston, Tex.	297
KPSN	Pasadena Star-News, Pasadena, Cal.	316
KQP	H. B. Read, Portland, Ore.	213
KQV	Doubleday Hill Elec Co., Pittsburgh, Pa.	275
KQW	First Baptist Church, San Jose, Cal.	227
KRE	Gazette, Berkeley, Cal.	258
KSAC	Kansas State Agricultural College, Manhattan, Kans.	341
KSD	Post Dispatch, St. Louis, Mo.	545
KSL	Radio Service Corp., Salt Lake City, Utah	300
KSMR	S. M. Valley R. R. Co., Santa Maria Cal.	210
KSO	A. A. Berry Seed Co., Clarinda, Ia.	242
KTAB	Tenth Ave. Baptist Church, Oakland, Cal.	240
KTBI	Bible Inst Los Angeles, Cal.	294
KTBR	Brown's Radio Shop, Portland, Ore.	263
KTCL	American Radio Tel. Co., Inc., Seattle, Wash.	306
KTHS	New Arlington Hotel, Hot Springs, Ark.	375
KTNT	N. Baker, Muscatine, Ia.	256
KTW	1st Presbyterian Church, Seattle, Wash.	454
KUO	Examiner Printing Co., San Francisco, Cal.	250
KUCA	Univ. of Ark., Fayettville, Ark.	300
KUOM	State University of Montana, Missoula, Mont.	245
KUSD	University of S. D. Vermillion, S. D.	278
KUT	University of Texas, Austin.	231
KVOO	Voice of Oklahoma, Bristow, Okla.	375
KWCR	H. F. Paar, Cedar Rapids, Ia.	278
KWG	Portable Wireless Tel. Co., Stockton, Cal.	248
KWKC	Wilson Duncan Studios, Kansas City, Mo.	236
KWKH	W. K. Henderson I. W. & S. Co., Kennonwood, La.	273
KWSC	State College, Pullman, Wash.	349
KWWG	City of Brownsville, Brownsville, Tex.	278
KYW	Westinghouse E. & M. Co., Chicago, Ill.	535
KZKZ	Electric Supply Co., Manila, P. I.	270
KZM	Western Radio Inst., Oakland, Cal.	241
KZRQ	Far Eastern Radio Inc., Manila, P.I.	270
NAA	U. S. Navy, Arlington, Va.	435
WAAB	V. Jenson, New Orleans, La.	268
WAAD	Ohio Mech. Institute, Cincinnati, O.	258
WAAF	Drovers Journal, Chicago, Ill.	278
WAAW	Omaha Grain Exchange, Omaha, Neb.	273
WABC	Asheville Battery Co., Inc., Asheville, N. C.	254
WABI	Bangor Ry. & Elec. Co., Bangor, Me.	240
WABO	Lake Avenue Baptist Church, Rochester, N. Y.	278
WABQ	Haverford College Radio Club, Haverford, Pa.	261
WABR	Scott High School, Toledo, O.	263
WABW	College of Wooster, Wooster, O.	207
WABX	H. B. Joy, Mt. Clemens, Mich.	246
WABY	John Magaldi, Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church, New Orleans, La.	275
WADC	Allen Theatre, Akron, Ohio.	258
WAFD	A. B. Parfet Co., Port Huron, Mich.	275
WAHG	A. H. Grebe Co., Richmond Hill, N. Y.	316
WAGM	R. L. Miller, Royal Oak, Mich.	225
WAIT	A. H. Waite & Co., Taunton, Mass.	229
WAIU	American Ins. Union, Columbus, O.	294
WAMD	Hubbard & Co., Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Inst., Auburn, Ala.	248
WARC	American Radio Res. Corp., Medford Hillside, Mass.	261
WBAA	Purdue University, West Lafayette, Ind.	273
WBAK	State Police, Harrisburg, Pa.	276
WBAL	Gas and Electric Co., Baltimore, Md.	246
WBAO	James Millikia University, Decatur, Ill.	270
WBAP	Star Telegram, Fort Worth, Tex.	476
WBAX	J. H. Stenger, Jr., Wilkes-Barre, Pa.	256
WBBL	Grace Covenant Presbyterian Church, Richmond, Va.	229
WBBM	H. L. Atlass, Chicago, Ill.	226
WBBP	Petoskey High School, Petoskey, Mich.	238
WBBR	Peoples Pulpit Ass'n., Rossville, N. Y.	275
WBBS	1st Baptist Church, New Orleans, La.	252
WBBW	Ruffner City High School, Norfolk, Va.	222
WBBY	Washington Light Infantry, Charleston, S. C.	268
WBBZ	C. L. Carrell, (Portable), Chicago, Ill.	216
WBCN	Southtown Economist, Chicago, Ill.	266
WBDC	Baxter Laundry Co., Grand Rapids, Mich.	256
WBES	Bliss Electrical School, Takoma Park, Md.	222
WBOQ	A. H. Grebe & Co., Richmond Hill, N. Y.	236
WBNY	Miss S. Katz, New York City.	210
WBPI	I. R. Nelson Co., Newark, N. J.	263
WBR	State Police, Butler, Pa.	203
WBRC	Bell Radio Corp., Birmingham, Ala.	248
WBRE	Baltimore Radio Ex., Wilkes-Barre, Pa.	231
WBT	Charlotte Chamber of Commerce, Charlotte, N. C.	275
WBZ	Westinghouse E. & M. Co., Springfield, Mass.	333
WBZA	Westinghouse Electric and Mfg. Co., Boston, Mass.	242
WCAC	Agricultural College, Mansfield, Conn.	275
WCAD	St. Lawrence University, Canton, N. Y.	263
WCAE	Kaufman & Baer, Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University, University Place, Neb.	254
WCAL	St. Olaf College, Northfield, Minn.	337
WCAO	Brager of Baltimore, Baltimore, Md.	275
WCAP	C. & P. Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp., San Antonio, Texas	263
WCAT	School of Mines, Rapids City, S. D.	240
WCAU	Universal Broadcasting Co., Philadelphia, Pa.	278
WCAX	University of Vermont, Burlington, Vt.	250

Station	Owner and Location	Meters
WCBA	C. W. [illegible]bach, Allentown, Pa.	254
WCBD	W. G. Voliva, Zion, Ill.	345
WCBE	Uhalt Radio Co., New Orleans, La.	263
WCBH	University of Mississippi, Oxford, Miss.	242
WCBM	Hotel Chapeau, Baltimore, Md.	229
WCBQ	1st Baptist Church, Nashville, Tenn.	236
WCBR	C. H. Messter (Portable), Providence, R. I.	205
WCCO	Gold Medal Station, Minneapolis, St. Paul, Minn.	416
WCK	Stix Baer & Fuller Co., St. Louis, Mo.	273
WCLO	C. E. Whitmore, Camp Lake, Wis.	231
WCLS	H. M. Church, Joliet, Ill.	214
WCM	Texas Market Department, Austin, Texas	268
WCOA	Municipal Broadcasting Station, Pensacola, Fla.	222
WCSH	Henry P. Rines, Portland, Me.	256
WSCO	Wittenberg College, Springfield, Ohio.	248
WCUW	Clark University, Worcester, Mass.	238
WCWS	C. W. Selen, Providence, R. I.	210
WCX	Detroit Free Press & Jewitt Radio and Phonograph Co., Pontiac, Mich.	517
WDND	Dod's Auto Accessories, Inc., 160-164 8th Ave., N., Nashville, Tenn.	226
WDZ	J. L. Bush, Tuscola, Ill.	278
WDAD	Dad's Auto Accessories, Inc., Nashville, Tenn.	226
WDAE	Tampa Daily News, Tampa, Fla.	273
WDAF	Kansas City Star, Kansas City, Mo.	366
WDAG	J. L. Martin, Amarillo, Tex.	263
WDAH	Trinity Metr. Church, El Paso, Tex.	268
WDAY	Radio Equipment Corp., Fargo, N. D.	261
WDBC	Kirk Johnson & Co., Lancaster, Pa.	258
WDBE	Gilham-Schoen Elec. Co., Atlanta, Ga.	278
WDBJ	Richardson Wayland Elec. Co., Roanoke, Va.	229
WDBK	M. F. Broz, Furn., Cleveland, O.	227
WDBO	Rollins College, Winter Park, Fla.	240
WDBR	Tremont Temple Baptist Church, Boston, Mass.	261
WDBZ	Boy Scouts of America, Kingston, N. Y.	233
WDCH	Dartmouth College, Hanover, N. H.	250
WDOD	Chattanooga Radio Co., Chattanooga, Tenn.	256
WDZ	J. L. Bush, Tuscola, Ill.	278
WDRC	Doolittle Radio Corp., New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc., Cranston, R. I.	441
WEAF	A. T. & T. Co., N. Y. City, N. Y.	492
WEAH	Hotel Lassen, Wichita, Kans.	268
WEAI	Cornell University, Ithaca, N. Y.	254
WEAM	Borough of North Plainfield, N. Plainfield, N. J.	261
WEAN	Shepard Co., Providence, R. I.	270
WEAO	Ohio State University, Columbus, O.	294
WEAR	Goodyear T. and R. Co., Cleveland, O.	390
WEAU	Davidson Bros. Co., Sioux City, Ia.	275
WEBC	W. C. Bridges, Superior, Wisc.	242
WEBD	Elec. Equipment & Service Co., Anderson, Ind.	246
WEBE	Roy W. Waller, Cambridge, Ohio.	234
WEBH	Edgewater Beach Hotel, Chicago, Ill.	370
WEBJ	Third Avenue R. R. Co., New York, N. Y.	273
WEBK	Grand Rapids Radio Co., Grand Rapids, Mich.	242
WEBL	Radio Corp. of Ama. (Portable).	226
WEBM	Radio Corp. of Ama. Portable Mobile Station	226
WEBQ	Tate Radio Co., Harrisburg, Ill.	226
WEBR	H. H. Howell, Buffalo, N. Y.	244
WEBW	Beloit College, Beloit, Wisc.	268
WEBZ	Savannah Radio Corp., Savannah, Ga.	263
WEEI	Edison Electric Illuminating Co., Boston, Mass.	476-349
WEHS	Robert E. Hughes, Evanston, Ill.	203
WEMC	Emm. Missionary College, Merrien Springs, Mich.	286
WENR	Ail-Amer. Radio Corp., Chicago, Ill.	266
WEW	St. Louis University, St. Louis, Mo.	248
WFAA	Dallas News & Journal, Dallas, Tex.	476
WFAM	The Times, St. Cloud, Minn.	273
WFAV	University of Nebr., Lincoln, Nebr.	275
WFBC	1st Baptist Church, Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church, Philadelphia, Pa.	234
WFBE	J. V. De Walle, Seymour, Ind.	226
WFBG	W. F. Gable Co., Altoona, Pa.	278
WFBH	Concourse Radio Corp., New York, N. Y.	273
WFBI	Galvin Radio Supply Co., Camden, N. J.	236
WFBJ	St. Johns University, Collegeville, Minn.	236
WFBL	Onondaga Hotel, Syracuse, N. Y.	252
WFBM	Merchants Lighting Co., Indianapolis, Ind.	268
WFBR	Maryland National Guard, Baltimore, Md.	254
WFBZ	Knox College, Galesburg, Ill.	254
WFDF	F. D. Fallain, Flint, Mich.	234
WFI	Strawbridge & Clothier, Philadelphia, Pa.	395
WFKB	F. K. Bridgman, Chicago, Ill.	217
WFRL	R. M. Lacey, Brooklyn, N. Y.	205
WGAL	Lancaster Elec. Supply Co., Lancaster, Pa.	248
WGBB	H. H. Carman, Freeport, N. Y.	244
WGBC	1st Baptist Church, Memphis, Tenn.	266
WGBF	The Finke Furniture Co., Evansville, Ind.	236
WGBI	Frank S. Megargee, Scranton, Pa.	240
WGBM	T. N. Saaty, Providence, R. I.	234
WGBU	Florida Cities Finance Co., Fulford By-the-Sea, Fla.	278
WGBR	Marshfield Broadcasting Association, Marshfield, Wis.	229
WGBS	Gimbel Brothers, New York, N. Y.	316
WGBX	University of Maine, Orono, Maine.	252
WGES	Oak Leaves Broadcasting Station, Oak Park, Ill.	250
WGHB	G. H. Boules, Developments, Clearwater, Fla.	266
WGN	The Tribune, Chicago, Ill.	303
WGMU	A. H. Grebe & Co., Inc., Richmond Hill, N. Y.	236
WGCP	Grand Central Palace, N. Y. City.	252
WGHP	G. H. Phelps, Inc., Detroit, Mich.	270
WGR	Federal Telephone Mfg. Co., Buffalo, N. Y.	319
WGST	Ga. School of Tech., Atlanta, Ga.	270
WGWY	Dr. G. W. Young, Minneapolis, Minn.	263
WGY	General Elec. Co., Schenectady, N. Y.	380
WHA	University of Wisconsin, Madison, Wis.	535
WHAD	Marquette University, Milwaukee, Wis.	275
WHAM	University of Rochester, Rochester, N. Y.	278
WHAP	Taylor Finance Corp., 426 West 31st St., New York City.	241
WHAR	F. P. Cook's Sons, Atlantic City, N. J.	278
WHAS	The Courier Journal-Times, Louisville, Ky.	400
WHAV	Wilmington Elec. Spec. Co., Wilmington, Del.	266
WHAZ	Rensselaer Polytechnic Institute, Troy, N. Y.	280
WHB	Sweeney School Co., Kansas City, Mo.	366
WHBA	Shaffer Music House, Oil City, Pa.	250
WHBC	Rev. E. P. Graham, Canton, Ohio.	254
WHBD	Charles W. Howard, Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Co., Rock Island, Ill.	222
WHBG	John S. Skane, Harrisburg, Pa.	231
WHBH	Culver Military Academy, Culver, Ind.	222
WHBJ	Laver Auto Co., Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Ellsworth, Me.	231
WHBL	J. H. Slusser, Logansport, Ind.	216
WHBM	C. L. Carroll (Portable), Chicago, Ill.	233
WHBN	1st Ave. Methodist Church, St. Petersburg, Fla.	238
WHBP	Johnstown Auto Co., Johnstown, Pa.	256
WHBR	Scientific E. & M. Co., Cincinnati, O.	216
WHBU	B. L. Bing's Sons, Anderson, Ind.	219
WHBW	D. R. Kienzle, Philadelphia, Pa.	216
WHDI	Wm. Hood Dunwoody Ind. Inst., Minneapolis, Minn.	278
WHEC	Hickson Elec. Co., Rochester, N. Y.	258
WHN	George Schubel, New York, N. Y.	361
WHK	Radio Air Service Corp., Cleveland, Ohio	273
WHO	Bankers Life Co., Des Moines, Ia.	526
WHT	Radiophone Corp., Deerfield, Ill.	238
WIAD	H. R. Miller, Philadelphia, Pa.	250
WIAS	Home Electric Co., Burlington, Ia.	254
WIBA	Capital Times, Madison, Wis.	236
WIBG	St. Paul's E. P. Church, Elkins Park, Pa.	222
WIBH	Elite Radio, New Bedford, Mass.	210
WIBI	Fredk. B. Zittell, Flushing, N. Y.	219
WIBJ	C. L. Carrell, Chicago (portable).	216
WIBO	Nelson Bros., Chicago, Ill.	226
WIBN	Elite Radio Stores, New Bedford, Mass.	210
WIBM	Billy Maine, Chicago, Ill.	216
WIBO	F. M. Schmidt, Farina, Ill.	226
WIBR	Thurman A. Owings, Weirton, W. Va.	246
WIBS	N. J. National Guard, Elizabeth, N. J.	203
WIBU	The Electric Farm, Faynette, Wis.	222
WIBW	Dr. L. L. Dill, Logansport, Ind.	220
WIBX	Grid-Leak, Inc., Utica, N. Y.	205
WIBZ	Powell Electric Co., Montgomery, Ala.	231
WIL	Benson Radio Co., St. Louis, Mo.	273
WIP	Gimbel Brothers, Philadelphia, Pa.	508
WJAD	Jackson's Radio Elec. Co., Waco, Tex.	353
WJAG	Norfolk Daily News, Norfolk Nebr.	270
WJAK	Rev. C. L. White, Greentown, Ind.	254
WJAM	D. M. Perham, Cedar Rapids, Ia.	268
WJAR	The Outlet Co., Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	275
WJAX	Voice of Jacksonville, Fla.	337
WJAZ	Zenith Radio Corp., Chicago, Ill.	322
WJBA	D. H. Lentz, Jr., Joliet, Ill.	207
WJBB	L. W. McClung, St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co., 2nd and Joilet Sts., La Salle, Ill.	234
WJBG	Interstate Radio, Inc., Charlotte, N.C.	224
WJBI	R. S. Johnson, Red Bank, N. J.	219
WJBK	Ernest F. Goodwin, Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co., Decatur, Ill.	270
WJBP	Seneca Vocational School, Buffalo, N. Y.	219
WJBQ	Bucknell University, Lewisburgh, Pa.	211
WJBR	Omro Drug Store, Omro, Wis.	228
WJBU	Bucknell University, Lewisburg, Pa.	212
WJJD	Loyal Order of Moose, Mooseheart, Ill.	370
WJR	Detroit Free Press and Jewett Radio and Phonograph Co., Pontiac, Mich.	517
WJY	Radio Corp. of Ama., New York, N. Y.	405
WJZ	Radio Corp. of Ama., New York, N. Y.	455
WKAA	H. F. Paar, Cedar Rapids, Iowa	278
WKAF	WKAF Broadcasting Co., Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico, San Juan, P. R.	341
WKAR	Mich. Agricultural College, Lansing	285
WKAV	Lacona Radio Club, Laconia, N. H.	210
WKBB	Sanders Bros., Joliet, Ill.	214
WKBE	K. & B. Electric Co., Webster, Mass.	231
WKBG	C. L. Carrell, (Portable) Chicago, Ill.	216
WKRC	Kodel Radio Corp., Cincinnati, O.	326.-422
WKY	C. E. Hill and H. S. Richards, Oklahoma City, Okla.	275
WLAL	1st Presbyterian Church, Tulsa, Okla.	250
WLB	University of Minn., Minneapolis, Minn.	278
WLBL	Wisconsin Department of Markets, Stevens Point, Wis.	278
WLIB	Liberty-Weekly Inc., Elgin, Ill.	303
WLIT	Lit Brothers, Philadelphia, Pa.	395
WLS	Sears Roebuck Co., Chicago, Ill.	345
WLTS	Lane Technical High School, Chicago, Ill.	258
WLW	Crosley Radio Corp., Cincinnati, O.	422
WLWL	Missionary Society of St. Paul the Apostle, N. Y. City.	288
WMAC	C. B. Meredith, Cazenovia, N. Y.	275
WMAF	Round Hills Radio Corp., Dartmouth, Mass.	441
WMAK	Norton Laboratory, Lockport, N. Y.	266
WMAL	Leese Optical Co., Washington, D. C.	213
WMAN	1st Baptist Church, Columbus, O.	278
WMAQ	Chicago Daily News, Chicago, Ill.	448
WMAY	Kings Highway Presbyterian Church, St. Louis, Mo.	248
WMAZ	Mercer University, Macon, Ga.	261
WMBB	American Bond and Mortgage Co., Chicago, Ill.	250
WMBF	Fleetwood Hotel, Miami Beach, Fla.	384
WMC	The Commercial Appeal, Memphis, Tenn.	500
WMCA	Hotel McAlpin, N. Y. C.	341
WNAB	Shepard Stores, Boston, Mass.	250
WNAC	Shepard Stores, Boston, Mass.	280
WNAD	University of Okla., Norman, Okla.	254
WNAL	Omaha Central High School, Omaha, Nebr.	258
WNAT	Lenning Bros. Co., Philadelphia, Pa.	250
WNAX	Dakota Radio App. Co., Yankton, S. D.	244
WNBH	New Bedford Hotel, New Bedford, Mass.	248
WNJ	Radio Shop, Newark, N. J.	252
WNOX	Peoples Tel. & Tel. Co., Knoxville, Tenn.	268
WNYC	Municipal Station, New York, N. Y.	526
WOAI	South East Equipment Co., San Antonio, Texas	395
WOAN	Vaughan Con. of Music, Lawrenceburg, Tenn.	283
WOAW	Woodmen of the World, Omaha, Nebr.	526
WOAX	F. J. Wolff, Trenton, N. J.	240
WOC	Palmer School of Chiro, Davenport, Ia.	484
WOCL	Hotel Jamestown, Jamestown, N. Y.	275
WODA	O'Dea Temple of Music, Paterson, N. J.	224
WOI	Iowa State College, Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co., Homewood, Ill.	217
WOKO	Otto Baur, N. Y. City	233
WOO	John Wanamaker, Philadelphia, Pa.	508
WOQ	Unity School of Christianity, Kansas City, Mo.	278
WOR	L. Bamberger & Co., Newark, N. J.	405
WORD	Peoples Pulpit Assn., Batavia, Ill.	275
WOS	Mo. State Marketing Bureau, Jefferson City, Mo.	441
WOWL	Owl Battery Co., New Orleans, La.	270
WOWO	Main Auto Supply Co., Ft. Wayne, Ind.	227
WPAK	N. D. Agricultural College, Agricultural College, N. D.	275
WPCC	N. D. Agri. College, N. D.	275
WPDP	Hiram L. Turner, Buffalo, N. Y.	205
WPG	Municipality, Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co., Harrisburg, Pa.	216
WPSC	Penn State College, State College, Pa.	261
WQAA	H. A. Beale, Jr., Parkersburg, Pa.	220
WQAE	Moore Radio News Station, Springfield, Vermont	246
WQAM	Electric Equipment Co., Miami, Fla.	263
WQAW	Scranton Times, Scranton, Pa.	250
WQAO	Calvary Baptist Church, New York, N. Y.	360
WQJ	Calumet Rainbo Broadcasting Co., Chicago, Ill.	448
WRAF	Radio Club, Inc., Laporte, Ind.	224
WRAM	Lombard College, Galesburg, Ill.	244
WRAV	Antioch College, Yellow Springs, O.	263
WRAW	Avenue Radio Shop, Reading, Pa.	238
WRAX	Flexon's Garage, Gloucester City, N. J.	268
WRBC	Immanuel Lutheran Church, Valparaiso, Ind.	278
WRC	Radio Corp. of America, Washington, D. C.	469
WRCO	Wynna Radio Co., Raleigh, N. C.	252
WREO	Reo Motor Co., Lansing, Mich.	286
WRHM	Rosedale Hospital, Minneapolis, Minn.	252
WRK	Doron Bros., Elec. Co., Hamilton, O.	270
WRNY	Experimenter Publishing Co., (Radio News) N. Y. City.	258
WRM	University of Illinois, Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., Motor Yacht Mu-1, N. Y. City.	236
WRST	Radiotol Mfg. Co., Inc., 5 First Ave. Bay Shore, N. Y.	216
WRVA	Laurus & Bros., Co., Richmond, Va.	256
WRW	Tarrytown Research Laboratory, Tarrytown, N. Y.	273
WSAI	U. S. Playing Card Co., Cincinnati, O.	326
WSAJ	Grove City College, Grove City, Pa.	229
WSAN	Allentown Call, Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAX	Zenith Radio Corp., Chicago, Ill.	268
WSAZ	Chase Electric Shop, Pomeroy, Ohio	244
WSB	The Atlanta Journal, Atlanta, Ga.	428
WSBC	World Battery Co., Chicago, Ill.	210
WSBF	Stix Baer and Fuller, St. Louis, Mo.	273
WSBT	South Bend Tribune, South Bend, Ind.	275

(Concluded on page 24)

A THOUGHT FOR THE WEEK

"And a little child shall lead them"—which applies frequently to the youngsters of a family who show their elders there are things in the radio, heaven and earth, that the older philosophy knows not.

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¼ Page, 4⅛" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

APRIL 3, 1926

Kind Words Uttered by Good Friends

Editor, RADIO WORLD,
145 West 45th St.,
New York City.

At the beginning of the Fifth Year of RADIO WORLD a brief glance into the future of radio is appropriate.

During the last two years the infant Radio has suffered from almost every disease known to childhood, including measles and very much whooping cough. The task most directly ahead of those who are to direct its destiny is to cure it of some of these diseases—notably those of a pulmonary nature, in other words to improve the speaking and singing voice of radio.

There is not a set on the market today which with its loud-speaker gives perfect reproduction of music, as transmitted from our best broadcasting stations. Every set on the market today either howls, squeals or in some way distorts the sound. This lamentable condition of affairs is quite unnecessary. Designers have been too economical; have sought to make one tube do the work of two or more; have tolerated back-feeding; have failed to sufficiently shield the various elements of their sets. Their slogan for the ensuing year should be "QUALITY," Improve, Improve.

I hope the day of the bargain sale receiving set is past, and that from now on designers will concentrate on the task of attaining the best possible quality of sound reproduction for their customers, even if the receiver costs considerably more, and the volume of sales is thereby diminished.

RADIO WORLD, and other leading journals in this field, have in my opinion a distinct mission to perform in raising the standard of sound quality in the radio receiving sets of the future.

LEE DE FOREST.

* * *

To RADIO WORLD:

Birthday Greetings:

May you continue to aid the Radio Industry and its patrons by your service, which has been so helpful to those who are interested in availing themselves of the information you are giving.

To your readers I would suggest that they interest themselves in learning the Telegraphic Code, wherein a wonderful field for further radio education, development and entertainment may be theirs, and thus be preparing for the next step which will be the transmission and reception of moving objects and sound, simultaneously, via Radio.

There is, at the present moment, well-defined, objective research taking place in the laboratories of the world's universities, industrial plants and by individuals, which will no doubt be startling in their results.

Weather conditions will be controlled by Radio.

Power direction, transmission and control is on the horizon.

Radio has already become the medium through which man may, with his fellowmen separated by distance or space, write and read, speak and hear, move and see, and touch and feel.

All creeds, nationalities and colors of the human race will be influenced by its service in promoting happiness, good will and peace.

Very truly yours,
HENRY M. SHAW,
President,
National Radio Trade Association.

* * *

Mr. Roland Burke Hennessy,
RADIO WORLD,
145 West 45th St., New York City.

My dear Mr. Hennessy:

My congratulations to you and to RADIO WORLD on the beginning of your fifth year. As an ordinary radio fan, I have been following you from the very start and as a rival editor, I have envied you the ability to do some of the things that you have done.

That your magazine is spreading the gospel of good radio was amply proved when demands from my own readers compelled me recently to publish one of your circuits and give you credit for it.

This is something I have never done for any other radio magazine.

Very truly yours,
HENRY M. NEELY,
Editor.
Radio In The Home.

The Fifth Year of Radio World

IT is difficult to explain just why an editor should expect the public to become excited over the birthday of his publication. A birthday is really a very personal matter, except in cases of eminent personages or tremendous events that perforce leave their impress on the pages of history. However, custom is sometimes stronger than reason, and therefore it is only natural that the publishers and editors of RADIO WORLD should be a little heady over the passing of the fourth birthday and the start of a fifth year of this publication.

RADIO WORLD has not upset all newspaper traditions by doing superlatively well all those things that other publications have been able to do only fairly well. It does not hide behind an irritating smugness and contend that it is fully satisfied with all the things it has attempted to do, nor does it believe that it cannot vastly be improved in the future. But—

RADIO WORLD can at least bask in the more or less complacent satisfaction that it has not utterly failed in any of its ambitions. It started out to serve the interests of radio fans, and, in a broader measure, the interests of everybody interested in any way in radio. How well this earnest attempt has been appreciated and understood is amply shown by the fact that each year has seen an increase in its army of newsstand purchasers, in its impressive paid-in-advance subscription list and in its advertising patronage.

But the greatest satisfaction of all comes in the knowledge that we, the editors and publishers and entire staff have succeeded in building a good will that is splendid in its size and vastly potential in its possibilities.

Let us not dscount the value of good will. It is that intangible but tremendous something that empires, republics, great corporations and combinations, and big and little men have attempted to create throughout the centuries. Those that have failed have done so because there was a basic weakness somewhere in their structures. Those that have succeeded have created an asset that cannot be measured by the yardstick of dollars.

Therefore RADIO WORLD, in building up a magnificent good will, has done something worth while and lasting. We know we have done this. Letters in our daily mail prove how closely we have grown to the hearts as well as the intellects of our readers. They trust us. They know that our first regard is for the interests of our readers. They know that truth as we see it is reflected in our reading columns. They know we are not afraid. They know also that in this strength that is ours we are not overbearing, nor vengeful, nor fearful of taking sides in matters because they happen to be the sides of the weaker. Success is only worth the candle if it comes with a certain quality of humility that is no kin of subservience. We treasure our friends. If we have enemies, we do not fear them.

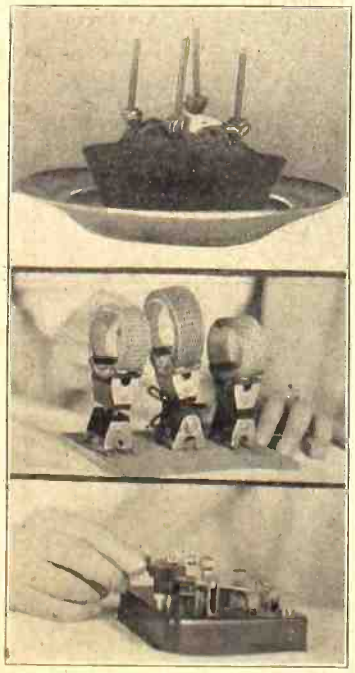
Service, service, and yet more service for our readers is our watchword.

And so, if during our fifth year we shall add to the good will we have already seen grow to fine proportions, we shall be content. THE EDITOR.

Radio Knife Cures

THE RADIO knife, recent radio development, is shown above being put into operation by one of the nurses at the Vanderbilt Clinic, New York City. Through the cutting edge of the knife, which as will be noted, resembles that of a needle, are run high frequency currents. A cold spark is emitted, bringing about an electrical cauterization, which does not burn the tissues. (International Newsreel).

Birthday Recalls Favorites of 1922



The fact that RADIO WORLD has passed through four happy years of existence, and thus entitled to a birthday cake with four lighted candles, recalls that four years ago honeycombs were the ruling coils on tube sets and the simple crystal set was popular. Radio has learned much and progressed far since then. Multi-tube sets are the rage and circuit design has been greatly improved.

Four years hence what do you suppose will be the radio situation?

THE RADIO TRADE

Fiat Loop Proves Efficient in Tests

The Fiat Loop, manufactured by the Radio Appliance Laboratory, 4,884 North Clark Street, Chicago, Ill., is a bank-wound loop of fine efficiency, as was proven in tests made in RADIO WORLD'S Laboratories. This loop is officially certified by Herman Bernard for use in conjunction with the 1926 Model Diamond of the Air.

The loop is wound for a .0005 or .00035 condenser across it. Thus it is adaptable for the Super-Heterodynes, reflexes, tuned radio-frequency sets and the newer Neutrodynes.

The Fiat loop is collapsible and is thus excellent for portability. It is of very attractive appearance and excellent workmanship.

The laboratory test report follows: self-inductance, .00019 henry; distributed capacity, 17.38 micro-mfd.; natural wavelength, 108 meters; resistance at 1,000,000 cycles, 8.8 ohms; wave band covered with .0005 mfd. condenser across the loop, 180 to 600 meters.

(Tested and Approved by RADIO WORLD)

Pillsbury Is Named Executive in Drive

E. B. Pillsbury, general manager of the Radio Corporation of America, has accepted the chairmanship of the committee to cover the radio industry in the annual Maintenance Appeal for the work of the Salvation Army in Greater New York. Mr. Pillsbury will appoint prominent men in the radio industry to help him in bringing the appeal to the attention of every company, executive and employee in the field.

The appeal will be before the public during the month of May, and the preliminary organization work is now being carried on under the direction of Brigadier Edward Underwood from campaign headquarters in the Knickerbocker Building. The budget calls for $517,000, which amount wil be used in financing the varied humanitarian activities carried on by the Army's 43 institutions of mercy throughout the city.

Business Opportunities Radio and Electrical

Rates: 10 c per word; Minimum, $1.00; Cash with order

WANTED—ALL KINDS OF METAL STAMPING in any kind of metal; we handle 50,000 pieces daily; can manufacture anything in metal; can make your dies for maufacturing any article; at low prices; we own our own water power, our overhead is small; we can save you from 20 to 40 per cent. in manufacturing metal stamping. Address the Hart Manufacturing Company, Unionville, Conn.

COMPLETELY EQUIPPED RADIO PLANT, machine shop, precision lathes, screw machines, presses, fifteen automatic triple winding machines, tools and dies, raw materials used in manufacturing nationally known phone and loud speaker, for sale at $5,000, about 25 per cent. of original investment. Box 00, Radio World.

RADIO MAN—ATTENTION—WILL SUBLET space in piano, phonograph establishment, doing big business; excellent transient section. Bronx. Further iformation, Room 4, 354 East 149th, N. Y. City.

SPORTING GOODS, LUGGAGE, RADIO suburbs of New York; 5 years established; $42,000 yearly business; will sell stock, fixtures and good will for $5,000; rare opportunity. Box G. G., Radio World.

Literature Wanted

THE names of readers of RADIO WORLD who desire literature from radio jobbers and dealers are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

Trade Service Editor,
RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature.

Name .....
City or town.....
State .....
Are you a dealer?.....
If not, who is your dealer?
His Name .....
His Address .....

A. H. Hill, Richwood, O. (Dealer).
H. D. Nichol, 8 Eaton Place, East Orange, N. J.
T. W. Hayes, 514 Walnut St., Anaconda, Montreal, Canada.
T. Pentland, Stockdale, Pa.
L. S. Vance, 915½ North Robinson, Oklahoma City, Okla.
Frank Lee, 1126 West 34th St., Oklahoma City, Okla.
Asa Schenck, 704 West 24th St., Oklahoma City, Okla.
G. N. Scheve, 1724 East 55, Cleveland, O.
Raymond Smith, 33 Algonquin Apt., Port Huron, Mich.
R. H. Thomas, 20 East Ravenwood Ave., Youngstown, O. (Dealer).
J. L. Bohon, R. 7, Sedalice, Mo.
J. E. Giddings, Watertown, N. Y.
C. N. Blaiock, 143 State Capitol, Atlanta, Ga.
Roy Percifield, Big Spring, Tex.
Peter B. Pehosky, Excelsior, Pa. (Dealer).
Robert Conner, Jr., 219 Lincoln Ave., Geneva, Ill.
John May, 1175 Market St., San Francisco, Cal.
H. E. Saumby, c/o Commodore Apts., Cleveland, O.
D. R. Burbank II, 38 Hemenway St., Suite 62, Boston, Mass.
J. M. Canestorp, Bergen, N. D. (Dealer).
Excelsior Supply Co., Box 229, Richmond, Va.
J. K. Blake, 610 McFadden Drive, Ponca City, Okla.
George H. Dunn, East Northport, L. Is., N. Y. (Dealer).
Milton Hellman, 6546 Greenwood Ave., Chicago, Ill.
David Wachstetter, Bethlehem, Pa. (Dealer).
Ben W. Lacher, 882 Kelly St., Bronx, N. Y.
Rodney Brown, 630 East 8th St., Portland, Ore.
Ira Waddell, 931 Clay Ave. Detroit Mich. (Dealer).
John Benedict, 68 West Side Ave., Hagerstown, Md.
John Collier, 195 Hampden St., Roxbury, Mass.
J. R. Denison, Pomeroy, Wash. (Dealer).
Walter Chapleau, 5650 Loomis Blvd., Chicago, Ill.
Ralph E. Sherman, 614 East 39th St., Brooklyn, N. Y.
J. H. Kinzel, Laeger, W. Va.
Fred E. Lovkey, 986 Beech St., St. Paul, Minn.
V. V. Bludgett, 2965 Gaul St., Philadelphia, Pa.
A. O. Anderson, Aquilla, Tex. (Dealer).
Adrian Post Compton, 164 Watson Ave., West Orange, N. J.
Oscar S. Riswold, Roesmount, Minn.
Michael Sotah, Jr., New Eagle, Pa.
P. J. Boaéuf, 1527 Oakland St., Ft. Wayne, Ind.
Clifford Dodd, Strathroy, Ontario, Canada.
Francis Easley, Vandergrift, Pa.

Exports for December Amount to $967,222

WASHINGTON.

Radio exports during December maintained the high average for 1925 with a total of 817,424 pounds of apparatus valued at $967,222. The principal purchasers of American radio equipment during December were Australia, $62,565; Japan, $41,567; Argentina, $23,391; Cuba, $18,037; Mexico, $37,274; Canada, $569,746; United Kingdom, $78,278, and Netherlands, $15,223.

PART 2 OF THE KB-8 APPEARED in RADIO WORLD dated March 20. Sent on receipt of 15c, or start sub, with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

The Split Portable

(Concluded from page 4)

transformer, nor shown in the diagram, hence this need not be considered further. The rest of the circuit is familiar to all who know anything about radio—a detector tube, followed by an audio amplifier.

As many who build Super-Heterodynes tackle the circuit for the first time, and have some difficulty in understanding the oscillator hookup, I will take this up specially.

A glance at the diagrams will show that the oscillator hookup is nothing less familiar than a 3-circuit tuner, with grid return to negative A. There are a primary coil, L1, a secondary, L2, and a plate coil L3. Unlike the 3-circuit tuner, the oscillator has a fixed plate coil, in inductive relationship to the grid coil, since the only object is to generate oscillations over the entire band, and this is accomplished by insuring oscillations at the highest oscillator wavelength (lowest frequency).

The primary is connected so that one terminal goes to the loop terminal other than the one that goes to grid. This of course is the grid return or low potential side of the loop. Instead of connecting the rotor plates of C1 and the corresponding loop tip to A plus direct, it is joined to one terminal of the primary L1 of the oscillator coil system, the end of this coil going to A plus. Hence the signal frequency travels in this primary and the mixing of frequencies takes place, because that primary is in inductive relationship to the secondary of the oscillator coil.

The condensers used for tuning were the General Radio Type 247-N, with a maximum capacity of .00035 mfd., and operating on a straightline wavelength characteristic. Hence a loop must be wound or purchased accordingly, unless one desires to use .0005 mfd. condensers instead, which is quite feasible. These would be General Radio Type 247-F. These condensers — both types — have counterweights, without gear. While they are heavy they are extremely rugged, and one must build a portable fortified against harm by accidental rough treatment. The Fiat loop suits 247-N.

The coil problem is a small one, since the loop is the radio-frequency tuning coil and will be purchased or wound by the constructor, and the oscillator coil may be a 3-circuit affair designed for .00035 mfd. tuning, and from which turns are removed until the dial readings of the oscillator are the same as those for the modulator. This identity of dial readings seems to be an important factor with many fans, and as it is hard to make coils commercially so as to insure such synchrony, fans desiring the much-vaunted benefit may resort to the turns-off method. The Sickles coil was used in the laboratory model and had the combined merit of efficiency and compactness. Moreover, its binder renders it relatively moisture-proof, a consideration of first importance where one builds a portable which inevitably must be put to the test of the cool damp air of mountain and lakeside nights.

On the score of departure from ordinary hookups, besides the three-fold audio transformer coupling, fully justified, there will be noted the absence of a potentiometer as a stabilizing agency and the presence of only one rheostat for the entire chain of tubes. The potentiometer was found unnecessary. As the hookup stands, the bias on the grids is 1½ negative, amounting to the rheostat drop, excepting the modulator and the second detector, which have grid returns to positive A. If this negative bias is found to induce too much free oscillation for the rheostat to control, the grid return of tubes (3) and (4) may be connected to negative filament, instead of to negative A, so that there will be zero bias on the grid. If the set is properly constructed this is bound to be a free oscillation squelcher.

Part II next week

Sound is Transmitted On Short Light Waves

CAMBRIDGE, MASS.

Light waves have been used successfully as the beam for transmitting sounds. The experiments were conducted by D. C. Stockbarger, instructor of physics. Massachusetts Institute of Technology. The directional effect is very pronounced. Mr. Stockbarger showed the range of transmission to be limited only by the intensity of the light source used and the directional quality by the diameter of the beam of light.

This is of great importance, experts say. In explaining his theory, Mr. Stockbarger said he found that by means of an apparatus which he had constructed he could send messages great distances by means of an extremely powerful searchlight so focused as to maintain a narrow beam throughout its range. Since the light waves most concerned in carrying the radio signals are those at the short wave end of the spectrum in the region of violet and ultra violet, it was obvious, he said, that the process when refined would employ only the invisible ultra rays.

Batteries Run Down Even When Not In Use

Even though you are not using your set, batteries will run down. A full charge storage lead battery of the 100 ampere hour type usually will last one month, when not in use. The battery is not completely run down, but it is not in best condition for use on a receiver employing more than three tubes. The run-down effect will not be noticed immediately upon lighting the tubes, as there will be a certain amount of energy stored up, this being greater than the original voltage,. This voltage will quickly run down. At all times though, the specific gravity of the acid will be low. Therefore, if you are not using the set, charge the battery every month. If you use the battery, say for three hours every night it should be charged every two weeks.

Common Ground Makes One Set Trap Another

Common grounds are as much an offender of re-radiation and wavetrapping as parallel antennas or oscillating receivers. If a ground is made to a specific pipe of the water system in an apartment house and another ground made to the same pipe, the tuning of one receiver to a specific wave length may trap out this program from the original set. One set, in an entirely different part of the house, will be able to tune out the same station that another set is trying to tune in. This can be avoided by finding out which portions of the water pipe (located in the kitchen and the bathroom, etc.) are used as grounds by various persons in the house. This offense one may appropriately call **wavetrapping.**

With receivers that oscillate, re-radiation is a constant offense. When a station is tuned in at a point where the tube is oscillating the same station will be heard by other receiver nearby. The receiver acts as a transmitter and may blot out, broaden or make louder the signals of any station tuned in.

List of Stations

(*Concluded from page 19*)

Station	Owner and Location	Meters
WSDA	Seventh Day Adventist Church, N. Y. City	263
WSKC	World's State Knitting Co., Bay City, Mich.	261
WSM	National Life and Accident Ins., Nashville, Tenn.	283
WSMB	Saenger Amusement Co., New Orleans, La.	319
WSMH	Shathick Music House, Owosso, Mich.	240
WSMK	G. M. K. Radio Corp., Dayton, O.	275
WSOE	School of Engineering, Milwaukee, Wisc.	246
WSRO	H. W. Fahlander, Hamilton, Ohio	251
WSUI	State University of Iowa, Iowa City, Ia.	489
WSWS	S. W. Strauss Co., Batavia, Ill.	275
WTAB	Fall River Daily Herald, Fall River Mass.	266
WTAD	R. E. Compton, Carthage, Ill.	236
WTAG	Worcester Telegram Publishing Co., Worcester, Mass.	268
WTAL	Toledo Radio & Elec. Co., Toledo, O.	252
WTAM	Willard Storage Battery Co., Cleveland, Ohio	389
WTAP	Cambridge Radio Elec. Co., Cambridge, Ill.	242
WTAQ	S. Van Gordon & Son, Osseo, Wis.	254
WTAR	Reliance Radio & Elec. Co., Norfolk, Va.	261
WTAS	Charles E. Erbstein, Elgin, Ill.	303
WTAW	Agricultural & Mech. College, College Station, Tex.	270
WTAX	Williams Hardware Mfg. Co., Streator, Ill.	231
WTAZ	T. J. McGuire, Lambertville, N. J.	261
WTIC	Travelers Insurance Co., Hartford Conn.	349-476
WWAD	Wright & Wright, Inc., Philadelphia, Pa.	250
WWAE	Electric Park, Plainfield, Ill.	242
WWAO	Michigan College of Mines, Houghton, Mich.	263
WWGL	Radio Engineering Corp., Richmond Hill, N. Y.	213
WWI	Ford Motor Co., Dearborn, Mich.	266
WWJ	Detroit News, Detroit, Mich.	353
WWL	Loyola University, New Orleans, La.	275

HERMAN BERNARD, managing editor of RADIO WORLD, broadcasts every Friday at 7 p. m., from WGBS, Gimbel Bros., N. Y. City, 315.6 meters. He discusses "What's Your Radio Problem?" Listen in!

Know Your DC Line Poles and Save Worry

If you have direct current in your home and you wish to charge your battery, great care should be exercised in obtaining the correct polarity. Place both leads from the line in a glass of salt water. Around the negative lead bubbles will form, while no action will take place around the other lead. If you should obtain the wrong polarity of the lines and connect them up in the same manner, anyone of the following things may happen:

(1) The battery will first start to discharge. (2)—The plates will start to buckle or bend. (3)—Heat will be generated and sulphation will take place. (4)—The separators will break and the cell may become short circuited, which would result in total ruining of the cell.

If only sulphation takes place (can be noted by the intense heat at the terminal lugs), then the polarity should be reversed immediately. It should be then discharged slowly and then given a slow charge. This process should be repeated until all of the sulphate formed, is driven off and falls to the bottom of the cell container. From here, the substance may be removed very easily. If the wrong polarity has been applied, the battery should be given to a local battery service station, as it is very difficu't to repair the plates.

Father Tells of Son's Record Crystal Set

WASHINGTON.

Congressman Arthur M. Free, of California, during the debate on the White radio bill, said:

"Any boy can take, as my boy did, a bolt, a little wire, and a crystal which costs a few cents, and make a radio set and he can listen in on any program anywhere in the United States. If he wants a little better set, he can take a little bit more wire, a few more nuts and bolts and get a tube, and he can make a tube set, paying $2.50 for the tube."

QUICK ACTION CLASSIFIED ADS

10 CENTS A WORD. 10 WORDS MINIMUM. CASH WITH ORDER

COMPLETE TUNED PLATE RADIO FREQUENCY UNIT in hand-rubbed cabinet. Six dollars. Connected ahead of any three circuit set converts it into a DIAMOND OF THE AIR. You can operate your set on a loop. Four and five tube DIAMOND OF THE AIR in fine cabinets, compartments for batteries. Mahogany or Walnut hand-rubbed finish. Thirty-five dollars. Three tube sets in handsome cabinets, operates Loud Speaker one thousand miles. Fifteen dollars. With built-in loud speaker, Twenty-five dollars. Loud tone crystal sets, three dollars. HEILMAN'S ELECTRICAL SHOP, WHYNOT, MISS.

COMPLETE SUPER-HETERODYNE PARTS $25.00. "B" Eliminator $15.00. Raymond Schlegel, 1118 North Negley, Pittsburgh, Penn.

DEAFNESS AND HEAD NOISES BANISHED. Information free. Write. Mr. E. Henk, 1227 Walnut, Milwaukee, Wisc.

RADIO FANS—GET A STINITE WAVE TRAP. Will make your set more selective. 79c postpaid in U. S. Send 6c stamps for our Radio Catalog. Discounts to Set Builders, Amateurs, etc. Radio Specialty Shop, 525 Park Avenue, Kent, Ohio.

ATTENTION RADIO FANS!!! A Five Tube T. R. F. Long Distance Set, 1926 Model, for $16.85. Fully guaranteed. J. S. Radio Co., 86 E. Fourth St., New York City.

BULLDOGS

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

SLEEPER'S KB-8 appeared in RADIO WORLD dated March 13 and 20. Sent on receipt of 30c., or start sub. with March 13. RADIO WORLD, 145 W. 45th St., N. Y. C.

FILL OUT AND MAIL NOW

SUBSCRIPTION BLANK

RADIO WORLD

RADIO WORLD 145 *West 45th Street, New York City (Just East of Broadway)*

Please send me RADIO WORLD for.....months, for which please find enclosed $.....

SUBSCRIPTION RATES:
Single Copy .....$ .15
Three Months 1.50
Six Months 3.00
One Year, 52 Issues..... 6.00
Add $1.00 a Year for Foreign Postage; 50c for Canadian Postage.

Byrd Arctic Party Will Have Best Radio

WASHINGTON.

The Byrd Arctic Expedition will be equipped with the latest type of radio equipment, according to officials of the Navy Department who are completing plans for the trip to the frozen north. The objects of the equipment are safety of ship, plane fog and weather reports; entertainment by broadcasts and messages from home. It is expected that many tests and experiments in communication may be carried out with both long and short waves.

The S.S. Chantier (call letters KEGC) will be equipped with a 1 kw navy spark transmitter, sending on 300, 600 and 800 meters. It will also have a short wave transmitter, to work on 80, 40, 20 and 10 meters. The plane is to carry a 60 watt short wave transmitter, capable of working on 61 and 44 meters.

News of the expedition will be handled largely through amateur stations of the American Radio Relay League, who will forward the messages to the addressee. Important tests will be made with several of the most important short wave stations. Exact schedules for operation will be announced at a later date by the Navy Department.

BST-6

B - for Beauty of Cabinet
S - for Selectivity
T - for Tone purity
6 - its 6 tubes for distance

"A thing of beauty is a joy forever"

The BST-6. 2 Feet 4 Inches Long. 9 Inches Inside Depth. 8¾ Inches High.

This marvelous six-tube tuned radio frequency receiver is Self-Equalized and built of low-loss materials thruout. Its clear, rich tone of astonishing volume is a revelation. The circuit consists of two stages of tuned radio frequency, tube detector and three stages of resistence coupled audio. Air-cooled rheostats and universal sockets.

Direct from factory to you $40.00

Cheaper than building your own

SPECIFICATIONS

Bakelite Panel, Walnut Finish—
With Etch-O-Gravure and Gold Decorations—
Bakelite Sub-Base—
Kurz-Kasch Bakelite-Walnut Pointers; Gold-filled, to Match—
Kurz-Kasch Bakelite Gold-filled Rheostat Knobs—
Lubree Straight Line Frequency Condensers—
Special Coils; Double Silk Enameled, Primary and Secondary—
Shore Audio Transformers—
Caswell-Runyan Two-tone Walnut-Finished Cabinet.

GUARANTEE

Each receiver is tested and retested, boxed and inspected before leaving factory, and guaranteed to reach you direct in perfect condition.
Workmanship thruout guaranteed the best. Assembled by experts.

IMMEDIATE DELIVERY

Send Check or P. O. Money Order to

Columbia Print, Radio Division 143 West 45th St.,

NEW YORK CITY

RADIO WORLD Guarantees the Responsibility of This Advertiser

HIGHBOY BST-6

"The joy of the hand that hews for beauty
Has the sweetest solace beneath the sun"

A Radio Highboy of unequaled value

The HIGHBOY is of genuine walnut-plywood designed by master craftsmen, beautifully finished in a rich two-tone. Dimensions 45¼x25¼x14¼. A piece of furniture that will last a lifetime, gladden the eye and bring joy and refinement to the home.

Equipped with the famous BST-6, a six-tube tuned radio frequency receiver of astonishing volume; of clear, rich, beautiful tone. The circuit consists of two stages of tuned radio frequency, tube detector and three stages of resistance coupled audio.

The concealed built-in loud speaker occupies the entire top of the HIGHBOY, overcoming entirely that tinny metallic sound of many of the old horn loud speakers and in its stead giving forth that rich sympathic tone of the old violin of long seasoned wood.

Beneath the radio itself is the two-door compartment with ample room to fully conceal the A, B and C batteries.

Direct from factory to you

$85.00

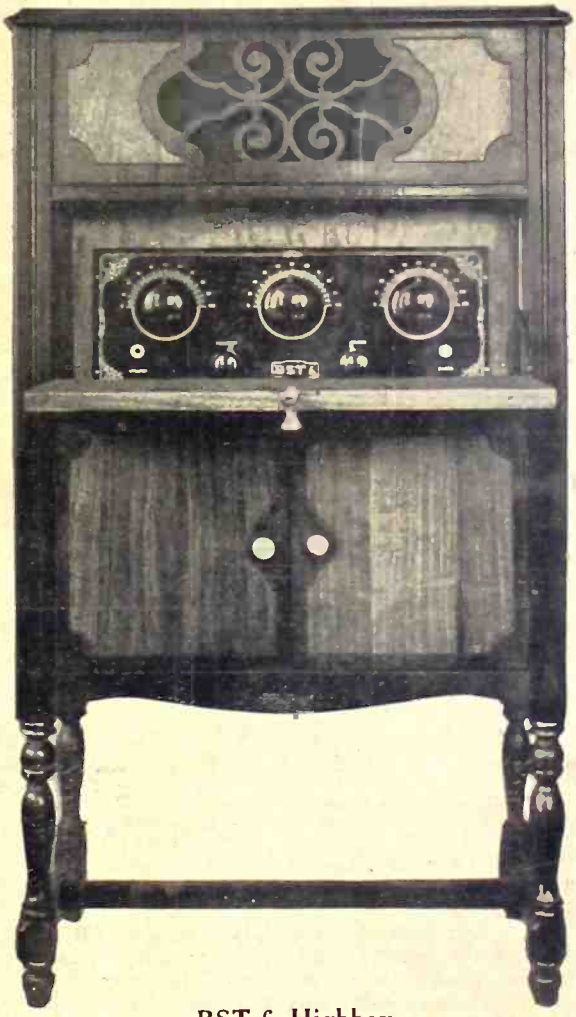
Includes the BST-6 Receiver Installed in Highboy Period Cabinet, as illustrated and loud speaker. F.O.B. New York

GUARANTEE

Each HIGHBOY is carefully examined so we know that the wood, carving, finish and trimmings are flawless and in perfect condition. It is packed by experts in a separate, specially-built, padded, wooden packing case, so that it must reach you in perfect condition.

The radio and loud-speaker are tested and inspected for workmanship, volume, tone and distance reception, so you will receive as nearly as is humanly possible a perfect radio in this BST-6 Highboy.

IMMEDIATE DELIVERY



BST-6 Highboy
Height 45¼", width 25¼", depth 14¼"

Send Check or P. O. Money Order to

Columbia Print, Radio Division 143 West 45th St.

NEW YORK CITY

RADIO WORLD Guarantees the Responsibility of This Advertiser

RESULTS

RESULTS EDITOR:

After reading the results that are being obtained by others with the Model Diamond of the Air receiver I feel it is my duty to tell of my own results. The volume obtainable from this set is tremendous.

During the international test week I picked up 5WA, Cardiff, Wales. At times the strength from this station were so loud that it could be heard throughout the room. I obtained a certificate of confirmation from the Chicago "Tribune." Other stations that came in during this week were 6KW, Tuinica, Cuba, and CZE, Mexico City, Mexico. Stations WGHT, KOA, WBAP, KPRC, WRR and WSMB are considered locals.

I wish to extend my congratulations to RADIO WORLD for publishing such an efficient hookup.

GEORGE MALISKI,
1915 Marshall St.,
Manitowoc, Wisc.

* * *

RESULTS EDITOR:

I built the Bernard 1-Tube DX set which appeared in the Oct. 24 issue of RADIO WORLD. The set works wonderfully. I have received over 20 distant stations, all with good volume. The stations which are close to each other as to wavelength are easy to separate.

JOHN B. HUNTON,
1914 2nd St.,
North Bergen, N. J.

RESULTS EDITOR:

Some time ago I constructed the Diamond of the Air and succeeded in picking up PWX, Havana, Cuba, on the night of Jan. 25, 1926. I held them from 10.30 p. m. to 11 p. m.

JOHN BLACK,
340 E. 55th St.,
N. Y. City.

* * *

RESULTS EDITOR:

I have constructed the Powertone, described in the Aug. 29, Sept. 5, 12, and Dec. 12 issue of RADIO WORLD. I find it to be the best set that I have made in the last two years. I can get stations in Miami Beach, Fla., on the loud speaker with ease.

S. W. FABER,
3058 Thompson St.,
Philadelphia, Pa.

* * *

RESULTS EDITOR:

Allow me to thank you for your wonderful hookup, the Diamond of the Air, published in RADIO WORLD. The Diamond has finally solved my problem of a suitable receiver for this location and should prove a boon to anyone living near a broadcasting station.

I built the 4-tube Diamond for loop use only, as I live just a few blocks of several high-powered broadcast stations and within about a mile or thereabouts of ten or more stations. You will note by prints enclosed that I omitted the antenna coil, using a rheostat for the detector tube and Amperites for the RF and audio tubes.

The tuning is remarkably sharp and I find it necessary to use vernier dials. Am now able to separate all the low-wave stations without the usual undertone and whistling and other noises caused by waves beating against one another. Can tune all waves with great volume. The tonal quality cannot be beat. WOK and KYW, Chicago, came in on phones using only the detector and RF circuit with the loop.—J. W. DOLL.

Compact Eliminator

(Concluded from page 11)

fixed resistance, R1, to a terminal of the fixed resistance, R3 and to the resistance terminal of the variable resistor, R2. The other terminal of C3 goes to the B minus post, to the other terminal of R3 and C4. The arm of the variable resistor, R2, goes to the B plus Det. post. The other terminal of R1 goes to the B plus 90 volt post. Bring a wire from the core of the transformer to the shield placed between the two circuits and then run it to the ground. The B minus post is not grounded though.

More Variety Asked for Sunday Programs

PROGRAM EDITOR:

I desire to vote for band concerts, instrumental music and instrumental solos.

I believe the majority of persons favor these as they come in better than vocal selections.

Another thing: Why can't we have a little more real good instrumental music on Sundays? That's the day we can best enjoy it and little can be had except sermons and vocal selections.

Please bring this before the public for a vote on just that particular type of entertainment. Let's have music besides sermons for Sunday.

I believe all announcers should refrain from bragging about themselves.

L. G. MILLER,
1019 So. 26th St., Lincoln, Neb.

LIST OF PARTS

One AC step-up transformer, having plate and filament secondary windings, with a special shield between these windings (Shore).

Two 30-henry choke coils, L8L9 (Shore).

Three 0.5 mfd. fixed condensers, C4C5C6, one unit (Aerovox).

One condenser unit; one 5 mfd. fixed condenser, C1; One 2.0 mfd. fixed condenser, C2; one 6.0 mfd. fixed condenser, C3 (Aerovox).

One variable resistor, Clarostat, R2 (American Mechanical Laboratories).

Two 10,000 ohm fixed resistors, R1 and R3 (Aerovox).

Two rectifying tubes (Tectron).

Two sockets, standard base.

One switch.

One special cabinet.

Accessories: A 10-foot lamp cord, plug, angle irons, screws, nuts, flexible wire, binding post strip, etc.

Here Is FRESHMAN'S Greatest Accomplishment—

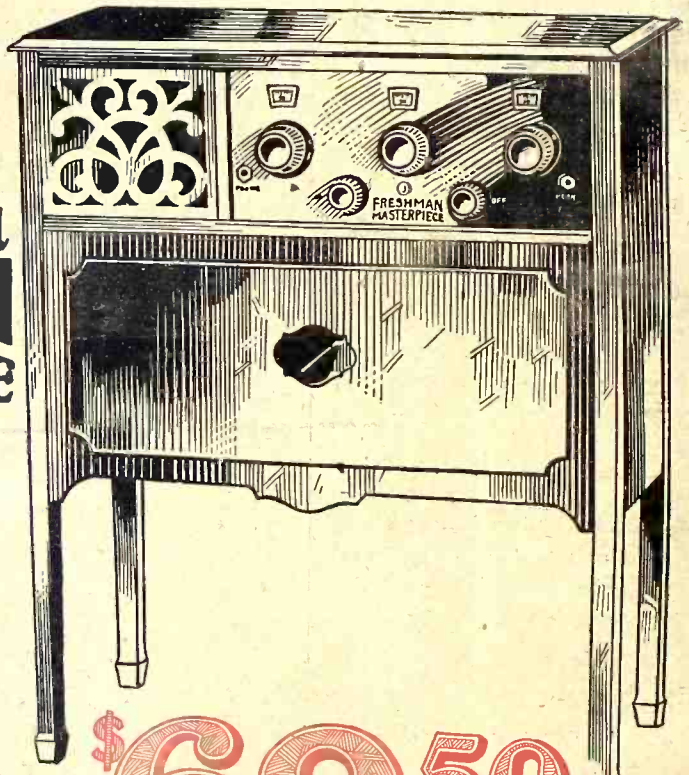
This BEAUTIFUL CONSOLE

This Wonder Set which is spreading entertainment, education and contentment in hundreds of thousands of homes in all parts of the world now has many additional points of superiority.

New and Improved FRESHMAN MASTERPIECE

MODEL 6-F-3

A handsome piece of furniture made of carefully selected genuine five-ply mahogany. A radio receiver with the finest of built-in loud speakers, in a console model which provides ample room for all batteries, chargers, eliminators and everything else that could possibly be used in connection with a radio set. Not a single wire visible to mar the appearance of the room.



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