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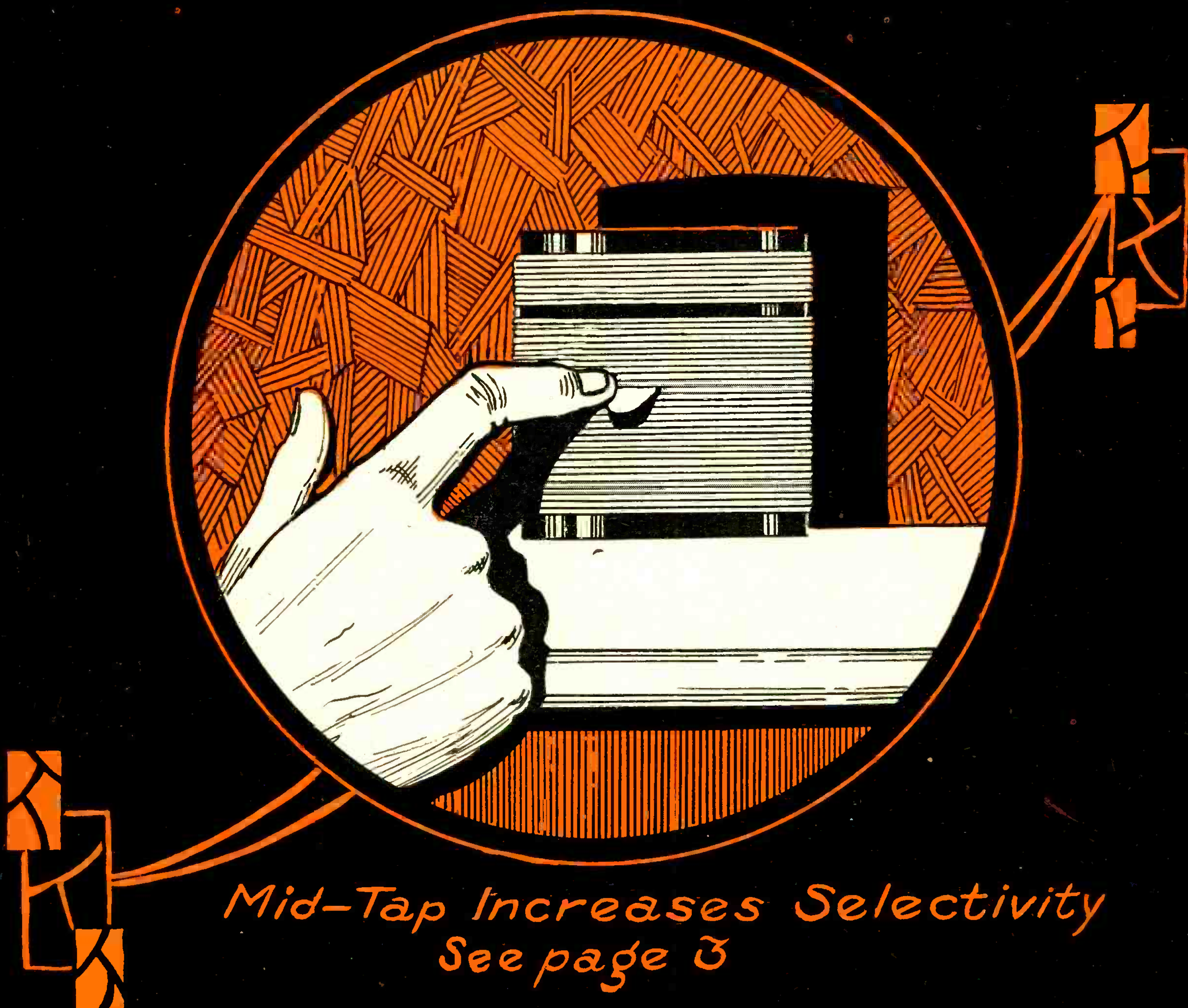

Mid-Tap Increases Selectivity

See page 3

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Mid-Tap Boosts Selectivity

Add Regeneration, Pierce Locals, Get DX!

Greatly Sharpened Tuning Is Achieved at Small Reduction of Volume and Inter-Station Interference May Be Eliminated

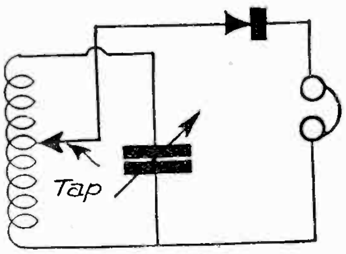


FIG. 1
Mid-tap of a crystal circuit coil.

By Dr. Louis B. Blan

THE old crystal receivers were not very selective. There was nothing wrong with the tuned circuits. They were as good in the old days as they are now. Good tuning coils and good tuning condensers were used to make the circuits. Yet the receivers were not selective.

The reason that they were not is that the crystal put a heavy load on the tuned circuit to which it was connected, and a heavy load will make anything sluggish. The load is a resistance, and as far as selectivity is concerned it is just as effective in reducing it as if the resistance were in series with the tuning coil. The more sensitive the crystal is the more effect it has in decreasing the selectivity, and it is possible to vary the selectivity of such a circuit by merely manipulating the cat-whisker.

A good way of increasing the selectivity of a circuit employing a crystal for detection is to connect the crystal-phone circuit across only a part of the tuning coil. This reduces the load on the circuit, but it also reduces the volume obtainable, which is a necessary price to pay for increased selectivity. That is not confined to crystal detector circuits but it is quite general. The smaller the portion of the tuning coil that is used in the detector circuit, the greater will be the selectivity and of course the lower will be the volume. In Fig. 1 is shown a simple crystal circuit in which the crystal and phone are connected approximately across one-half of the total number of turns on the coil.

Applies to Tube Circuits

The remedy applies also to a tube detector circuit. Although the input circuit of a vacuum tube is supposed to have infinite resistance, in which case its effect on the selectivity would be nil, it actually has a finite value of resistance which causes a load on the tuned circuit and hence decreases the selectivity. The finite resistance is due to several factors. One is the conductivity of the grid to filament circuit when the grid is positive with respect to the filament. This is the greatest factor in well-designed circuits. Another factor is the leakage conductance of the insulation of the tube and socket. In a well designed circuit this should be very small, but in many receivers it may be quite large. This leakage conductance is partly due to surface leakage of the insulators and partly to volume conductance of the insulating material used.

When the grid leak is connected directly between the grid and the filament the grid leak adds to the conductance between the filament and the grid, and this increases the load on the tuned circuit and hence decreases the selectivity. The difference between this method of connecting the grid leak and that shown in Fig. 2 is not great but it is measurable. That shown in Fig. 2 is preferable from the point of view of selectivity, because in this case the grid leak does not add to the conductivity from grid to filament but rather decreases it, and still it performs the function of grid leak just as well as if it were connected in the other way.

Use In Detector Circuit

The increase of selectivity in a tube circuit by the mid-tap method may be adopted also for the tube detector circuit. Again it is done at a sacrifice in volume, because only a portion of the voltage existing across the tuning coil is impressed on the grid. However, the reduction is not so great as it would apear at first sight.

When the load is reduced on the coil, or rather on the tuned circuit, the amplitude of the oscillations in the circuit increases, so that the voltage across is much greater when the load is small than when it is large. Hence the voltage across one half of the coil is more than half of the value of the voltage across the entire coil when it is more heavily loaded. In other words, connecting the detector circuit across only a portion of the coil increases the selectivity, but it does so at a slight sacrifice in volume.

When regeneration is used in connection with a vacuum tube detector the effective selectivity and volume may be greatly increased under all conditions of operation. The effect of the feedback is to decrease the effective resistance in the grid circuit, whether this resistance is in the condenser, tuning coil, or in the load on the tuned circuit. With a tube for detector it is possible to get the circuit to oscillate, and thus to get greatest sensitivity for almost values of resistance in the grid circuit. It is only necessary to increase the tickler coupling until oscillations start, when the effective resistance in the grid circuit is zero.

Difference Between Extremes

This does not mean, however, that a poorly designed circuit can be made as effective as a good one by merely increasing the tickler coupling. There is a wide difference between the just-before-oscillation sensitivity of a poor and good circuit. When each circuit breaks into oscillation the effective resistance in the grid circuit is zero, but the voltage across the entire tuning coil is very much greater in the low-loss tuning system, and consequently the signal is much greater than in the poorer system. And the ultimate selectivity in the better system is also greater.

The mid-tap system is used by Herman Bernard on his four-tube Universal receiver, which will be described in RADIO WORLD beginning with the March 12 issue The detector stage is regenerated, thus increasing selectivity still more, and boosting volume, so that it is possible to cut through locals to get DX.

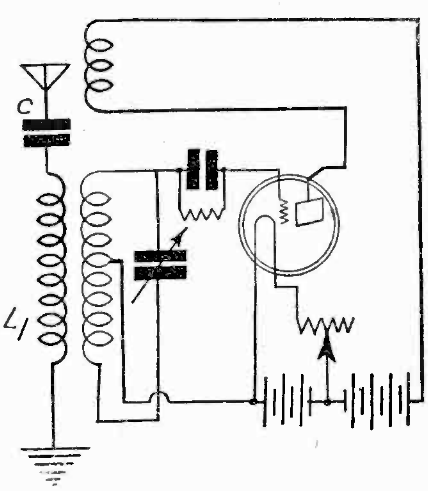


FIG. 2
Introduction of mid-tap method in a tube detector circuit.

Loose Coupling

One thing that increases the selectivity in all cases is using a loose coupling between the secondary and the primary coils in a tuned transformer. The reason for this is that the primary circuit introduces a resistance in the tuner, and the introduced resistance is greater the closer the coupling. This is particularly true in the first transformer, the primary of which is in the antenna circuit. The resistance of the antenna circuit is considerable and when the primary circuit is coupled closely to the secondary tuned circuit the resistance introduced is also quite great.

The resistance introduced by the antenna not only depends on the resistance in the antenna circuit and the coupling but also on the inductance and the capacity of the antenna circuit.

A Glowing Circuit Tester
Quickly Checks Prongs, Filament and Plate

Flashlight Bulb's Brilliance, When Heated by RF Current of Oscillation, Gives Relative Condition of Tubes

By Herbert E. Hayden
Photographs by the Author

YOUR set suddenly ceases to function. The filaments of all the tubes are burning at normal brilliancy, the B battery is in a good condition, but the volume is very low or signals are absent entirely. What is the trouble? The circuit tester described below will give you the answer in a very short time in most cases of trouble.

This tester is based on the operation of a vacuum tube oscilllator. There are many types of oscillator that may be used but that shown in Fig. 1 is about as simple and effective as any.

List of Parts

C_1, a small fixed condenser, mica or air dialectric.

L, a small 2.2 volt light bulb with socket.

L_1L_2, a radio frequency transformer.

C_2, a fixed condenser about .001 mfd.

R, an Amperite suitable to tube used.

VT, a vacuum tube preferably —01A.

A burned-out tube with a standard or X type of base.

A few feet of three-lead connector cable.

A small wooden board for mounting parts.

Use a High Frequency

The oscillator should be so adjusted that its frequency is very high, as this will operate in more places than will one whose frequency is low. Therefore the condenser C_1 and the winding L_1 should be small. It does not matter what their values are, just so the circuit will oscillate. For example the condenser C_1 may be an .00025 mfd, and the coil may consist of a dozen turns on a two inch diameter. In the photographs herewith the coil is wound on a one-inch diameter with No. 26 double silk covered wire, about 50 turns being used. The secondary winding L_2 is wound on the same form with the same kind of wire and it has a few more turns than the primary. The essential thing is not the size of the windings nor the size of the condenser, but that two windings of approximately the same inductance are placed close together and connected so that when a condenser is connected across one of them and properly connected to a tube that the circuit forms an oscillator.

The little light bulb is connected in series with the tuned circuit C_1L_1 and it is used as an indicator of oscillation. When the circuit oscillates the tube glows.

Only Three Leads

The method of connecting the terminals of the coils L_1L_2 to obtain oscillation is as follows. Supposing that the two windings are placed on the same form in the manner shown in the photographs and wound in the same direction. Then the two end terminals go to the grid and plate, the larger winding being in the grid circuit. The inside terminal of the grid coil is connected to minus A and the inside of

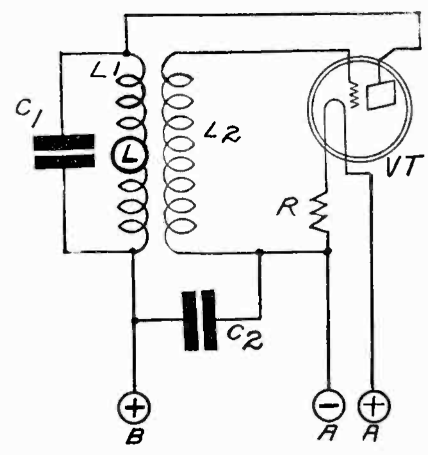


FIG. 1

Circuit diagram of the oscillator used in the tester.

the plate coil is connected to C_2 and to plus B.

The three leads to A minus, A plus and B plus are cabled and made a few feet long, and they terminate in a base removed from a standard X type of tube. The base is first removed from the burnt-out tube by breaking the glass with a hammer or by heating the sealing wax to loosen it. After the glass tube has been loosened from the base the two are still held together by means of the four leads which are soldered to the prongs, but may easily be separated by melting the solder at the tips of the prongs by means of a soldering iron.

Having removed the base from the tube a wooden plug of about the same size as the original glass tube should be fitted into the base. This plug should have a hole about a fourth of an inch drilled through its center. An alternative is to fill up with sealing wax.

The three battery leads should be put through the hole and the terminals should be put through the proper prongs on the base, that is, the plus B terminal should be connected to the plate prong and the two filament leads should be connected to the corresponding prongs on the base. Solder the tips of the three used prongs and trim of excess wire and solder.

Tape the wooden plug with friction tape to bind the base and plug together firmly. The tester is then ready for use.

Now suppose it is desired to test a receiver. If the plug is inserted into one of the sockets in the set the oscillating tube VT lights up because the two filament prongs may contact with the live filament leads in the set, provided of course that the receiver is turned on. The plus B prong makes contact with the plate terminal in the socket and therefore the oscillating tube gets its plate voltage.

If the indicating bulb lights up the tube VT is oscillating, showing that it gets both the proper filament and plate voltages. This also proves that everything is OK with the socket in which the plug has been connected. If the tube which the plug replaced does not work it is the tube which is at fault. But if the light fails to glow, hence indicate oscillation, it shows that not all is well with the socket into which the plug has been inserted. If the filament lights up when a tube is inserted, the trouble is with the plate circuit, and indicates an open somewhere, as a faulty jack or a burnt-out primary of a transformer.

In the same way every socket in the set may be tested. A faulty tube or a faulty plate supply circuit may be quickly located.

In certain cases the tester tube will not get sufficient plate voltage to oscillate. This is particularly true when the coupling device through which the plate voltage is obtained is a resistance or a high impedance choke coil. In such case the coupling device may be short circuited.

Why a High Frequency

The object of using a high frequency in the tester circuit is to take advantage of the distributed capacity of the windings of the choke coil or of the primary of the transformer. The object of C_2 is also to facilitate oscillation.

The instrument may also be used to test the efficiency of vacuum tubes. Suppose the plug is inserted into a socket whose filament and plate voltages are known to be reliable. If then a tube is inserted into the tester socket the indicator bulb should light up if the tube is good. If the tube is not good it will not oscillate and the light will not give any indication.

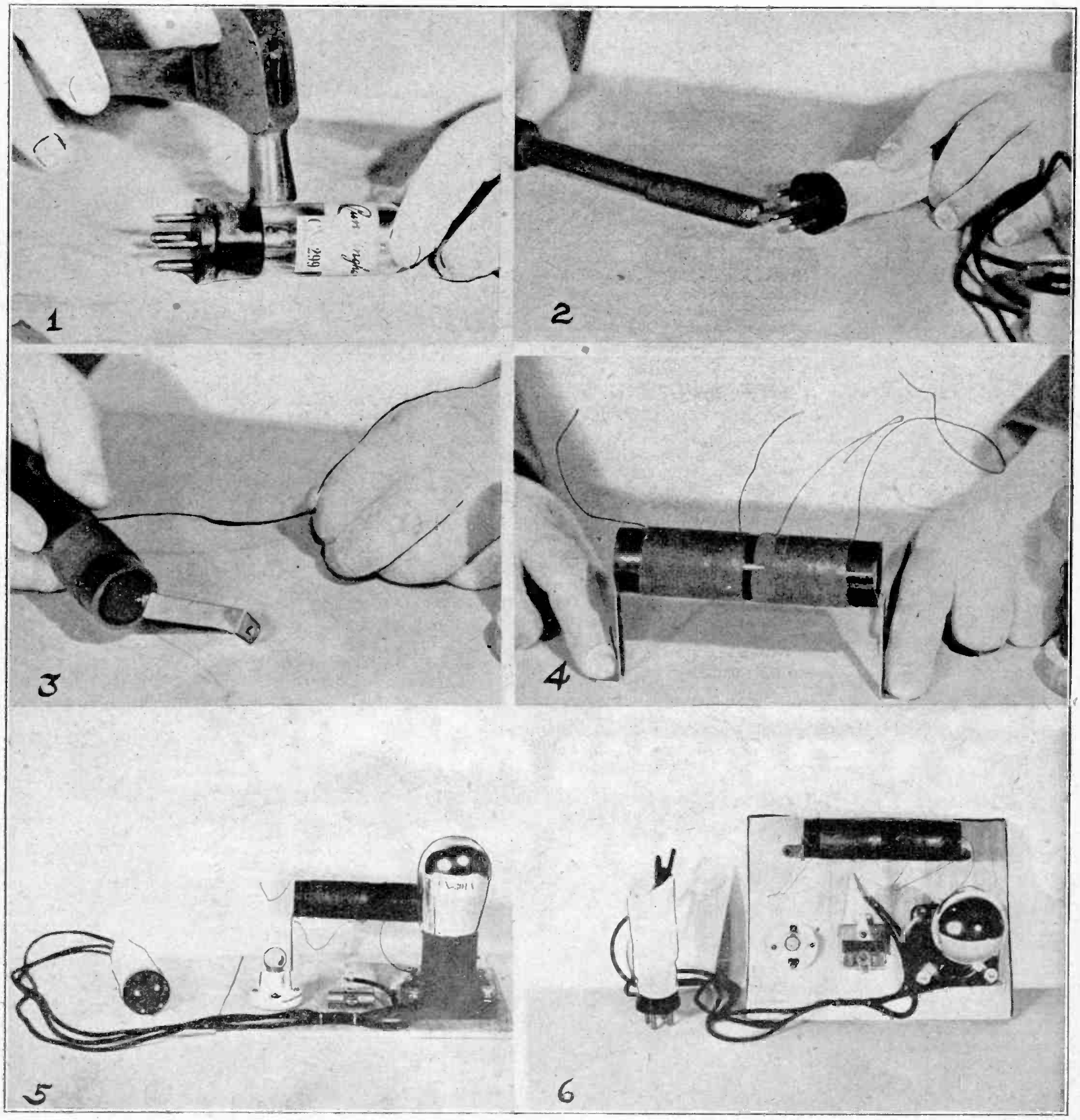
The intensity of the oscillation in any particular socket will be indicated qualitatively by the brilliancy of the indicator bulb. In some cases the brilliancy may be so great as to endanger the indicator bulb. This point should be carefully watched and the operator should be ready to turn the switch or to pull out the test plug if the light burns dangerously high. Only a short time is necessary for a test and there is no need of leaving the tube oscillating for any length of time.

Instead of winding the oscillating coil with fine wire on small diameter tubing it may also be wound with heavy wire and on a large diameter. For example it may be made of a few turns of annunciator wire four inches in diameter. Such a coil would be self-supporting and no special winding form would be necessary. While this method of construction will not make as neat a job it will be equally efficient, or even more efficient.

If the circuit will not oscillate the failure may be due to one or more of several things. One thing is inadequate coupling between the plate and the grid coils. For the higher frequencies this need not be very great but for the frequencies in the broadcast range the coupling will have to be quite close. If the circuit will not oscillate when a tube known to be good is used as test tube, the coupling between the two windings should be increased. This may be done by placing the two windings closer together or by increasing the number of turns on the secondary winding or by employing both of these methods.

It's Exceptionally Easy to Construct the Automatic Test Device

All You Need Is an RF Transformer of About 1-to-1 Ratio, Socket, Plug, and a Couple of Fixed Condensers



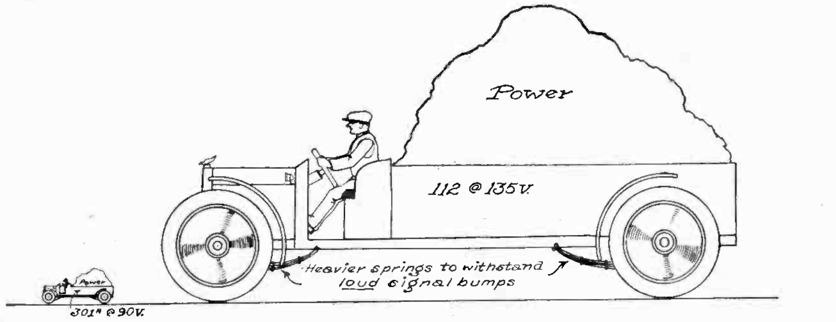
PHOTOGRAPHS ILLUSTRATE THE CONSTRUCTION OF CIRCUIT TESTER

(1) The burnt-out vacuum tube may be "debased" by breaking the glass or by heating the sealing wax around the rim. (2) After the bulb and the base have been separated the elements, the remaining glass may be removed from the prongs by heating the tips of the prongs with a soldering iron. This figure also shows how the new leads may be soldered to the prongs. (3) The oscillating coil may be wound on a length of tubing 1 inch in diameter in the manner shown in this figure. (4) The finished coil with mounting legs appears like this. (5) This shows the assembly of the tube tester. The testing tube is shown at the right. For this a standard socket should be used, one which will fit the majority of tubes. In the background is shown the oscillating coil, at the left is the indicating lamp and its socket, while in the middle foreground is the bias by-pass condenser. The plug at the end of the long three lead cable was made out of the base of an X socket. (6) This shows the layout of the tester from another angle.

One way of testing a tube with this tester is to take the tube to be tested out of its socket in the receiver and to replace it with the battery lead terminal plug. The tube to be tested is then inserted in the socket of the tester. If it oscillates all is probably well.

Set's Efficiency Raised 800%
By Power Tube With Proper Voltages

Comparing the 112, at 135 Plate Volts, With the 301A at 90 Volts, the Undistorted Output Is Eight-Fold, Insuring Quality



OPERATED at the maximum plate voltage of 135 volts, with 9 volts negative grid bias, the CX-112 gives eight times the undistorted power output of the 301-A at 90 plate volts and 4.5 volts negative grid bias. At 90 volts on the plate the 112 would give about 2 1-2 times the maximum undistorted power output of the 301-A at the same plate voltage.

By Herman Bernard
Associate, Institute of Radio Engineers

IN the final audio stage it has long been the favorite practice of radio engineers to use a power tube, and its inclusion presented no problem to them, but when the public took its cue from the expert and rallied 'round the power tube, the public quickly found itself seeking information on a subject new to it.

The questions that arise in the public mind are naturally often addressed to dealers, who sum up the answer by specifying the particular power tube best suited for the installation. The tube manufacturers had to take on the sudden task of educating the dealers and their clerks to a working knowledge of power tube performance. For a short while the questions rained in thicker and faster than the information, and clerks were occasionally stumped, as on one occasion when I happened into a radio store on Fulton Street, New York City.

A woman asked a clerk at the tube counter: "I want a power tube for my set; what tube shall I get?"

He asked her what kind of a set she had, what type of tubes she used, whether she had B batteries, and of what make and size, and whether the set had provision for a C battery. As to the last point, she said she was blessed if she knew.

The Shopping Instinct

"Well, you've got 90 volts of C battery, your set isn't of the extra-powerful kind, and you'd better use a 112 tube." He took one down from the shelf, whereupon she asked him if he had any other kind. "Yes," he said, "there's the 371. It handles more power—"

"And how much does that cost?" she quickly asked.

"Not a cent more than the other one," he answered.

"Well, batteries or no batteries, that's the one I want," she announced. More power, same money! That settled it! All her shopping instinct had come to her rescue—except that she would have made things more convenient for herself, and would have obtained as good results from her particular set, if she had selected the 112. And the difference is not due to the fact the 112 has an oxide coated filament and the 371 a thoriated tungsten filament.

If a receiver is very powerful indeed, and delivers a heavy load to the final audio-frequency tube, the 371 meets the heavy demands necessarily put upon it. In such an instance it is advisable to use high plate voltage and suitable negative bias, which is also comparatively high. The great majority of receivers, however, are not so powerful that the 112 will not handle the volume in a wholly satisfying manner, showing considerable improvement indeed over the tube likely to be replaced in the final audio stage. It is the quality that is improved, rather than the volume increased, although larger volume sometimes results as a byproduct, due to the use of higher plate voltage, or, in the case of the 371, also to the low plate impedance.

Comparative Table

The advantage of using a power tube in the final audio stage is well illustrated in the following comparative table:

	CX-301-A		CX-112	
Pos. plate volts	90	135	90	135
Neg. grid volts	4.5	9	6	9
Plate current, milliamperes	2	2.6	4	6
Undistorted output, watts..	.015	.05	.04	.12

This shows no higher plate voltage than 135 volts for the 112 tube, since much higher is not advisable, and for the same reason the 301-A has the same maximum plate voltage. Note the capability of the 112 in handling strong signals at 135 plate volts. The maximum undistorted power output is .12 watt, or about two and a half times that of the 301-A at the same plate voltage and grid bias. And notice that the 112 at 135 plate volts has eight times the maximum undistorted power output of the 301-A at 90 volts! Hence most receivers, particularly of the factory-made type, do not nearly overtax the 112 with signal voltage at 135 plate volts. The opposite condition is quite possible if the last tube were of very modest power capacity and operated only at 90 plate volts. The 112 will give abundant service, and justifies the extra 45-volt "B" battery (to bring the usual 90 volts up to 135 volts), and small extra negative bias.

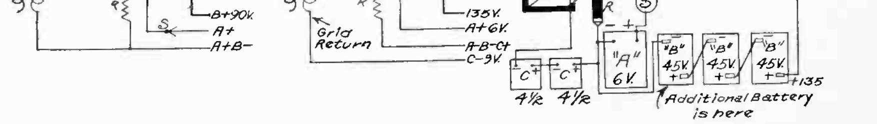
Thus, where a receiver is equipped with connections for a C battery—needed whenever a power tube is used—it is a simple matter to use two 4.5-volt C batteries to supply the 9 negative grid volts and add an Eveready No. 486 Layerbilt 45-volt B battery to gain that fetching clarity and richness of reproduction of the 112, even on strong notes from local stations which otherwise might cause "blasting" in the loudspeaker. Remember, however, that the prescribed negative bias must be applied, otherwise the full signal voltage, hence quality, will be lacking. Also, suitable negative bias reduces the plate current more than 50 per cent., hence makes B batteries last twice as long.

The higher plate voltage is very friendly toward the reproduction of low notes by the reluctant speaker.

The 112 a Versatile Tube

The 112, while essentially a power tube, is not confined in its use to the final audio stage, for it is an excellent radio-frequency amplifier and detector. Its superior load capacity makes it a good second detector in a Super-Heterodyne, where the power to be handled is quite high.

The 371 is suitable only for the final audio stage of broadcast receivers, and is not to be used as radio-frequency amplifier or detector. It has an outstanding value in its recommended position, where there is very considerable power to handle, for at 180 plate volts, with 40.5 volts negative bias (20 milliamperes plate current drain) the maximum undistorted output of the 371 is .65 watt. The 371, therefore, is the tube that bears otherwise ex-



THE OLD WAY of using in the final audio stage "any old tube that lights" is shown schematically at left, 90 volts being applied to the plate. In center is the diagram of the new way, a 112 tube at 135 volts. The pictorial representation of the new way is shown at right. S is a switch and R is a 112 Amperite. These diagrams apply to sets using 5-volt tubes. For so-called 3-volt tube sets the power tube would be the 220, plate voltage 135, negative grid bias 22.5 volts.

Filtered Output An Economy

Reduces B Current and Protects Speaker

DC Resistance of the Output Transformer Primary, or the Choke Coil In the Plate Circuit Must Be Low

(*Concluded from page 6*)

cessive burdens, and without straining under them, thus rendering the possibility of distortion even more remote.

The CX-112, at 135 volts, drawing 6 milliamperes, has the same maximum undistorted power output as has the CX-371 at 90 volts. But the grid biases and plate currents differ. The 9-volt bias and 6 milliampere drain in the case of the 112 are contrasted with the 16-volt negative bias of the 371 at a plate current of 11 milliamperes. Hence, at 90 volts the 371 draws more plate current than does the CX-112 at 135 volts.

There are other power tubes, of course. The three principal Cunningham power tubes are the CX-112, the CX-371 (both already discussed), and the CX-220. There are many sets employing the so-called 3-volt tubes throughout, since the filaments of these tubes can be conveniently heated at that voltage from dry cells. The 220 is the power tube for such sets, and requires a 22.5 volt negative bias at 135 plate volts. The 220, under these conditions, draws 7 milliamperes plate current and has a maximum undistorted output of .11 watt, or about the same as the 112 at the same plate voltage, and as the 371 at 90 plate volts. This is a very respectable showing for the 220, especially as it is most often used in receivers that deliver a moderate input to the grid of the final audio tube.

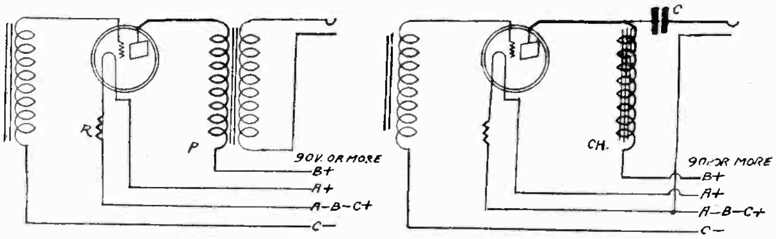
The power tubes draw twice as much filament current as the other tubes in the receiver that operate at the same filament voltage. For instance, the CX-112 and the CX-371 draw .5 ampere each, at 5 volts, contrasted with the .25 ampere filament drain of the CX-301-A. The CX-220 draws .12 ampere, as compared with the .06 ampere drain of the CX-299, at 3.3 volts.

The point about power tubes is that the set produces the volume and the proper power tube is chosen to handle that volume without contributing any distortion.

As plate voltages of more than 90 volts commonly are used in conjunction with power tubes, it is excellent insurance to use a filtered output, consisting either of an output transformer, usually 1-to-1 ratio, or a choke coil and condenser combination. Thus the direct current does not flow through the fine wire of the speaker windings, and these are safeguarded from burnout. It should be noted that the DC resistance of the choke coil or transformer should be low—not in excess of 800 ohms.

Also the voltage actually applied to the plate is much higher, since the direct current resistance of the primary of the proper transformer, or choke coil, is much less than that of the speaker windings. If the resistance of the speaker windings is 1,500 ohms and the CX-371 is operated so as to draw 20 milliamperes, then the voltage drop or loss in the speaker windings would be 30 volts, nearly equivalent to throwing away an entire 45-volt B battery!

The capacity of the condenser in the choke coil hookup should be large, preferably 4 mfd. or more. The choke coil, or primary of the output transformer, positively must have a low direct current resistance.



THE FILTERED OUTPUT in its two forms, a 1-to-1 transformer (General Radio, 369) at left, the primary P having a low direct current resistance, and a choke coil-condenser combination at right. Either system saves considerable B voltage.

Special Detector Tube Requires Good Audio

By Roger M. Wise

In charge of Engineering, E. T. Cunningham, Inc.

The new alkali vapor detector tube, type CX-300-A, has been exceptionally popular because of the superior performance of the tube, especially in the reception of faint signals from distant stations. In attaining the exceptional sensitivity certain design constants were chosen which at times require consideration, this applying particularly to the audio amplifier.

As generally used, that is, in sets of recent design, or with resistance or impedance coupling, little thought need be given the tube, which will perform at full efficiency unless followed by too much audio amplification. The recent trend toward the use of low-ratio audio transformers having ample cores and good-sized primaries is favorable to good performance from the CX-300-A, since the tube has an output impedance somewhat higher than that of ordinary detectors. The combination of CX-300-A detector and CX-371 power amplifier tube in the last stage is very satisfactory, the higher output of the detector tube providing the signal voltage required for full output from the power tube.

With the resistance coupling, to which the 300-A is well adapted, the only precaution necessary is to see that the plate coupling resistor is not too high in resistance, as the sensitivity of the tube decreases if the plate voltage is dropped too low. The resistor must be of good quality or it may become "noisy" and interfere with reception.

When substituting the tube in sets of older design or in low-priced models, it is well to investigate the audio transformer if the results are not all they should be. If the transformer is very small the quality will not be satisfactory, even with the general purpose type of detector, and the results are even less satisfactory with the special detector, in fact all of the advantages of the utbe may be lost. A very satisfactory remedy in a case of this kind is to change the wiring of the set in such a way as to use the secondary of the audio transformer as a plate coupling impedance. To do this it is necessary to add a coupling condenser of .01 to .1 mfd. capacity and a grid leak.

The proper connections are shown in Fig. 1. This change produces a marked improvement in tone quality and is well worth the small trouble involved. The coupling condenser must be of high quality and free from leakage, as the bias on the following tube will be disturbed by any flow of current through the condenser.

Excessive audio amplification should be avoided. The use of more than two stages using audio transformers, or three stages of impedance or resistance coupling, is not desirable, since a slight tube hiss, usually inaudible, may be amplified to the point where it becomes a disturbing factor in reception.

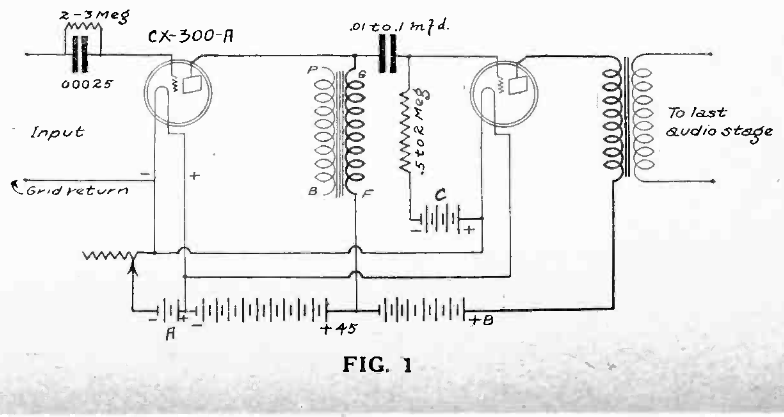
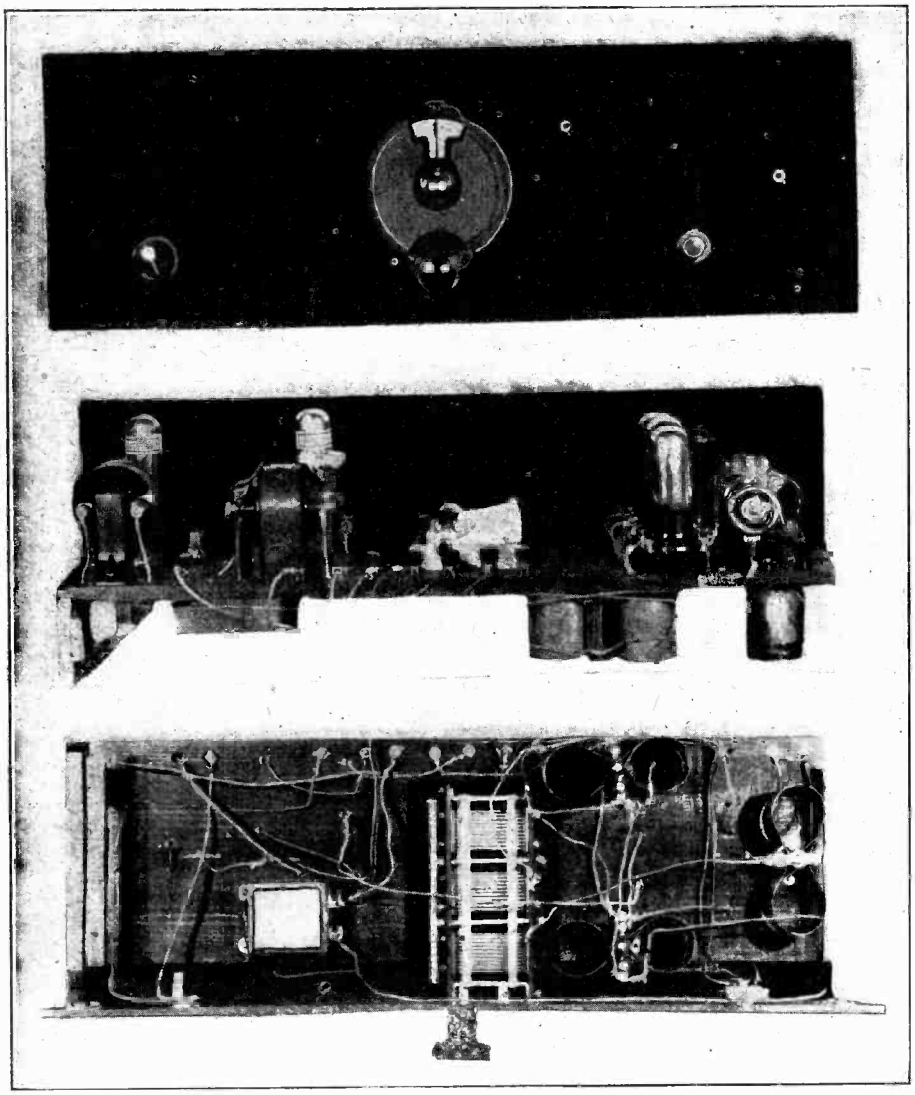


FIG. 1

One Dial—and Signals Snap In!

Five Tube Set Embodies Popular Design

Principally a Good Performer on Locals, the Single Control Set Nevertheless Brings In Distant Stations as Well



FIGS. 1, 2 AND 3

The panel view discloses the rheostat at left, used as a volume control; the tuning dial and, at right, the switch. The rear view gives an insight into the placement of parts on the subpanel. The bottom view shows the baseboard cut out for the tuning condenser, and also most of the wiring.

By Capt. Peter V. O'Rourke

THERE is a great deal of satisfaction in being able to tune in one station after another by simply turning a single dial. The signals just snap in with full volume without any tedious searching for the right combination of dial settings. That the satisfaction with such receivers is lasting and general is attested by the fact that this type is rapidly gaining in popularity.

Single control receivers have been designed for convenience of operation and aural comfort in listening to programs. They have not been designed especially for long distance reception. Although distance can be received with satisfaction. Of course, with distant reception on any receiver signals are occasionally, uncertain, with accompanying noise and fading. The thrill associated with distant stations comes when the operator of the receiver hears the call letters. But this thrill is often denied the patient DX hunter by the negligence on the part of the announcer to disclose the call letters.

The Situation on Locals

On local stuff the situation is quite different. The quality of the programs is usually good, the transmission excellent, the accompanying noise negligible, and reception is always dependable. There is no great need for precise setting of individual tuned circuits nor for any high degree of selectivity. For such reception the single control receiver is ideal. Turn the switch, twist the dial and subside in the easy chair. The broadcasting station will do the rest.

The technical condition that must be satisfied before a receiver can be successfully operated with a single dial is that the two or more tuning condensers in the circuit be exactly alike for all settings and that the two or more tuning coils also be exactly the same. This does not mean that they should be the same at the upper limit only, but also at the lower limit, and at all other points in between.

Care In Manufacture

To bring this about the coils must be very carefully made so that their inductances as well as their distributed capacities be the same. The condensers must also be so constructed that their zero setting capacities be the same and that as the dial is turned that the rate of change of capacity in each is the same. Not only must extreme precautions be taken in making the condensers and the coils alike but these parts must also be placed judiciously in the set. If they are not it does not make any difference how carefully the parts have been made.

Due to unavoidable difference which creep into the parts and their placement it is desirable to make a final adjustment of capacity because it is in this which most of the differences will occur, especially those due to placement. There are two general methods of adjusting the capacities; one by the use of vernier condensers across the separate sections of the gang condenser and the other by setting the rotors on the shaft. In some cases it is desirable to use both methods. The vernier balancing condensers may be of the two-section neutralizing type, as BC in Fig. 4.

The Convenient Rotors

Some tuning condensers are so made that the rotors are mounted on a removable shaft. The rotors are attached to the common shaft by means of a set screw. If one of these set screws is loosened the corresponding rotor may be set at any angle with respect to the others. To make use of this the finished receiver is tuned in on a certain station near the lower end of the broadcast range. Then one of the rotors is changed with respect to the others so as to make the signal the loudest. If this cannot be done with the first rotor go to the next and adjust that. To get the best adjustment it is necessary to adjust two with respect to the third, and while the adjustment is being made it is necessary to retune to the same station frequently. When the adjustment has been made for the higher frequency range it should be tested on the higher wavelength range also. The adjustment should be entirely satisfactory at both ends, especially with BC to help. However, in some cases it may be best to make the adjustment at the mean setting of the broadcast range. If then there should be any residual differences at the ends they will not be serious. The mean range is about 950 kilocycles, but as the longer wave stations are more important with this particular set, the station selected as mean should be around 800 kilocycles.

Placement of Coils

The circuit diagram of a single control receiver is shown in Fig. 4. There are three tuning coils of the binocular type in the circuit. This type is used because the stray coupling between any two of them is smaller than in many other types, and low stray coupling is quite necessary

Capacity Balance Important
In a Single Control Broadcast Receiver

Three-Section Tuning Condenser With Adjustable Rotors Simplifies Solution, While a Small Extra Balancing Capacity Helps, Too

LIST OF PARTS

One Continental three-section .00035 mfd. tuning condenser (C1C2C3).
One Continental junior condenser (BC).
One Carter rheostat, 50 ohms (R).
Three Bodine Twin-eight RF transformers (L1L2, L3L4, L5L6).
One Carter filament switch (SW).
One National velvet vernier dial, type C.
Two Hart and Hagemann audio transformers (AFT1, AFT2).
Twelve Eby binding posts.
One Polymet 1 mfd. by-pass condenser (C0).
One Polymet .0005 mica by-pass condenser (C5).
One Polymet .00025 mfd. grid condenser with clips (C4).
One 2 megohm Lynch grid leak (R1).
Two panel brackets.
One 7x21" panel.
One 20" wooden baseboard.

The capacity in the first circuit C1L1L2 is likely to be a little higher than that in the others, due to the antenna coupling. Hence the location of the external balancing condenser BC in the two other circuits. This condenser, when turned, adds capacity to one circuit while comparatively reducing the capacity in the other .

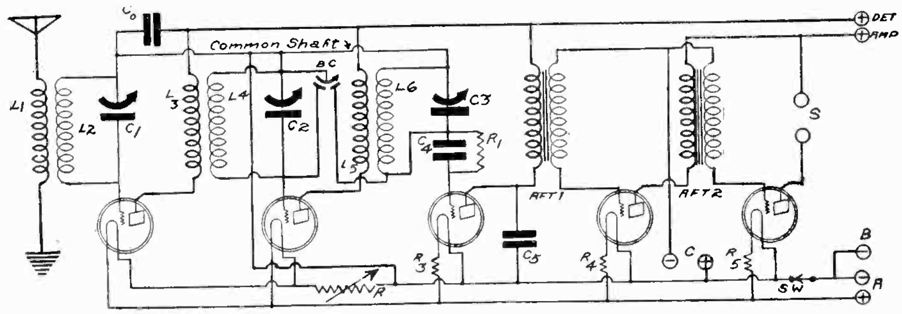


FIG. 4
The circuit diagram of the single control receiver.

for the success of single control receivers. The placement of these coils relative to each other and to the tuning condensers is shown in the Fig. 3, the photograph of the bottom side of the baseboard. Two of the coils are placed near the condenser and one of them is placed at some distance away and at right angles to them. The distance between these coils is great enough to minimize the electro-static coupling between them as well as the magnetic coupling.

The placement of the triple condenser is also shown in Figs. 2 and 3. Since the coils are placed under the baseboard it is necessary to raise this a considerable distance, but at the same time it is desirable to keep the condenser in the middle. To make this arrangement possible part of the baseboard is cut away so that the condenser may be placed in the opening.

To limit the filament current in the tubes filament resistors are used for three of the tubes. The detector, being a CX-299, takes a 60 milliampere ballast designed for 4½ volts at the source, and the two audio tubes, being CX-320, take 120 ballasts designed for the same voltage.

Rheostat Controls Volume

For the two radio frequency amplifiers a rheostat R2 is used. This rheostat should have a resistance of about 25 ohms for normal operation, but as this rheostat is also used for controlling the volume and self-oscillations, its resistance value may be considerably greater, say 50 ohms. With this rheostat it is possible almost to completely cut out the signal without actually cutting out the tubes, or without distorting the audio frequency output.

Condenser C0 is 1.0 mfd. by-pass across that portion of the B battery which serves the RF tubes and detector. C5 is the usual by-pass from the plate of the detector tube to the minus A post, with a .0005 mfd. value.

The grid leak R1 and the grid condenser C4 have the usual values of 2 megohms and .00025 mfd. The two audio frequency transformers should be of especially good manufacture.

The rheostat R is shown on the panel, Fig. 1, in the lower left corner, while the filament switch SW is shown in the opposite corner. The dial which controls the tuning is in the exact center of the panel.

BIG NEW APARTMENTS TO BE WIRED FOR RADIO

As soon as the Hudson River Bridge is completed, a ninety story apartment house, rising 1,000 feet, equipped with every conceivable labor-saving device, will be built on the Palisades, N. J., opposite Spuyten Duyvil, N. Y., according to Dr. Charles V. Paterno, a veteran builder.

A powerful radio set, manned by a special operator, and connected with all the apartments, will be a feature. Several outlets, so that more than one station can be heard, will be placed in each apartment.

Strong Audible Waves Often Rebound to Set

Attention paid to details makes for perfection of the whole. Just as drops of water can wear away the hardest stone, so will an accumulation of neglected details cause the finest apparatus to render mediocre results. This is particularly true of radio sets, as the effects of one detail will be amplified and multiplied many times. One of the most neglected and least thought of details is the effect of vibration on the performance of our sets.

The air is full of vibrations. Some are strong and some are so weak they are hardly perceptible. We all know the effect of an explosion of dynamite and how the concussion will break windows. We have a similar condition in our radio set when we have plenty of volume coming from our loudspeaker, only its effect is not so disastrous. In each case we have varying pressure of air. The loudspeaker is a mechanism which transforms electrical vibrations into air vibrations by causing a change of air pressure at audible frequencies. These changes of pressure reach us in the form of sound waves at audible frequencies, and actuate our hearing apparatus. Above a certain frequency, generally near 6,000 cycles, our ears fail to respond to these vibrations, but the vibrations are present, though we cannot hear them.

Vibrations due to sound generally will be diffused evenly throughout a room and decrease in volume until they die out. However, if they are too strong, they will still have considerable force when they reach the walls of a room and will then be deflected and reflected, thereby causing echos and a very noisy background. Furniture, rugs and draperies will absorb the strong waves when the waves reach the walls and will dampen the background noises due to these waves.

Sound waves hitting the tubes of radio sets will cause them to vibrate, and this vibration will be transmitted to the grid and the effect amplified throughout the set, in turn actuating the speaker. This process so then repeated until the result becomes so loud that broadcast reception may be entirely lost. Vibrations hitting the cabinet are likewise transmitted to the grid, provided they are strong enough, as would be the case if the loudspeaker were placed directly upon the set cabinet. Thus we see the value of protecting the tubes with vibration absorbers.

Vertical vibrations are caused by heavy walking or shocks from other sources, which will cause the tube to vibrate vertically. This effect is soon dampened because the grid will recover its normal position, but if the grid is loose and not securely fastened within the tube, this vertical vibration will also cause the building up of a very powerful audio hum.

From the above effects we can see the desirability of absorbing both the horizontal and vertical vibrations which are ever present. Recognition of these facts has brought about the design of a socket, such as the Resilio socket, which will absorb both kinds of vibrations and prevent their building up within the amplified.—G. W. Hoehn.

Whimsies of DX Analyzed

Expert Cites 'Cosmic Interference' as Factor

By James H. Carroll

Associate, Institute of Radio Engineers

DX, or the regular reception of distant stations, a pastime among radio veterans and a source of new interest and joy to the newcomer, was unfailingly poor during the major portion of 1926 with the exceptions of the months of November and December, when it picked up again without being quite up to the old standard. So far this year it has been better but very irregular, and many explanations have been advanced.

To describe the condition, let us assume that a deflecting magnetic shield is at times interposed by some invisible hand between transmitter and receiver one night here and another night somewhere else. The shield working directionally in one location is lifted toward the Southern point of the compass letting the Southern stations pass and barring out most of the Western and Northern stations while letting the Southern broadcasters through with great volume and clarity. Another night, reception would obtain in a reverse direction while for many nights the shield would be impenetrable except for a few 500-mile stations, and, of course, the locals.

Scientists Investigate

As this condition continued and became more noticeable, scientific minds of all classes, including leading radio savants, set to work to solve the problem. When the trans-Atlantic tests proved so unfruitful it became evident that some unusual set of phenomena was accountable, and research was doubled. Brilliant Auroral displays were widely noted at the time and theories were advanced that here lay the causes, This theory, to the trained radio mind, readily proved untenable.

Some engineers advanced the theory that the unusual pall of soft coal smoke thickly enveloping several sections of the country, due to the anthracite coal miners' strike, caused ionization of the atmosphere which condition would have a dampening or deflective effect on the radio wave. If this were true, there would be hardly any daylight reception at all, for the atmosphere is thus acted upon by the sun's rays on every clear day, the ionization process reaching its maximum as the sun crosses the meridian, receding toward sunset, as is evidenced by the strengthening of the radio signal and the longer path of the transmission after dark.

Rumors were even set forth that some weird genius had invented an oscillating apparatus of tremendous power which engulfed all radio waves in its capacious maw, or, perhaps, shot them off into infinite space. This he was supposed to be operating in some mountain fastness, where, when it was fully developed, he would be ready to turn it to some fell purpose. Perchance this mythical Mr. X held a grudge against soupy contraltos, catty sopranos, musical saw players, propagandizing and useless stations, et al. Many other wild theorems were advanced, and it is passing strange (as they say in the classics) that some pseudo scientist did not advance the supposition that the changing course of the Gulf Stream was the cause of it all.

Cites "Cosmic Interference"

To arrive at the most logical theorem and the most probable causation, we must coin a new term, "Cosmic interference," which after all is the basic obstacle to real DX reception. The main factor in cosmic interference—sun spots and their flotilla of accompanying magnetic storms —is the most serious interruptions to radio transmission. We are now entering into the fourth year of a sunspot cycle. Sunspots occur in eleven-year cycles, although these cycles vary irregularly. There is a sunspot minimum and maximum period. It is possible, then, that last year witnessed a sunspot maximum period and it is therefore highly probable that this year brings the approach of the minimum and that DX reception may become more nearly normal.

It is my belief that the ultra-violet ray has a deterrent effect on the radio wave in many ways and this ray, always present in the sun's emissions, is much stronger during sunspot conditions and the intensified activity coupled with the violent magnetic eruptions is mainly at the bottom of DX difficulties. A sunspot, which in its umbra or central darkest portion, has a diameter of approximately 20,000 miles, is capable of creating terrific magnetic disturbances in interstellar space of which our Mother Earth falls in for a full share. This fiery whirlpool was in evidence on the face of the sun even January 22 to 24, 1926, and the total extent of the group to which this spot belonged was estimated to be about 140,000 miles.

Seething Bolts

Imagine, therefore, the radiant bombardment by the streams of solar energy containing intermingled electro-magnetic currents, ultra-violet rays and even rays unkown to science that overwhelmed the terrestrial atmosphere. This particular emanation shot forth from a high solar latitude—over twenty degress—an angle whose interception would strike the territories most affected by the blanketing of DX. The date was also coincident with a period of poor reception conditions. Checking off the dates of other vast solar disturbances they tally perfectly with bad reception periods, proving the sunspot theorem to be a logical hypothesis.

Experiments carried on by astronomical observers show that during the past eighteen months the ultra-violet radiation from the sun has increased eighty-three per cent, a most imposing figure. Now, whether this only portends the normal increase in accordance with the maximum of the cycle or shows that we must expect a continuance of this condition indefinitely is not safe to predict. At any rate, it is far in excess of what it should be at this period of the cycle. It may be that as the solar orb ages its physical disturbances increase in violence, as its power expends itself, and its solar energy increases accordingly. No scientist has as yet advanced this theory, but if it should be so, DX reception will become more difficult as time goes on. The only remedy in that case would be higher power for the selected stations that have proven their worth and the building of multi-tube and super-sensitive receivers. Higher power, properly modulated is a blessing to the fan, giving him the acme of good reception. And with the advance in tube construction together with price reduction due to quantity production by the tube manufacturers, the multi-tube set is the only answer to many radio problems and is now within the means of every fan.

Static "Messages"

One reader writes me: "I am glad to read that Professor Pupin agrees with you, for in an article of yours, 'Radio and the Fourth Dimension', printed in RADIO WORLD some months ago, you advanced the same theory that he has just propounded as new". While I thank my reader for his interest and for honoring me by linking my name with that of Professor Pupin I must disclaim any belief in the theory that static is a solar message, i. e., something that way be deciphered like barometer pressure. I do believe that static, or a form of static, may be caused by solar electrical emissions, and there are many other forms of electrical emissions constantly entering our atmosphere from strange sources together with unknown rays from unseen solar bodies that have much to do with the making of static. One of these is the mysterious cosmic rays which science is bending every energy to unveil. Our position in interstellar space also may have bearing on the transmission of radio waves, as our universe is constantly hurtling forward at tremendous speed through infinity. This is in addition to Earth's other motions, viz, around the sun and on its axis. Herein lies an interesting field of speculation for the profound thinker and the imaginative mind as to radio results. If we could only be transported backwards in time with our radio equipment for a score of centuries, when the cluster of planets which comprises our tiny universe sped through a portion of infinite space many quadrillions of miles from where we are now dashing through immensity!

However, I believe that this year will witness a return to better DX conditions. At any rate, the earnest radio enthusiast will not not be discouraged by any temporary obstacles. The harder the problem, the greater the triumph in solving it, and notwithstanding the magnetic shield of last year many good DX logs were tabulated by beginners and oldtimers alike and this year we will all do as well or better, I trust.

New Hour Instituted Over Blue Network

A new feature on the program of WJZ and the stations of the National Broadcasting Company's Blue Network, WBZ and KDKA, is the Ruud Light Opera Hour, sponsored by the Ruud Manufacturing Company. This new period is devoted to the rendition of popular selections from past and present light operas, musical comedies and revues and features as soloist Gladys Rice, soprano, and Frank Munn, tenor, supported by a large orchestra under the direction of Walter Haenschen.

Miss Rice, beautiful young soprano soloist, is the daughter of the old-time vaudeville team of Sally Cohen and John C. Rice. Miss Rice is a radio favorite and has been heard many times with the Capitol Theatre Gang. Miss Rice's voice has not been confined to the microphone however, as she played the prima donna role in "Sweethearts" and also recorded for three of the largest phonograph companies. She also danced in one of Broadway's musical hits, "The Spring Maid."

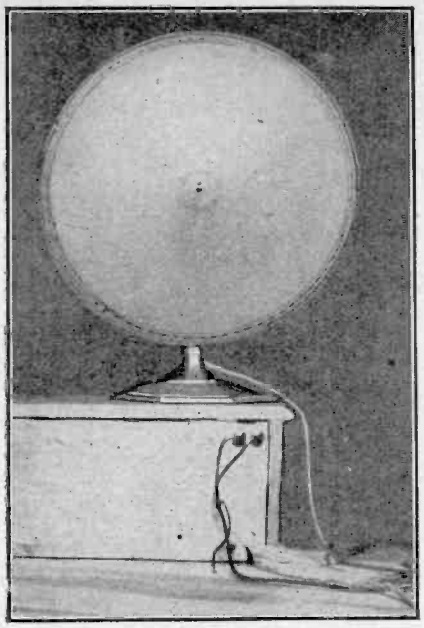
Munn is a native New Yorker, born in 1896 and educated in the public and high schools of the metropolitan district. He was trained in mechanical engineering and specialized in automotive engineering. He began the study of voice when he was twenty-five. While singing at a performance he was so favorably received that he decided to abandon mechanical engineering in favor of a musical career. He was signed up with a large recording company and is now making many appearances in the concert field in addition to his radio work.

ANOTHER KENTUCKY STATION

Hopkinsville, Ky.

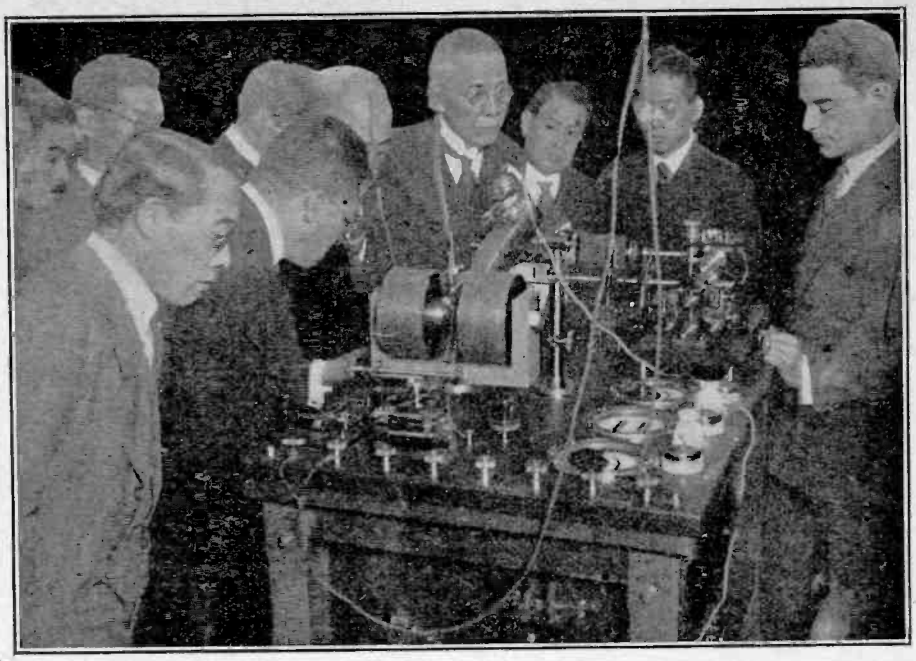
A broadcasting station will soon be established in this city by the Acme Mills, Inc.

EXIT AT REAR



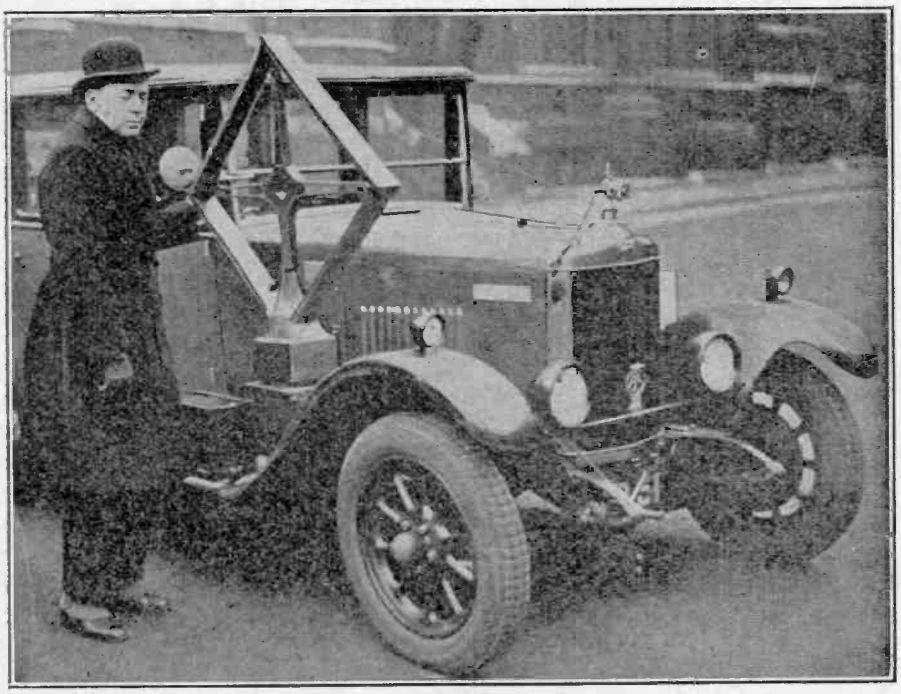
(Wide World)
PLACING BINDING posts on back of the radio cabinet removes the possibility of becoming entangled with the cord, and causing the speaker to fall, which may be common when the cord is attached to a plug in front of the cabinet.

BELIN DEMONSTRATES



(Herbert Photos)
PROFESSOR BELIN, famous French scientist, demonstrated his latest device whereby photographs are transmitted over wires, as well as by radio. A group of government officials saw the demonstration and complimented the distinguished professor on the excellent results in the demonstration.

DX SET IN EXPERT'S CAR



(Herbert Photos)
CAPTAIN LEONARD PLUGGE, of London, European radio experimenter, with his completely equipped auto, which carries a sensitive nine-tube set capable of picking all of the European programs from anywhere in Europe. The speaker is located in the roof of the car, while the controls of the set are placed on the dashboard.

CONVICTS PERFORM

(Wide World)
GEORGE LEE, serving a life sentence in the Eastern Penitentiary, Pa., singing a love song in his native Chinese, as a part of a special radio program given by fifty convicts, over WIP, Philadelphia and heard by thousands.

Engineers' Board Investigates Broadcasts

Washington.

A survey of radio broadcasting conditions designed to reveal facts upon which an effective system of Federal control can be based was decided upon by the American Engineering Council at its recent meeting in Washington. The American Engineering Council some time ago made a study of "elimination of waste in industry" and its recommendations are now being followed by Secretary of Commerce Hoover.

The survey will be made by a specially appointed committee consisting of many of the outstanding engineers in the radio field. It includes Dr. J. H. Dellinger, chief of the Radio Laboratory of The Bureau of Standards; Dr. C. M. Jansky, assistant professor of radio engineering, University of Minnesota; Alfred N. Goldsmith and David Sarnoff, of the Radio Corporation of America; Calvert Townley, of the Westinghouse Elec. & Mfg. Company, and L. E. Whittemore, of the American Telephone and Telegraph Company.

In announcing the proposed investigation, Dean Dexter S. Kimball, of Cornell University, president of the Council, declared that legislation was imperative to forestall chaos.

"With the increasing demand for broadcasting licenses beyond the possibility of granting such privilege," says he, "a situation of baffling complexity is bound to ensue.

"Educational broadcasting, according to tentative plans, will be a feature of the engineering radio study. Many educators have informed the council that they will cooperate. We are confident also that the trade and commercial problems involved can be thoroughly brought to light with the cooperation of the business interests. Practically no opposition to an investigation has been voiced."

The Harkness KH-27 Receiver

Assembly and Wiring Instructions in Detail

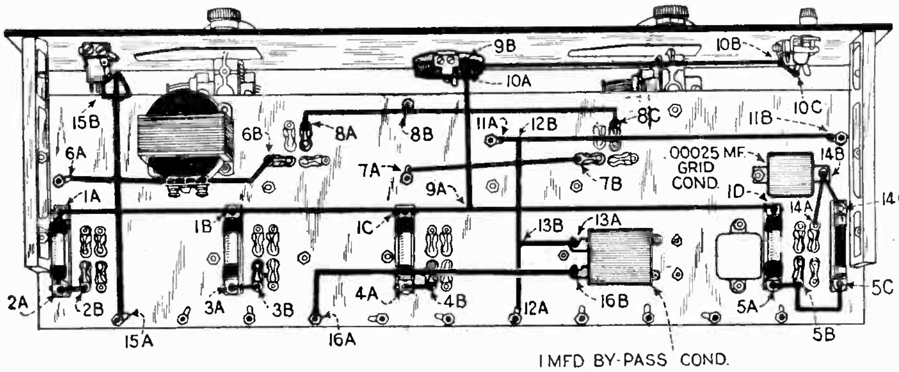


FIG. 1
Bottom view of the set illustrating positions of the first fifteen wires.

By Kenneth Harkness
Consulting Radio Engineer
Designer of the Harkness Reflex and Harkness Counterflex Circuits.

PART II

IN the concluding paragraphs of the first article of this series, which appeared in last week's issue, an explanation was being given of an unusual and distinctly useful effect of the coupling devices in the Twinchoke audio amplifier of the KH-27. The effect results in quadrupling the power output of each tube, enabling this amplifier to handle four times as much volume as a transformer-coupled amplifier.

As explained last week, it is necessary to prevent the generation of grid currents in a transformer coupled amplifier. Otherwise considerable distortion takes place. The normal potential of each grid must be adjusted to some negative value with respect to the filament. This restricts the strength of signal which may be impressed on the grid without causing overloading or producing grid currents. The Twinchoke amplifier is not restricted to the same extent. The normal potential of the grid may be adjusted to the best operating point without considering the necessity for preventing grid currents. In the case of a -01A tube, the normal potential of the grid can be made zero with respect to the filament. A much stronger signal (twice as strong) may then be impressed on the grid without causing overloading and the power output is thereby quadrupled. Grid currents are, of course, generated but these grid currents do not cause distortion which is audible to the human ear.

Technically-inclined readers may find the above difficult to believe. Personally, I did not believe it until I had demonstrated it in actual practice to my own satisfaction and the satisfaction of others. There is some difference of opinion as to the reason for the effect but there can be no question that it actually takes place and that grid currents do not cause audible distortion. An easy and simple method of demonstrating the effect is to insert an -01A tube in the last stage of the audio amplifier of the KH-27 and impress 200 volts or more on the plate of this tube. Do not change the Amperite. Retain the type 112.

An Unusual Situation

Provide some means for quickly changing the C battery potential from about 15 volts negative to 15 volts **positive** (that is, **reverse** the C battery) and ask some friends to tell you which sounds better. If possible have some good judge of radio tone quality listen to the test. I can tell you in advance that they will either be unable to tell the difference or will agree with you that the tone quality is better when the grid is made positive. Needless to say, a large grid current flows when the grid is made positive; yet there is no distortion. As a matter of fact, I have substituted an -01A tube in place of a 210 tube in the output stage of a power amplifier, with 450 volts on the plate, and zero normal grid potential (no C battery) without noticeably reducing the power output or producing distortion.

These stunts, of course, are not recommended as good practice. If you want to use a -01A tube in the last stage of the KH-27, employ a plate potential of 135 volts and use no C battery.

With the CeCo type J-71 power tube in the last stage, using a C battery, still better results can be obtained.

The KH-27 Receiver is very easy to build and is not expensive. Standard parts, easily obtainable, are used in its construction. The front panel is also a standard size so that any desired type of cabinet can be used to house the set.

The list of parts needed to build the receiver was given last week. (Note:—1 micamold grid leak mounting was omitted from the list by mistake). It will be noted that drilled and engraved front and sub-panels are manufactured for this set, making it unnecessary for the builder to drill these panels. The manufactured sub-panel is also supplied with six tube sockets attached, the sockets being rivetted to the panel.

The photographs of Figs. 2 and 3 published last week, and the drawings which are reproduced in this issue, clearly depict the positions occupied by the various parts of the set.

When the parts have all been secured, first attach the sub-panel to the front panel by means of the two bakelite mounting brackets. Then turn the set on end so that you can reach both sides of the sub-panel and mount the parts on the sub-panel as follows:

Mount on the lower side of the sub-panel the four Amperites, the grid leak mounting, the .001 mfd. fixed condenser, the two 1 mfd. by-pass condensers and the output filter choke coil. Note that the type 112 Amperite is mounted at the extreme right, when viewing the set is in Fig. 3, and the grid leak mounting at the extreme left. The .001 fixed condenser is placed beside the Amperite of the detector tube, on the left.

Then, mount on top of the sub-panel the coils T1, T2 and T3, the two X-L Variodensers (used as neutralizing condensers) the eleven binding posts and the three Twinchoke Audio Couplers. Next, remove the shafts from two of the Hammarlund condensers. Mount one of these condensers on the right side of the front panel. Then bolt the second condenser to the sub-panel, behind the first, and pass the long brass shaft, specified in the list of parts, through both condensers. Screw the rotors to the shaft, both in the same positions with respect to their stators. The condenser extension shaft should pass easily through the two condensers. If it does not, loosen the bolts holding the condensers to the sub-panel and line them up correctly.

Mount the third variable condenser on the left of the front panel, also the antenna switch and the loudspeaker jack. On the right mount the pilot light bracket and the filament switch; in the centre, the rheostat. Finally, attach the two vernier dials on the condenser shafts. This completes the assembly.

How to Wire the Set

When the set has been completely assembled, proceed with the wiring. Use bus-bar for most connections. It is more convenient.

The electrical circuit diagram was given last week. The actual wiring of the set, however, is more clearly illustrated in the four diagrams which appear in this issue. These diagrams are made from photographs of the set itself and show the actual positions occupied by each and every wire. There is no difference between this week's and last week's diagrams, except that the schematic last week shows the filament resistors in the negative leg. Use either method. Each connection is numbered and explained in the text. The first diagram illustrates wires 1 to 16; the second, wires 17 to 34, etc. To follow these diagrams place your assembled set in the position shown in the first diagram; start with wire No. 1 and solder this wire in place, connecting terminals 1A, 1B, 1C and 1D. Then solder wire No. 2 from 2A to 2B, and continue with each numbered wire in the same

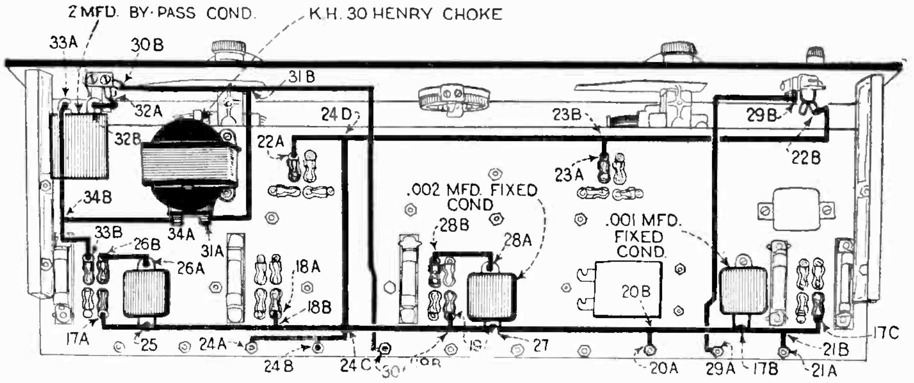


FIG. 2
Same view as No. 1 showing the positions of Wires 16 to 34.

manner until all 63 wires are in place. Your set will then be correctly wired. This method of illustrating the wiring is very easy to follow and ensures accuracy. It does not take very long to finish the wiring. You can complete the set in one evening.

When wiring the KH-27, check your connections against the instructions given below:

Diagram No. 1

Bend and solder the following wires, as illustrated in drawing.

Wire No. 1—From Amperite terminal **1A** to Amperite terminals **1B, 1C** and **1D.**

Wire No. 2—From Amperite terminal **2A** to tube socket contact **2B.**

Wire No. 3—From Amperite terminal **3A** to tube socket contact **3B.**

Wire No. 4—From Amperite terminal **4A** to tube socket contact **4B.**

Wire No. 5—From Amperite terminal **5A** to tube socket contact **5B** to grid leak mounting terminal **5C.**

Wire No. 6—From Coil T1 mounting bolt **6A** (this mounting bolt forms electrical connection to grid terminal of Coil T1 on top of sub-panel) to tube socket contact **6B.** (This wire must not touch choke coil. If necessary cover with spaghetti).

Wire No. 7—From Coil T2 mounting bolt **7A** (forming electrical connection to grid terminal of Coil T2) to tube socket contact **7B.**

Wire No. 8—From tube socket contact **8A** to 2 ohm fixed resistance terminal **8B** (through mounting bolt) to tube socket contact **8C.**

Wire No. 9—From Wire No. **1** at point **9A to rheostat terminal 9B.**

Wire No. 10—From Wire No. 9 at point **10A** to battery switch terminal **10B** to pilot light bracket terminal **10C.**

Wire No. 11—From Coil 2T mounting bolt **11A** to Coil T3 mounting bolt **11B.** (On the top of the sub-panel these mounting bolts will later be connected to the B plus terminals of Coils T2 and T3).

Wire No. 12—From 67 Volts binding post **12A** to Wire No. 11 at point **12B.**

Wire No. 13—From by-pass condenser terminal **13A** to Wire No. 12 at point **13B.**

Wire No. 14—From detector tube socket contact **14A** to grid condenser terminal **14B** to grid leak mounting terminal **14C.**

(Note that the **opposite** terminal of the grid condenser is electrically connected to the grid terminal of Coil T3 by the mounting bolt holding both coil and grid condenser to the sub-panel. No wire is necessary.)

Wire No. 15—From Antenna binding post **15A** to center blade of Antenna Switch **15B.**

Wire No. 16—From Ground binding post **16A** to by-pass condenser terminal **16B.**

Diagram No. 2

Wire No. 17—From tube socket contact **17A** to .001 condenser terminal **17B** (at opposite end of panel) to tube socket contact **17C.**

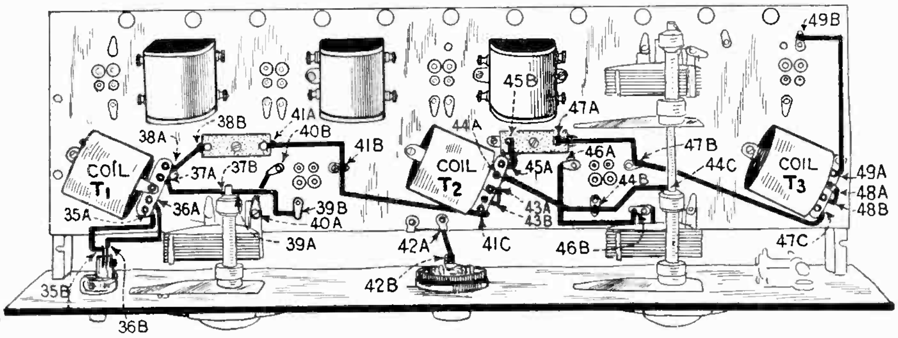


FIG. 3
Top view of the KH-27 depicting connections Nos. 35 to 49.

Wire No. 18—From tube socket contact **18A** to Wire No. 17 at point **18B.**

Wire No. 19—From tube socket contact **19A** to Wire No. 17 at point **19B.**

Wire No. 20—From B Battery Minus Binding Post **20A** to Wire No. 17 at point **20B.**

Wire No. 21—From A Battery Minus Binding Post **21A** to Wire No. 17 at point **21B.**

Wire No. 22—From tube socket contact **22A** to Pilot Light Bracket terminal **22B.**

Wire No. 23—From tube socket contact **23A** to Wire No. 22 at point **23B.**

Wire No. 24—From C Battery Plus Binding post **24A** to Ground binding post **24B** (which already has a wire connected to it) to Wire No. 17 at point **24C** to Wire No. 22 at point **24D.**

Connection No. 25—Solder terminal of .002 fixed condenser to Wire No. 17 at point **25.**

Wire No. 26—From .002 fixed condenser terminal **26A** to tube socket contact **26B.**

Connection No. 27—Solder terminal of .002 fixed condenser to Wire No. 17 at point **27.**

Wire No. 28—From .002 fixed condenser terminal **28A** to tube socket contact **28B.**

Wire No. 29—From A Battery Plus binding post **29A** to battery switch terminal **29B.**

Wire No. 30—From B. Battery Plus binding post **30A** to loudspeaker jack terminal **30B.**

Wire No. 31—From Choke Coil terminal **31A** to Wire No. 30 at point **31B.**

Wire No. 32—From Loudspeaker Jack terminal **32A** to by-pass condenser terminal **32B.**

Wire No. 33—From by-pass condenser terminal **33A** to tube socket contact **33B.**

Wire No. 34—From choke coil terminal **34A** to Wire No. 33 at point **34B.**

Diagram No. 3

Turn set over so that it occupies position shown. Then bend and solder the following wires:

Wire No. 35—From Coil T1 terminal **35A** to Antenna Switch terminal **35B.**

Wire No. 36—From Coil T1 terminal **36A** to Antenna Switch terminal **36B.**

Wire No. 37—From Coil T1 terminal **37A** to variable condenser rotor terminal **37B.**

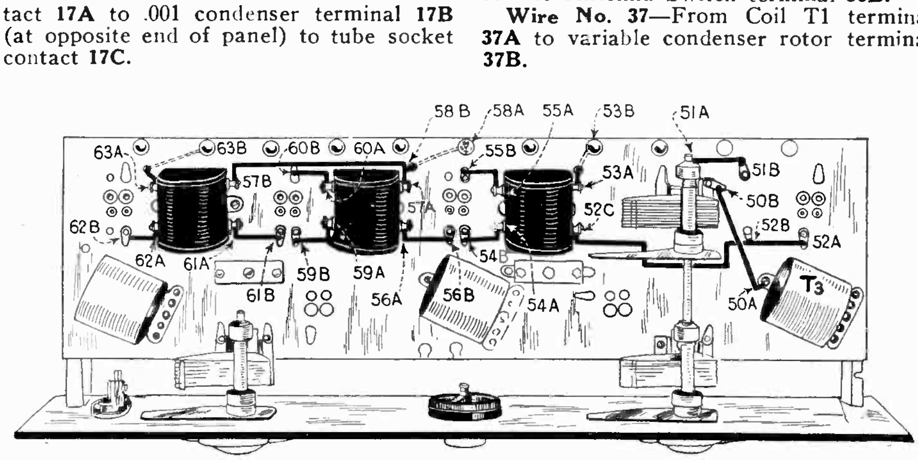


FIG. 4
The remaining wires, from Nos. 50 to 63 are shown in this diagram.

Wire No. 38—From Coil T1 terminal **38A** to X-L Variodenser terminal **38B.**

Wire No. 39—From variable condenser rotor terminal **39A** to tube socket contact **39B.**

Wire No. 40—From variable condenser stator terminal **40A** to tube socket contact **40B.**

Wire No. 41—From X-L Variodenser terminal **41A** to tube socket contact **41B** to Coil T2 terminal **41C.**

Wire No. 42—From 2 ohm fixed resistance terminal **42A** to rheostat terminal **42B.**

Wire No. 43—From Coil T2 mounting bolt **43A** (connecting below sub-panel to 67 Volt binding post) to Coil T2 terminal **43B.**

Wire No. 44—From Coil T2 terminal **44A** to tube socket contact **44B** to variable condenser rotor terminal **44C.**

Wire No. 45—From Coil T2 terminal **45A** to X-L Variodenser terminal **45B.**

Wire No. 46—From tube socket contact **46A** to variable condenser stator terminal **46B.**

Wire No. 47—From X-L Variodenser **47A** to tube socket contact **47B** to Coil T3 terminal **47C.**

Wire No. 48—From Coil T3 mounting bolt **48A** (connecting below sub-panel to 67 Volt binding post) to Coil T3 terminal **48B.**

Wire No. 49—From Coil T3 terminal **49A** to tube contact **49B.**

Note that no connection is made to the fourth terminal of Coil T3 which is not used.

Diagram No. 4

Wire No. 50—From Coil T3 terminal **50A** to variable condenser stator terminal **50B.** Note: Terminal **50A** connects to the grid condenser below sub-panel by means of the mounting screw. No wire is needed.

Wire No. 51—From variable condenser rotor terminal **51A** to mounting bolt of .001 fixed condenser **51B** (connecting below sub-panel to negative side of filament circuit).

Wire No. 52—From tube socket contact **52A** to .001 fixed condenser terminal **52B** (through mounting bolt) to Twinchoke Coupler plate (P) terminal **52C.**

Wire No. 53—From Twinchoke Coupler B Battery (B) terminal **53A** to B Detector Plus binding post **53B.** Use flexible wire for this lead, passing it through hole in sub-panel.

Wire No. 54—From Twinchoke Coupler grid (G) terminal **54A** to tube socket contact **54B.**

Wire No. 55—From Twinchoke Coupler filament (F) terminal **55A** to tube socket contact **55B.**

Wire No. 56—From second Twinchoke Coupler plate (P) terminal **56A** to tube socket contact **56B.**

Wire No. 57—From second Twinchoke Coupler B battery (B) terminal **57A** to third Twinchoke Coupler B battery terminal **57B.**

Wire No. 58—From 90 Volts binding post **58A** to Wire No. 57 at point **58B.** This wire passes through hole in sub-panel. Use flexible lead.

Wire No. 59—From second Twinchoke

(Concluded on page 25)

Radio University

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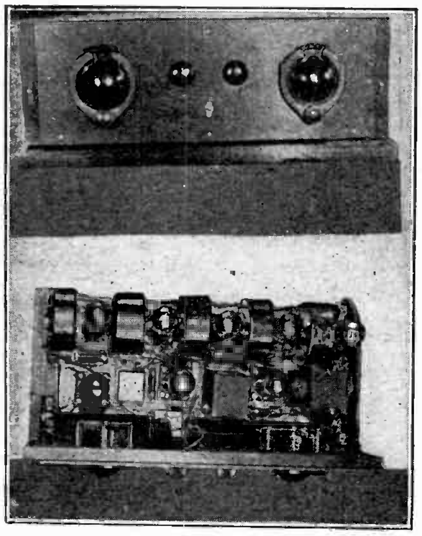
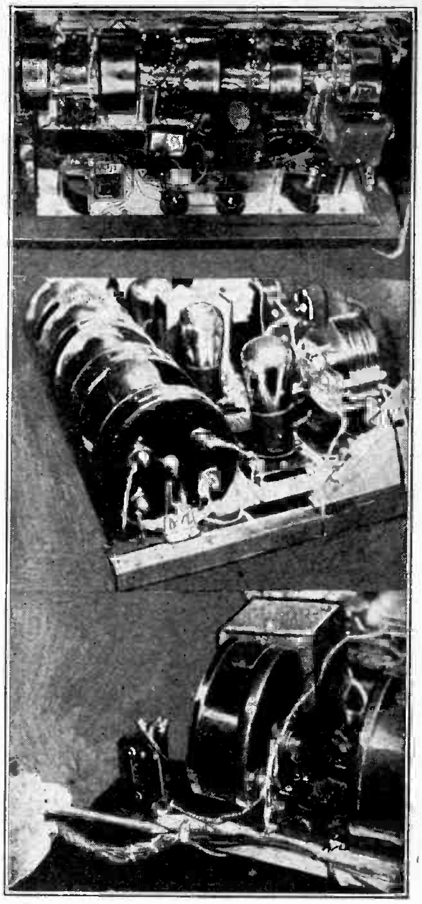


FIGS. 507 AND 508, (top to bottom)
The panel view is seen in the top photo, while a clear layout of the parts is seen in the bottom photo. Note the hasps, or small locks, located on each side of the wooden frame provided for in the cabinet, to which panel is bolted, which prevents the complete unit from slipping out of the cabinet, and also presents a means of taking out the set.

RECENTLY I was presented with a set of five Madison-Moore coils, four of which are marked radio frequency transformer 1, 2, 3 and 4, and one of which is marked oscillator coupler. These coils, I understand, are for insertion in a Super-Heterodyne receiver. I also have two, twenty ohm rheostats; three 112 Amperites; a 1A Amperite; a Rabco radio frequency choke; and two Kurz-Kash Aristocrat Vernier Port Dials. Please give a circuit diagram of a Super, using these parts, also diagrams or pictures, illustrating how to place the parts. I wish to place the set in a Pooley console cabinet compartment.
—Jackson Millis, Portland, Me.

The circuit diagram of this set is shown in Fig. 506. Eight tubes are used in this set. The first tube, 1, is the first detector. This is followed by an oscillator, 2, which is followed by three stages of intermediate frequency amplification, 3, 4 and 5. A second detector, 6, comes next, which is followed by two stages of transformer audio frequency amplification, 7 and 8. The filament temperature of the first detector and the oscillator tubes are each controlled by a 112 amperite, R4. The filaments of the first two RF stages are controlled automatically by a 112 amperite, R_3. The filaments of the third RF and the second detector tube is also automatically controlled by a 112 amperite, R_4. The first audio amplifier tube filament is controlled by the 1A amperite, R_5. The filament of the last audio tube is controlled by the last 112 Amperite, R_6. The oscillator coil is connected up between the oscillator and the first detector, and is indicated by the three coil sections. The other coils are shown in two coil sections and arranged as per advancing stage. C_1 and C_2 are both .0005 mfd. variable condensers, C_1 tuning the loop circuit, and C_2 tuning the grid winding in the oscillator circuit, C_3 and C_4 are both .5 mfd. fixed condensers. C_6 is a .0005 mfd. fixed condenser. The RF choke is indicated at the plate output circuit of the second detector. AFT_1 and AFT_2 are both low ratio audio frequency transformers, either of the three to one or all stage type. C_5 is a .00025 mfd. fixed condenser, while a 2 megohm grid leak, R_7, is shunted across this. R_8 is a variable resistance, from zero to 5 megohms, and is used to control the volume. S is a filament switch. The —01A tubes are used throughout, except in the last audio stage, where a power tube such as the CX171, is used. B plus 1 equals about forty-five volts and B plus 2 equals ninety volts. The plate voltage for the last tube is determined by experimenting. This applies to the C voltages for both audio tubes, as well. The C battery in the first detector circuit is of the four and one half volt type. The coils are placed in the rear of the baseboard, which is twenty-two inches long, and seven inches wide. In between each coil, a socket is placed. From right to left, the first detector is first, the oscillator next, followed by the three stages of intermediate frequency amplification. The two audio transformers are in front of the oscillator coupler and the socket holding the first radio frequency amplifier tube. Between the transformers, the second audio tube is placed. After the first transformer, the first audio socket is screwed down. One of the .5 mfd. fixed condensers is next inserted, followed by the second detector tube socket. The Amperites are placed adjacent to the filament posts of their respective sockets. The two rheostats are equally spaced in the center of the panel, with a variable condenser to the right and left hand sides of each. The filament switch is placed exactly in the center of the panel. The position of the radio frequency choke and the by-pass condenser C_6 can be seen in Fig. 508, it being placed very close to the detector plate post. The volume control may be placed on the baseboard, which was done in this instance, or on the panel. When placed on the panel, it is suggested that it be inserted underneath the filament switch. The entire wiring of the set is done with the aid of bell wire. The battery leads are connected to a cable, as shown in Fig. 511. Binding posts inserted on the back of the cabinet, are connected to the output posts of the set. It will be noted that the A minus posts on all the coils, except the one in the second detector circuit are connected to the shield. The second detector return is to plus A. The shield in this case is also brought to minus A, but not to grid return. The special metal enclosure of the coils, allows them to be placed very close to each other, without any fear of having intermagnetic coupling. It will be noted that the pickup coil is placed in the plate circuit of the detector tube, instead of the grid circuit, as is usually done. The receiver is very simple to tune. Should you find that the tuning becomes a bit tricky, either reduce the filament voltage of the oscillator tube, or the plate voltage via a 2000 ohm variable resistance, or insert a 20 ohm rheostat in the second detector circuit. When doing the latter, supplant the 112 Amperite connected between the two tubes, with a 1A Amperite. The loop used may be built at home, if desired. Using a foot and one half frame, wind fourteen turns of No. 18 bell wire, spaced one-quarter inch. You can also use an antenna, if you wish. The primary of the coil required would consist of ten turns, while the secondary wound on the same form, which is three inches in diameter,



FIGS. 509 to 511, (top to bottom).
Another view of the layout of the parts in the Super-Heterodyne is shown in the top photo. The center photo shows how the coils are mounted, while the bottom photo shows how the cable is mounted on the baseboard, with the aid of a staple, and also attached to the battery leads.

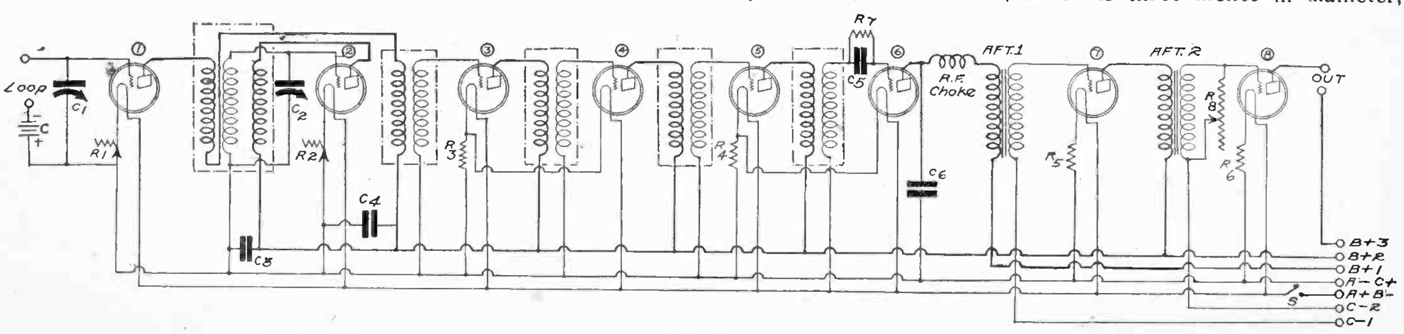


FIG. 506
The circuit diagram of the eight-tube Super-Heterodyne, using Madison-Moore coils.

consists of forty-four turns. No. 22 double cotton covered wire is used. The windings are spaced one-quarter of an inch. The secondary winding is connected in between the loop post connections, the primary being brought to the antenna and the ground. Use a short antenna, about one hundred feet.

* * *

REFERRING TO the circuit diagram of the four-tube receiver shown in the Radio University columns of the Oct. 2 issue of Radio World. (1)—Can a double condenser, each section having a capacity of .00037 mfd. be used in the third stage of radio frequency amplification and the detector, using the coils specified, e. g., ten turn primaries, and sixty-six turn secondaries, wound on three and three-quarter inch diameter tubings, using No. 24 double cotton covered wire? I intend to use a single condenser in the second RF stage. (2)—I am going to use a power tube in the last stage of audio. Will this necessitate the use of an individual B and C voltage line? (3)—What other changes will be necessary?—Clancy Mutters, Butte, Mont.

(1)—Yes, this condenser can be used. However, reduce the number of turns on the secondaries to forty-five, on all coils. (2)—Yes. (3)—You will have to insert a new ballast resistor. Be sure it is of the proper size. When connecting up the C battery, be careful not to put the high voltage required for the last tube onto the grid of the preceding tube, whose plate receives a comparatively low B voltage.

* * *

THE CIRCUIT diagram in the Radio University columns of the Sept. 18 issue of Radio World, seems to be different than other diagrams, representing the same principle. That is, there is no grid leak or condenser, or rheostat, etc.—Grant Bunners, Baltimore, Md.

This diagram was to illustrate a certain fundamental principle, e. g., the proper grid return. The grid leak and condenser is connected in series with the grid post and one portion of the secondary winding of the coil, also the rheostat is connected in series with the negative filament, if this is to be used in a set.

* * *

CAN THE two stages of resistance coupled audio-frequency amplification in the five-tube set, shown in the Radio University columns of the May 15 issue of Radio World, be supplanted by a stage of transformer coupled audio frequency amplification, a four to one transformer being used? (2)—Can the filament control jack be left out. (3)—Can I use two separate ballast resistors to control the filaments of each of the audio tubes?—Gerry Mason, Atlanta, Ga.

(1)—Yes. (2)—Yes. However, you will have to insert a filament switch in series with the positive A lead. If this is not connected in the circuit, you will not be able to turn off the tubes. A single circuit jack can be used in the output of the last audio tube. Do not use the same B voltage on the plates of both audio tubes. That is, use about ninety volts for the plate of the first audio tube, and one hundred and thirty-five volts for the plate of the last audio tube. No provision is made for the insertion of a C battery; this should be made. Connect the F post of the first transformer to the minus post of a C battery; four and one-half volts. Connect the F post of the other audio tube to the minus post of a nine volt C battery. Connect the plus posts of both these batteries to the minus A post. (3)—Yes.

* * *

IS THE circuit relating to keeping DC off the speaker windings shown on page nine of the Sept. 4 issue of Radio World correct? I have seen some diagrams, with the bottom terminal of the jack going to the B plus Amp. post, instead of to the minus A post. Which is right?—Thomas McDowel, Atlantic City, N. J.

Using the method illustrated, prevents any possibility of shock, since the return

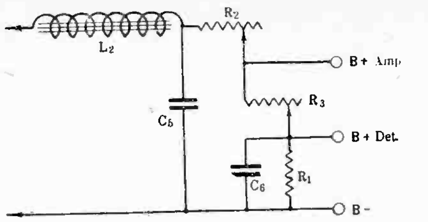


FIG. 512

The wrong way to connect up a resistance for obtaining a varied detector B voltage, as sent in by Harry Morgan.

is too such a low voltage. If this is returned to the plus of the B battery, you have a fairly high voltage here and a great possibility of receiving a shock, should you place your fingers across the jack or tips on the output. Both systems will give the same results, though.

* * *

I AM building a B eliminator, using a Raytheon tube. The circuit diagram as far as the output from the chokes goes, is standard. However varied B voltages are obtained, according to the system diagrammed in the enclosed circuit. L_2 is the last thirty henry choke; C_5 is a 8 mfd. fixed condenser; R_2 and R_3 are both Clarostats. R_1 is a 10,000 ohm fixed resistor and C_6 is a .1 mfd. fixed condenser. Is this O. K?—Harry Morgan, Pittsburgh, Pa.

The results with this sytem will not be satisfactory. When the amplifier B voltage is varied, you vary the detector B voltage at the same time. Feed back is possible through the audio and detector tubes, since the voltages are fed through a single line. This will probably cause howling as well as "motor boating". As to the remedies. First, connect the terminal of R_3, now going to B plus Amp. to the main B plus line, before contact is made with the resistance of R_2. Second, connect a 1 mfd. fixed condenser from the B plus main line, which is connected to the resistance in the B plus detector circuit, to the B minus line. Be sure the condensers have a high breakdown voltage.

* * *

I AM going to build the two-tube reflex, shown in the Radio University columns of the May 18 issue of Radio World. I have a three and one-half inch form twelve inches long, plenty of No. 22 double cotton covered wire, a couple of .005 mfd. variable condensers, three, three-to-one audio transformers, a twenty ohm rheostat and a crystal detector. Please state how to wind the coils, and also how to use the extra transformer, etc.—Michael Ress, City Island, N. Y.

Two tubings are needed. These should each be about five inches long. The primaries are first wound. These consist of ten turns. The secondaries are then wound. These consist of thirty-five turns The secondary is spaced about one-quarter of inch from the primary, on each tubing. The wire you have is used. You will also need a two and one-half inch tubing. This is to be used as a tickler, and placed inside of the secondary winding of one of the coils near the end of the winding. Thirty-four turns of No. 26 single silk covered wire are wound on this tubing. This winding should be made in two sections, e.g., seventeen turns, a space of a one-quarter inch and then the remaining seventeen turns. Across the secondaries the .0005 mfd. variable condensers are shunted. One of the three-to-one transformers is connected in the reflex state, while the other is connected in the first stage of straight transformer coupled audio. The rheostat is used to control the filament temperature of the reflex tube only. The filament of the first audio tube is controlled by a ¼ ampere ballast resistor. The other transformer is used in a second stage of audio coupling, with the P post going to the top terminal of the jack; the B post going to the bottom terminal of this jack; the G post on the transformer being brought to the G post on the new socket and the F post being brought to the minus post of a nine volt C battery. The plus post of this battery is brought to the minus post of the A battery. The plate post of the last socket is brought to the top terminal of a single circuit jack or a binding post. The bottom terminal of this jack is brought to a binding post, to which the 135 volt post of an eliminator or battery is connected. A ½ ampere ballast resistor is inserted in series with the negative leg of the filament on this socket. The F plus post of this socket is brought to one terminal of a filament switch. The other terminal of this switch is brought to the plus A post. The F plus post of the first audio socket is also brought to the F plus post of the second audio socket. No C battery need be used on the grid of the first audio tube, and therefore this portion of the wiring is not changed. The single circuit jack in the first audio tube output is not necessary, and may be left out, connecting the plate and B plus posts directly to the P and B posts on the transformer. The —01A tubes should be used in all the stages.

* * *

I AM building the four-tube Diamond of the Air, but am confused as to the exact connections on the coils, e.g., beginning and end of the windings. Where can I obetain this data?—Roland Lews, New Rochelle, N. Y.

An excellent description of this receiver, giving you coil as well as other important information was published in the Nov. 20 issue of Radio World.

WHAT PRODUCES TONE QUA

Causes of Distortion Traced From Microp

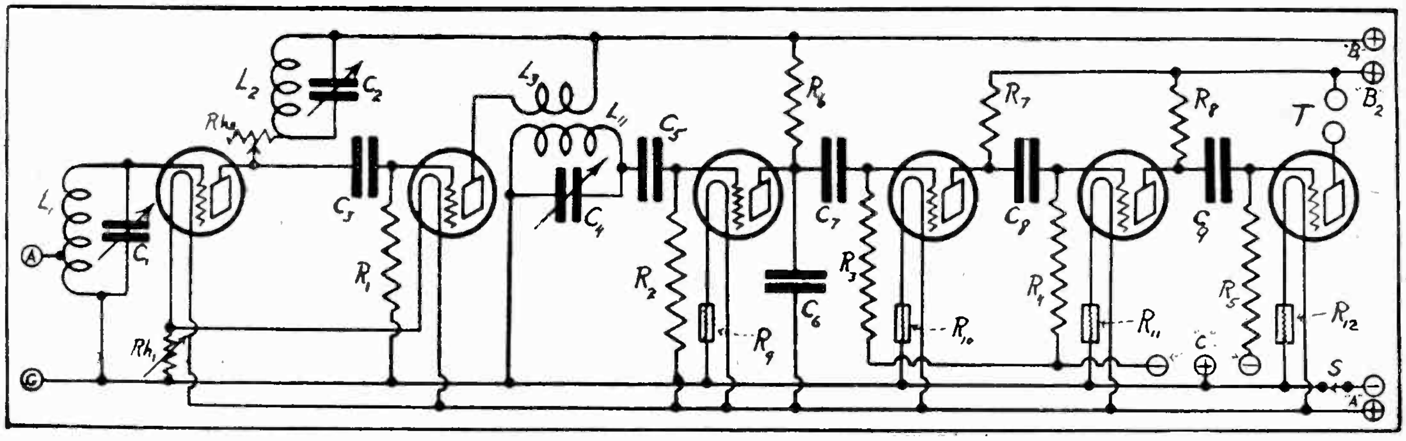


FIG. 1

Stopping condensers in the grid circuits of resistance coupled amplifiers should be large, 0.1 mfd. or more.. A by-pass condenser like, C6 across the first coupling resistor should not be larger than 0.0005 mfd. The grid leaks should also be of high value or a condenser of modest capacity will suppress the low notes.

By J. E. Anderson
Consulting Engineer

EVERYBODY interested in radio reception now wants quality of signals, that is, natural reproduction. That brings up the questions: what is meant by natural reproduction and what are the factors which enter into the receiver to make the signal natural or unnatural?

In non-technical terms one may say that the reproduced signal is natural when an observer cannot tell the difference between the original and the reproduced. Technically, natural reproduction is such that the reproduced signal is an exact replica of the original in every respect except intensity. The reproduced signal may be weaker or stronger than the original, yet it may be an exact reproduction in every other respect. One condition for naturalness of the reproduced signal, then, is that the amplitude of the sound wave emitted by the loud speaker is at all times and for all audible frequencies exactly proportional to the amplitude of the sound wave that impinges on the microphone in the broadcasting studio, or better, to the amplitude of the sound as it leaves the sound producer. Included in this condition is the requirement that no other frequencies shall enter into the signal during its many transformations and amplifications.

The Two Divisions

The problem of natural reproduction naturally falls into two distinct divisions. One is the problem of transmission and the other is that of reception.

The first problem that enters at the transmitter end is that of echo, and this is similar to echo problems in auditoriums. If the walls of the studio reflect the sound waves not only the original sound wave affects the microphone but also the reflected waves. The plural is used here because there is not only one reflected wave but there is an infinite number of them. One should speak of the reverberation rather than of the reflected waves. The better the walls reflect the sound the longer will the reverberation of a given sound last, and the more will the transmitted wave be distorted. Where reverberation is severe it is almost impossible to understand the signal as transmitted, or even to understand what is said or played in the studio.

The problem of echo has been solved in most studios by padding the walls or by hanging suitable draperies so that no waves will be reflected. The walls or hangings then absorb all sound waves that impinge on them and only the original wave strikes the microphone.

The Microphone's Task

The next problem is that of the microphone itself. This must be such that it does not introduce any other frequencies. such as harmonics, and also that it transmits sound of all frequencies with the same efficiency. This is not easy to accomplish. There are certain types of microphone which are fairly impartial to different frequencies, but they are not very efficient and for that reason they are not used much. One such microphone is the condenser type of transmitter. The most commonly used microphone is the carbon type. This is very sensitive, and is properly called a microphone, but it has the disadvantage of introducing harmonics into the signal and also of responding more readily to certain frequencies than others. These difficulties can be fairly well controlled with the proper equipment and in a well constructed transmitter distortion in the microphone need not be of appreciable magnitude.

Following the microphone is the signal amplifier and the modulator. The problem of the amplifier is exactly the same as that of the amplifier at the receiving end, and remarks on that will be postponed until later in this article. The problem of the modulator is that of impressing the radio frequency wave with the audio frequency signal in such a manner that variation in the amplitude of the radio wave is exactly proportional to the amplitude of the audio signal as it reaches the modulator.

Correction Is Possible

Between the sound producer in the studio and the transmitting antenna there are many sources of distortion. These may all be corrected by a suitable filter network called an equalizer. The function of this is to cut down amplitude of all audio frequency currents which are higher than normal and to build up those which are sub-normal. The result of the correction is the same amplitude for all frequencies. This equalizer must not only correct for the distortion arising in the audio portion of the transmitter but also for the suppression of the side band frequencies in the antenna circuit. The antenna is tuned to the carrier frequency and this frequency is transmitted with a higher efficiency than the side band frequencies which are all off tune to an extent depending on the frequency difference between the carrier and a particular side frequency.

Side Bands Considered

A recent advance in broadcasting has also undertaken to correct for side band suppression at the receiving end. That is the equalizer used in the transmitter not only equalizes for inherent deficiencies in the transmitter, but also for deficiencies in the receiver arising from the necessity of using too great selectivity. Since there are no two receivers of the same selectivity it is necessary to base the adjustment on a typical receiver.

Whether this trend of development will lead to a general improvement of quality in receivers remains to be seen. Perhaps it would be better to try to make each component part of the transmitter-receiver as nearly perfect as possible and to correct for any residual defects at the receiver. When the transmitter is so adjusted as to compensate for suppression of side bands by the tuner in the recevier the frequency characteristic of the transmitted signal has a rising curve, that is the higher notes in the signal are boosted to a higher amplitude than the lower notes in the signal.

The Receiver Itself

Even the space between the transmitter and the receiver is not free from distortion effects. One of these effcts is that the various radio frequencies constituting the modulated radio wave do not travel at the same speed nor follow the same path from sender to receiver. This introduces fading of signals and the rate of fading may be such that an audible beat note may be introduced into the signal. This problem has not yet been solved but fortunately it does not give rise to much trouble in most cases of reception over moderate distances.

We have now reached the receiving

LITY EXPOUNDED BY EXPERT

phone to Reproducer and Remedies Suggested

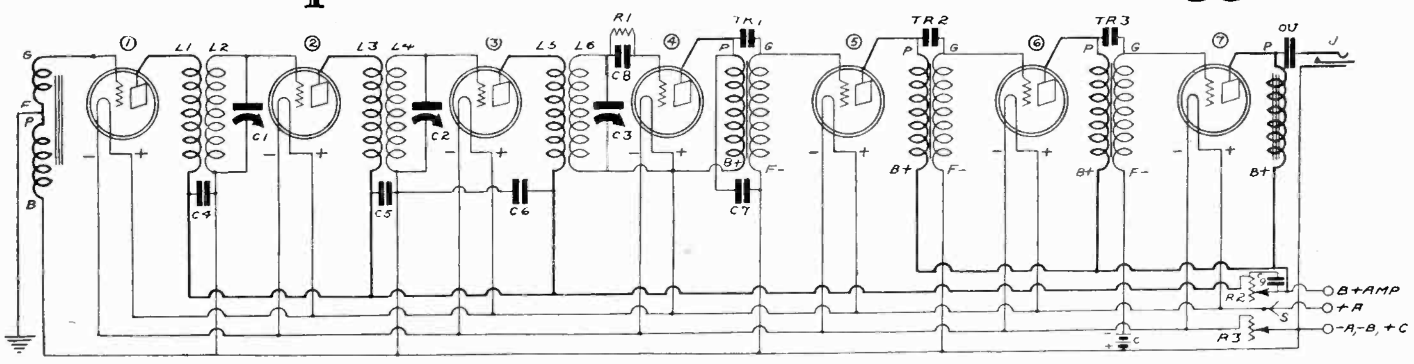


FIG. 2

Condensers used for by-passing direct current parts should be large. Thus condensers C4, C5, C6 and C9 should be very large to be effective. Condensers across audio frequency parts should be small or they will by-pass the higher audio frequencies as well as the radio frequencies. Thus C7 should be small, not larger than .0005 mfd. Coupling condenser in the grid circuits should be large. Thus condensers marked TR1, TR2 and TR3 should be larger than 0.1 mfd. Series condenser through which the signal must pass to the reproducer must be large. Thus OU should be 4 mfd. or larger. The choke coil in the plate circuit of the last tube should be very large, say 100 henries or more.

set. The first problem in this is identical with the last problem in the transmitter, that of suppression of side bands, or side frequencies. This arises from the present necessity of employing a tuning system of a high degree of selectivity. If the tuner is not selective enough other stations than one desired will force themselves in and spoil the reception. If the tuner is so selective as to cut out interference the higher notes will be suppressed so that the signal will sound boomy and of a low pitch. Some people prefer this type of reception and they refer to it as soft. It may be that but it is not natural. As has already been pointed out, this may be corrected to a certain extent at the transmitter, or may be corrected at the receiver by employing an equalizer. Radio has not yet reached the point where equalizers can be commercialized because a diffent design is required for each type of amplifier, for each tuner, and even for each carrier frequency. If the selectivity could be standardized the question of equalization of signal for side band suppression could well be taken care of by the transmitting station.

There are other causes of boominess, than too great selectivity. One is the use of by-pass condensers across audio frequency parts. For example, the by-pass condenser across the primaries of transformers or across the coupling resistors or impedances.

Placement of By-pass

It makes no difference where the by-pass condenser is located in the circuit; it produces the same effect of suppressing the high audio frequencies in the signal. It may be across any primary coupling transformer or across the loudspeaker, or it may be across coupling impedances. The common recommendation of putting a rather large condenser across the loudspeaker to improve reception is not in harmony with getting natural reproduction. The effect is to "soften" the tone by cutting out the higher audio frequencies, and in many cases it is merely a confession of weakness somewhere.

By-pass condensers are necessary in some places, but wherever they are used they should never be any larger than absolutely necessary to accomplish their object. For example, it should not be necessary to use a larger by-pass across the first audio coupling impedance, resistance, or primary than .0005 mfd. If a larger one must be used it will necessarily be at a sacrifice of naturalness. This applies in the case of intermediate frequencies as well as radio frequencies.

By-pass condensers across direct current sections of the circuit should be as large as practical. The larger they are the better the set will function. The only limitation should be space and the strength of the pocketbook. This refers to by-pass condensers across the B battery, C battery, and the A battery and across the output of a B battery eliminator, as well as to condensers across the voltage regulating resistors used in conjunction with eliminators.

Effect of Condensers

The effect of these condensers is to stop regeneration by virtue of coupling in the common impedance. The better the audio frequency amplifier is, as a rule, the greater is the necessity for large by-pass condensers of this type. They will prevent blasting of the speaker due to amplification peaks, and they will also prevent blocking, fluttering, motorboating and similar troubles due to the same cause.

Another cause of suppression of high notes is series radio frequency choke coils which are used to keep the radio frequency currents out of the audio frequency channels. A series choke coil will have exactly the same effect as a shunt, or by-pass, condenser provided that the impedance of the two at a given frequency is the same. It makes very little difference where the choke coil is placed in series with an audio frequency conductor. In some positions the choke coil has very little effect on the audio frequency current, but in nearly all such cases it does not perform its function as a choke and might as well be omitted. A case in point is a choke coil in series with the grid circuit of a resistance coupled amplifier where it is in effect in series with the grid leak resistance.

Under the heading of by-pass condensers should come the distributed capacity of audio frequency coils, such as the primaries and secondaries of transformers, the coupling impedances of amplifiers employing this type of coupling, and the choke coil in the plate circuit of the last tube where the DC and AC components are separated. These capacities all have the effect of cutting out the higher frequencies and producing the "soft" effect which some people prefer to natural reproduction.

High, Low and Middle

In the above discussion the meaning of higher audio frequencies is those lying above about 2,000 cycles per second. Frequencies lying between 2,000 and 400 cycles may be called the middle frequencies. These are the most easily reproduced frequencies, and many receiving installations are not able to bring in any but those lying in this range. Such are decidedly poor receivers. The frequencies lying below 400 are quite different to bring out, and particularly those lying below the 100 mark. But to have natural reproduction it is absolutely necessary to bring these out with full amplitude, even as low as 30 cycles per second. But there are not many receivers, even in these days of "perfect" reproduction, that will bring them out. Some of the better type of audio frequency transformers do very well. The various types of impedance coupling do somewhat better. and resistance coupling when properly designed brings them out best of all.

When transformers of correct design are used the only thing to watch out for is not to use any series condenser through which the audio signal must pass before it gets to the signal, or, if they are used, to employ condensers of large enough capacity so that their impedance even at the lowest audio frequencies is low. This has special reference to the condenser in series with the loud speaker when the DC and the AC components are separated.

Effect on Signal

When impedance, resistance, dual impedance or auto-transformer coupling is employed it is necessary to use series blocking condensers in the grid circuits. The signal must pass through these and consequently they have the effect of suppressing the low frequencies. For this reason the capacity of these condensers should be as large as practical. The choice of capacity depends mainly on the permissable signal suppression at a given low

(*Concluded on page* 18)

High Resistance AF Leaks
Recommended for Best Tone Quality

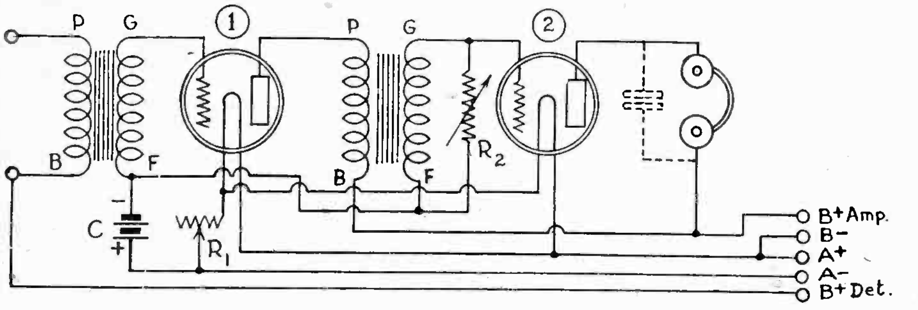


FIG. 3

The condenser across the reproducer should be omitted because it only suppresses the higher audio frequencies. The offender in this case is shown in dotted lines.

Capacity of Coupling Condenser in Such a Case May Be Smaller, But Not Less Than 0.1 Mfd.—Product of C and R Should Be a Constant

(*Concluded from page 17*)

frequency, say 30 cycles per second, and on the value of the grid leak which is in series with it. The effect of the grid leak on the suppression is almost invariably neglected by designers of circuits, and even by theoretical writers on the subject. The fact is that if the grid leak is infinite the smallest condenser will have negligible effect on the suppression of the low notes. But in no practical circuit, or even in no possible circuit, will the grid leak have infinite resistance. The resistance must be taken into account when choosing the condenser. When the grid leak is effectively 1,000,000 ohms, a condenser as small as 0.1 mfd. will pass; that is, the signal suppression at about 30 cycles is negligible. A condenser as large as one 1.0 mfd. would be better provided that the condenser is properly constructed and is in fact a condenser, but perhaps it is never necessary in broadcast reception to use as large a value as this. But the low limit should be put at 0.1 mfd. when the grid leak is 1 meg. If the grid leak has a lower value the condenser must be made larger to bring out the low notes with the same amplitude. A rough rule is to keep the product of the resistance in ohms and the capacity of the condenser a constant value. That is, if a 0.25 meg. leak is used the condenser should have a capacity of 0.4 mfd. to maintain the same efficiency on the low notes as the 0.1 mfd. and the 1.0 meg. grid leak combination.

Use High Value Leaks

It should be pointed out in this connection that if the amplifier as well as the plate power source has been correctly designed it should never be necessary to use a lower value of grid leak than 1 meg. Even higher values should work with entire satisfaction and with greater signal step-up. The secret of operation of resistance coupling is to maintain the grid negative for all values of the input voltage swing and to prevent any regeneration through the common impedance.

The one series condenser that must be large for natural reproduction is the condenser in series with the reproducer when the DC and AC components are separated. In this position the capacity should never be less than 4.0 mfd. and a condenser of twice, three or four times that capacity would work much better. In most cases it is better to use the choke coil and condenser method for separation than the output transformer method. It is easier to stop motorboating and similar troubles.

So far the discussion has been confined to amplitude distortion, that is, to suppression of either high or low frequencies. There is another type of distortion which militates against natural reproduction, and that is frequency distortion. This is the introduction of harmonics of the fundamental frequency. This type of distortion is introduced by non-linear characteristics of parts of the circuit, such as vacuum tubes and transformer cores.

There is no audio frequency transformer which does not introduce harmonics, because it contains iron. Air core transformers are right in this respect but they cannot be used for audio frequencies. One method of preventing harmonics from entering the signal by this route is to prevent saturation of the core of the transformer. Nearly all transformers have an air gap in the iron circuit for this reason. With suitable air gap in the core and with a sufficient amount of iron in the core, this distortion may be kept down to a low value. But even in the best of them there is a certain amount of harmonics which enter the signal.

Tube Harmonics

The most prolific source of harmonics is the amplifying tube. Its characteristics is not linear, but if the tube is operated properly the amount of harmonics from this source also is negligible.

To keep harmonics from being introduced by the tube adequate plate potential and filament current must be used. Also the grid potential must be carefully adjusted to match the tube used and the plate voltage employed. This applies with equal force to all amplifier tubes regardless of plate potential, amplification constant of tube and to the type of coupling. The grid must be kept negative at all times and the tube must not be overloaded, or rather it must not 'be overworked.

Another important consideration in working a tube is that it must work into a load impedance which is high in comparison with the plate impedance of the tube. The maximum undistorted output of a tube is obtained when the load impedance is twice the output impedance of the tube itself. For example, if the output resistance of the plate of the tube is 10,000 ohms the load must have an impedance of 20,000 ohms. But if the load impedance is higher the quality will be better, though the output will be less.

A Word for Resistance AF

One reason why resistance coupling is superior to transformer coupling as far as quality is concerned is that the load impedance is several times higher than the impedance of the tube. If the load resistance is 100,000 ohms and the resistance of the output is 10,000, the ratio of load to tube impedance is 10, which insures that the output be relatively free from harmonics.

Another way of minimizing the harmonics in amplifiers is to use an even number of stages, particularly of resistance and impedance coupling. In this case the distortion introduced by one tube is partially eliminated by the next. The detector tube is to be counted as an audio tube for the purpose of this determination.

Keeps Up Low Notes

The use of a high load impedance in comparison with the impedance of the tube not only tends to keep out harmonics but it also tends to keep up the lower notes in the signal.

The use of push-pull amplification also tends to minimize harmonics. It eliminates all even harmonics. If the characteristic of the tube were symmetrical about the operating point, which it is more or less, in certain types of tubes, there would be no even harmonics generated. It would then be unnecessary to use a push-pull system of amplification. But in most cases the characteristic is not symmetrical, and the second harmonic is much greater than the third. Hence a system of amplification which eliminates the even harmonics will improve the output considerably, especially when the tubes used are worked to the limit.

The Speaker Problem

The problem of the reproducer is almost the same as that of the microphone, except that it is inverted. The energy in the electric circuit must be converted into sound energy. If the transmission and the receiver amplification has maintained the true ratio of the signal it is up to the speaker to translate the energy so that the ratio will not be changed, or the reproduction will not be natural. This is a problem not yet satisfactorily solved. Even the best cone speaker will not emit a sound wave which is proportional to the input at all frequencies. That is, the speaker will favor certain notes and suppress others. There are certain natural frequencies of vibration of every speaker, and these frequencies will be brought out much more strongly than the others. There is one, the lowest natural frequency, which is emphasized more than any of the others. In a certain type of popular cone type of speaker this falls rather low and this gives the speaker a drummy or boomy sound. It is fortunate, however, that it does come at a low frequency. Frequencies below the fundamental natural frequency are not reproduced well because the surface of the sounding board is not large enough. The higher frequencies are not brought out so well because the moving system has too much inertia, that is, it is too heavy to follow the rapid vibrations. The frequencies lying in between the various natural frequencies are brought out fairly well because the various naturals are not far between and the air damping introduces resistance which smoothes out the output. The various natural frequencies in a cone type of speaker are not simple harmonic like the overtones in a piano string, and they produce discard if they are sounded together. This, however, is not likely to introduce any distortion in the signal because the cone is driven at all frequencies and it does not vibrate freely.

Complete List of Stations

Corrected up to January 26, 1927

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KBMH—Detroit, Mich., Braun's Music House..352.7
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KDKA—East Pittsburgh, Pa., Westinghouse, house E. & M. Co. 309.1
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KDYL—Salt Lake City, Ia., Inter. Bdcstg. Corp.245.8
KFAB—Lincoln, Neb., Neb. Buick Auto Co..... 340.7
KFAD—Phoenix, Ariz., Elec. Equip. Co.......... 273
KFAF—San Jose, Cal., A. E. Fowler........... 217.3
KFAU—Boise, Idaho, Indep. Sch. Dist. of Boise 280.2
KFBB—Havre, Mont., F. A. Buttrey & Co........ 275
KFBC—San Diego, Calif., W. K. Azbill.........380
KFBK—Sacramento, Calif., Kimball Upson Co....535.4
KFBL—Everett, Wash., Leese Bros............ 224
KFBS—Trinidad, Cal., School District No. 1.... 238
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KFDM—Beaumont, Tex., Magnolia Petroleum Co. 315.6
KFDX—Shreveport, La., First Baptist Church 236.1
KFDY—Brookings, S. D., S. D. State College.299.8
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KFHL—Oskaloosa, Ia., Penn College........... 240
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KFIU—Juneau, Alaska, Alaska Elec. Light & Power Co. 226
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KFJI—Astoria, Ore., E. E. Marsh.............. 245.8
KFJM—Grand Forks, N. D., Univ. of N. D.... 278
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KFJY—Fort Dodge, Ia., Tunwall Radio Co...... 246
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KFKA—Greeley, Colo., Colo. State Teachers Col. 273
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KFLV—Rockford, Ill., Swedish Evan. Church...229
KFLX—Galveston, Tex., Geo. Roy Clough....... 240
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KFMX—Northfield, Minn., Carlton College.... 336.9
KFNF—Shenandoah, Ia., Henry Field Seed Co. 461.3
KFOA—Seattle, Wash., Rhodes Dept. Store.....454.3
KFOB—Burlingame, Cal., K. F. O. B., Inc..... 225.4
KFON—Long Beach, Calif., Nichols & Warimer, Inc. 232.4
KFOO—Salt Lake City, Utah, Latter Day Saints Union 236
KFOR—David City, Neb., Tire & Electric Co... 226
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KFOY—St. Paul, Minn., Beacon Radio Service. 252
KFPL—Dublin, Tex., C. C. Baxter............. 252
KFPM—Greenville, Tex., New Furniture Co..... 242
KFPR—Los Angeles, Cal., L. A. County Forestry Department 231
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KFQD—Anchorage, Alaska, Anchorage Radio Club 300
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KFOX—Seattle, Wash., A. M. Hubbard........210
KFQZ—Hollywood, Cal., Taft Products Co..... 226
KFRB—Beeville, Tex., Hall Brothers.......... 248
KFRC—San Francisco, Calif., Don Lee, Inc.......267.7
KFRU—Columbia, Mo., Stephens College........ 499.7
KFSD—San Diego, Cal., Airfan Radio Corp...... 245.8
KFSG—Los Angeles, Calif., Echo Park Evan. Assn. 275.1
KFUL—Galveston, Tex., T. Goggan & Bros.... 258
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KFXB—Big Bear Lake, Cal., B. C. Heller...... 202.6
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KFXF—Denver, Col., Pikes Peak Broadcasting Company 430.1
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KGBX—St. Joseph, Mo., Forster Hall Co.........347.8
KGBY—Shelby, Neb., Albert C. Dunning........ 202.6
KGBZ—York, Neb., Federal Live Stock Remedy Company 333.1
KGCA—Decorah, Ia., C. W. Greenle............ 280.2
KGCB—Wayne, Neb., Wayne Hospital..........434.5
KGCG—Newark, Ark., Moore Motor Co......... 239.9
KGCH—Wayne, Neb., Wayne Hospital..........434.5
KGCI—San Antonio, Tex., Liberto Radio Sales...239.9
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KGCX—Vida, Mont., First State Bank.......... 240
KGDA—Dell Rapids, S. D., Home Auto Co......254.1
KGDE—Barrette, Minn., Jaren Drug Co.........232.4
KGDJ—Cresco, Ia., R. Rothert.................. 405.2
KGDI—Seattle, Wash., N. W. Radio Service Co..416.4
KGDJ—Cresco, Ia., R. Rathert..................202.6
KGDM—Stockton, Calif., Victor G. Koping......217.3
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KGY—Lacey, Wash., St. Martins College....... 277.6
KHJ—Los Angeles, Cal., Times Mirror Co...... 405.2
KHQ—Spokane, Wash., Louis Wasmer......... 394.5
KICK—Anita, Ia., Atlantic Auto Co.............272.6
KJBS—San Francisco, Cal., J. Brunton & Sons Co. 220.4
KJR—Seattle, Wash., Northwest Radio Serv. Co. 384.4
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KLDS—Independence, Mo., Reorganized Church of Jesus Christ.......... 440.9
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KLZ—Denver, Col., Reynolds Radio Co..........384.4
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KMIC—Inglewood, Calif., J. R. Fouch...........387
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KMO—Kokomo, Wash., KMO, Inc...............249.9
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KSBA—Shreveport, La., W. G. Patterson.........260.7
KSD—St. Louis, Mo., Pulitzer Publishing Co... 545.1
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KSL—Salt Lake City, Utah, Radio Service Corp. 299.8
KSMR—Santa Maria, Cal., Santa Maria Valley R. R. 282.8
KSO—Clarinda, Ia., A. A. Berry Seed Co,...... 405.2
KSOO—Sioux Falls, S. D., Sioux Falls Bdcst. Ass.360
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KXL—Portland, Ore., KXL Bdcstg...............400
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A THOUGHT FOR THE WEEK

IF everybody in radio would stop worrying themselves and others about next summer and devote energy and brains to the task of making radio safer and bigger and better now, it would be a good thing for the science and the trade. And this is said in full appreciation of the many bromides about taking time by the forelock, etcetera ad nauseum.

RADIO WORLD

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

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

Buffalo University Gives Special Courses

Buffalo, N. Y.

The University of Buffalo recently announced two special lecture courses on the theory of radio communication.

Professor L. Grant Hector, assistant professor of physics at the university, will conduct the courses as he did last year. He has written many articles on radio and recently published a new radio textbook, "Principles of Modern Radio Receiving."

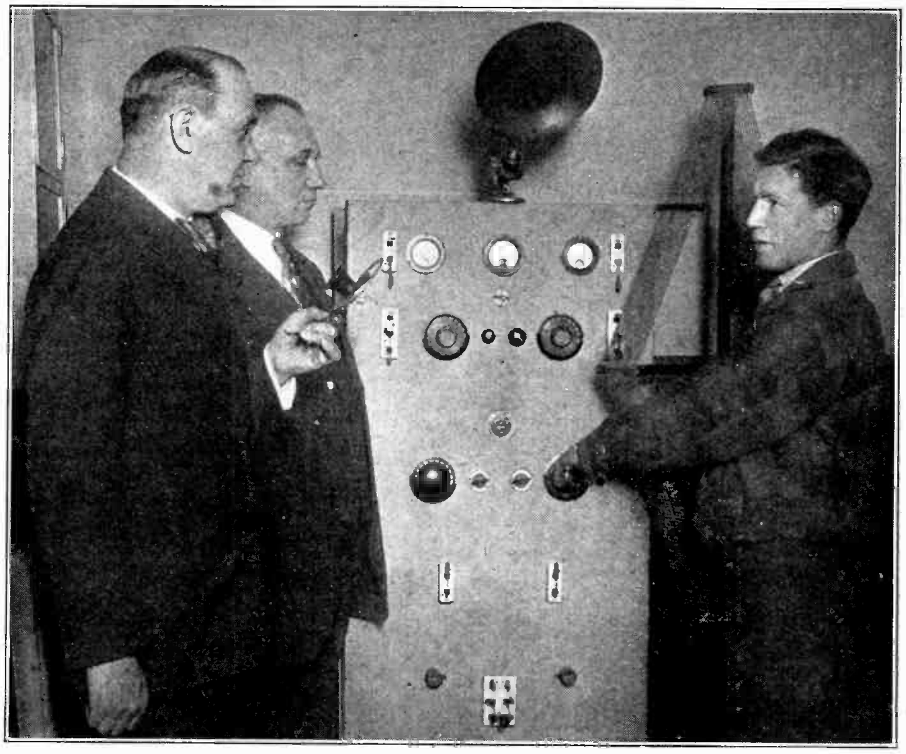
Course A will be a general course for owners of radio sets who are interested in learning more about transmission and reception. Course B will be an advanced course for those who already have a fair knowledge of the subject of radio. In addition to the lectures there will be discussions of topics treated in the lectures and problems submitted by the students.

INSTALLS RADIO DEPARTMENT

Waterbury, Conn.

The Charles Schmidt & Son, hardware and house furnishing store, 825 North Main St., recently installed a radio department.

POLICE ON BEAT TO GET CRIME DATA



(Wide World)

MICHAEL RUSCH, youthful inventor (right) alongside of the powerful transmitter at Police Headquarters, Passaic, N. J., which will be used to transmit crime or other important information to policemen on beat, within a radius of three and one-half miles, should the miniature special receiver, invented by Rusch, prove a success. Abram Preiskel, Director of Public Safety (extreme left), and Chief of Police Richard Zober, are being shown how the transmitter should be tuned so that its messages may be picked up by the small set being carried by a patrolman.

Sheriffs Ask Stations to Help Catch Felons

Will Flash News of Murders, Bank and Store Robberies, So That Broadcasters Can Let Public Know Facts That May Lead to Captures

Minneapolis, Minn.

The introduction of a radio criminal detection scheme was advocated by the state sheriffs' association at their annual meeting at the Courthouse recently.

Following approval of the plan by the association, H. H. Cory, secretary of the Northwest Radio Trade association, said that in a week or so there would be placed in operation for trial a system of detection of criminals by radio.

Under this plan, murders, bank or store robberies would be wired by local police and sheriffs to the telegraph offices in Minneapolis. The telegraph offices would notify radio stations in the city immediately, which in turn, would broadcast the news in bulletin form at once.

Radio dealers, of whom there are 3,000 in the Northwest and 1,500 in the state, would pick the message up on sets which they keep going continually in their stores for demonstration puproses, and notify local authorities to be on the lookout for fleeing criminals.

According to the plan, sheriffs will address their telegrams to the broadcasting stations, naming the place held up, time of robbery or crime, number of men engaged, description of automobile including license number, direction taken, and description of men.

It was suggested that bulletins be sent at the time of the crime, and that a regular period each day, more detailed information be broadcast by radio stations.

The sheriffs indorsed putting the plan on trial.

Old-Time Bicycle Rider Gets Aid Due to Radio

Radio has proved a real blessing for Major Taylor, former bicycle rider who held various records over twenty-five years ago. Recently Bill Fellmeth, sports expert of WAAM, in the course of his sports talk which he broadcasts every night at 7 o'clock, mentioned that the veteran Negro velodrome star was lying ill with pneumonia at his Connecticut home, and with his funds exhausted, was in need of medical and other aid.

The response of the radio sport lovers was immediate. Among those who happened to be listening in was Walter Bargett, editor of "The American Motorcyclist and Bicyclist." He was about to leave New York for New England, and on his trip he made inquiries as to Major Taylor's whereabouts and visited the "old-timer."

Mr. Fellmeth's is one of the most popular radio sport talks. Daily he gives all the latest sports results, not overlooking any field of major sport. Besides his interesting analysis of doings in sport, he scores many "beats" on the newspapers, according to letters from his listeners who each evening await his bulletins on "who won."

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WMAL—Washington, D. C., M. A. Leese Optical Co. 293.9
WMAN—Columbus, O., Haskett Radio Station 278
WMAQ—Chicago, Ill., Chicago Daily News.... 447.5
WMAY—St. Louis, Mo., Kings Highway Preb. Church 248
WMAZ—Macon, Ga., Mercer University...... 261
WMBA—R. Is. (portable), L. J. Beebe...........249.9
WMBB—Chicago, Ill., American Bond & Mortgage Co. 250
WMBC—Detroit, Mich., Michigan Broadcasting Co., Inc. 256
WMBD—Peoria Heights, Ill., Peoria Heights Radio Lab. 279
WMBE—St. Paul, Minn., Dr. C. S. Stevens.....220
WMBF—Miami Beach, Fla., Fleetwood Hotel Corp. 384.4
WMBG—Richmond, Va., Havens & Martin........220
WMBH—Chicago, Ill., (portable) E. D. Aber...280
WMBI—Chicago, Ill., Moody Bible Inst..........288.3
WMBJ—Monessen, Pa., W. Roy McShaffrey....277.6
WMBK—Hamilton, O., J. C. Slade...............360
WMC—Memphis, Tenn., Commercial Pub. Co...499.7
WMCA—Hoboken, N. J., Greely Square Hotel 340.7
WMPC—Lapeer, Mich., 1st Meth. Ch............222
WMRJ—Jamaica, N. Y., P. J. Prinz.............227.1
WMSG—N. Y. C., N. Y., Radio Eng. Corp......302.8
WMVM—Newark, N. J., E. J. Malone, Jr.......475.9
WNAB—Boston, Mass., Shepard Stores........ 280.2
WNAC—Boston, Mass, Shepard Stores.......... 430.1
WNAD—Norman, Okla., University of Okla.... 254
WNAL—Omaha, Neb., Omaha Central High School 258
WNAT—Philadelphia, Pa., Lennig Brothers Co. 250
WNAX—Yankton, S. D., Dakota Radio Apparatus Co. 244
WNBH—New Bedford, Mass., New Bedford Hotel 247.8
WNJ—Newark, N. J., H. Lubinsky..............350
WNOX—Knoxville, Tenn., Peoples Tel. & Tel. Co. 267.7
WNRC—Greenboro, N. C., W. M. Nelson........224
WNYC—New York, N. Y., Department of Plants & Structures 526
WOAI—San Antonio, Tex., Sou. Equip. Co..... 394.5
WOAN—Lawrenceburg, Tenn., Vaughan Con. of Music 356.4
WOAW—Omaha, Neb., Woodmen of the World 526
WOAX—Trenton, N. J., F. J. Wolff...........240
WOBB—Chicago, Ill., Longacre Engrg. Const'n. Co. 365.2
WOC—Davenport, Ia., Palmer School of Chiropractic 483.6
WOCB—Orlando Bdcstg. Co., Orlando, Fla.... 293.7
WOCL—Jamestown, N. Y., A. B. Newton...... 275.1
WODA—Patterson, N. J., O'Dea Temple of Music 390.9
WOI—Ames, Ia., Iowa State College........... 270
WOK—Homewood, Ill., Neutrowound Radio Mfg. Co. 217.3
WOKO—Peekskill, N. Y., H. E. Smith......... 232.4
WOKO—Peekskill, N. Y., O. Bauer............233
WOKT—Rochester, N. Y., Titus-Ets Corp.......340
WOO—Philadelphia, Pa., J. Wanamaker 508.2
WOOD—Grand Rapids, Mich., Grand Radio Co. 241.8
WOQ—Kansas City, Mo., Unity School.......... 278
WOR—Newark, N. J., L. Bamberger & Co..... 405.2
WORD—Batavia, Ill., Peoples Pulpit Association 275
WOS—Jefferson City, Mo., State Marketing Bureau 440.9
WOWO—Fort Wayne, Ind., Main Automobile Supply Co. 227
WPAB—Norfolk, Va., Radio Corp. of Va.......319
WPAK—Agricultural College, N. D., N. D. Agricultural College 275
WPAP—Cliffside, N. J., (See WQAO) 361.2
WPCC—Chicago, Ill., North Shore Congregational Church 258
WPCH—N. Y. C., N. Y., Concourse Radio Corp. 273
WPDQ—Buffalo, N. Y., Hiram L. Turner...... 205.4
WPEP—Waugegan, Ill., M. Mayer...............212.6

(Concluded on page 26)

Problems of Packing Studied by Laboratory

Ingenious Equipment Designed to Conserve National Resources By Reducing Breakage in Shipment—How to Keep Cubical Contents at Minimum

By Robert Rutgers

Packing is one of the big problems in many branches of radio and if it is not properly done it brings a lot of "grief". Poor packing of radio receivers, for instance, a vice often practiced by small manufacturers, may cause so much damage in shipment as to put the manufacturer out of business.

The art of packing, or the science, if you will, is engaging laboratory attention.

A step in the right direction was made by the Government a few years ago when the Forest Products Laboratories were established at Madison, Wisconsin. Here, under the direction of experts very ingenious equipment has been designed and built for the testing of all kinds of packing cases in order to determine the proper construction and material for use in shipping the various products manufactured in our country. This laboratory is working also for the conservation of our natural resources and is highly efficient in its work.

E. T. Johnson, of the New England Box Company, chairman of the traffic committee of the National Battery Manufacturers, recently addressed the manufacturers on the subject of packing. He said: "There is a rule used in the designing of packing boxes that should be considered if you desire economy; that is that a box of a given cubical content and made square in dimension requires less material than a long, narrow box of the same cubical content. To illustrate this point, if we should take three ordinary 13-plate rubber jars, set them side by side and then make a box for them, we would have of course, the regular 13-plate battery box and this container would have approximately 2½ sq. ft. of material. If we then took these three jars and placed them end to end and made a long, narrow box such as used in the old Overland battery, we would find the material in this box would be approximately 3½ sq. ft. Here we have two boxes of exactly the same cubical contents and yet one has 40% more material than the other. This certainly illustrates the rule of having your box as near to square as possible in order to save material and incidentally keep the cost of the container as low as possible. This rule applies particularly to nailed up boxes and is not so true on wire-bound boxes, because of the heavy ends used in wire-bounds."

Navy Will Exhibit At Show in Seville

Preliminary arrangements for sending an exhibit to the exposition to be held at Seville, Spain, in October, 1928, are being made by the Department of the Navy. Radio displays depicting the part played by the Navy in development of radio communication will be the chief display.

The full text of the announcement follows:

The Navy Department is making the preliminary arrangements for sending an exhibit to the exposition which is to be held in Seville, Spain, commencing in October, 1928, and continuing until the following June.

The exhibit will include radio and sound material illustrating the Navy's part in the development of means of communication by radio and the development of the sonic depth finder and underwater sound transmission; material from the Hydrographic Office with charts and other aids to navigators; and an exhibit from the Naval Observatory which will include the time service.

This exhibit will be placed in the United States Government building which will be erected at the exhibition under the direction of Ex-Governor Thomas E. Campbell, who has been appointed Commissioner General.

Crosley's New Device Electrifies Phonograph

Cincinnati.

A device to convert an ordinary phonograph into an electrical phonograph by means of a radio set has been announced by the Crosley Radio Corporation.

This invention, known as the "Merola" gets its name from the initial letters of "Magnetic electric reproduction". It has just gone into manufacture.

The Merola consists of a tone arm, magnetic reproducer unit and volume control device. In appearance it exactly resembles the ordinary phonograph tone arm, which it replaces. It is equipped with a cord and adapter. The adapter is inserted into the detector socket of any receiving set using standard storage battery or UX type of tube base and the tone arm is attached to the phonograph. After this connection is made the music from the phonograph record is reproduced through the receiving set and loud speaker with excellent volume.

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.

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature

Name ....

Address ....

City or town..

State ....

B. A. Jacques, Globe, Arizona.
W. M. Procop, 409½ East 2d St., Stuttgart, Ark.
Paul E. Kyle, North St., Prospect, O.
F. W. Jackson, 782 Hawthorne St., St. Paul, Minn.
L. F. Pagst, 939 S. Groue St., Irvington, N. J.
Anthony M. Bodor, 530 Woodbine Ave., Warren, Ohio.
Ulna Smith, 6511 Ridge, St. Louis, Mo.
H. G. Ahlburg, Globe Hotel, Cedar Rapids, Ia.
Jack Osgood, 4616 Cooke St., Duluth, Minn.
Robert A. Kitchen, Halethorpe, Md.
J. M. McGuire, Box 34, Clymer, Pa.
George J. Roth, 4121 Parrish St., Philadelphia, Pa.
S. A. Swift, 22 Beacon St., Woburn, Mass.
Thomas C. Knight, 2621 Cortelyou Road, Bklyn., N. Y.
Vender A. Scott, 169 Edgecomb Ave., N. Y. C., N. Y.
M. E. Linn, 6449 Harvard Ave., Chicago, Ill.
Dr. W. French Thurston, 1334 Third Ave., Los Angeles, Calif.
Hobert L. Motsinger, Goreville, care J. Johns, Goreville, Ill.
John J. Brewer, 155 North First St., Troy, N. Y.
Mrs. Al J. Westine, 4209 Washington Blvd., St. Louis, Mo.
Clarence Munson, 124-48 135th Place, South Ozone Park, L. Is., N. Y.
E. W. Gage, 913½ Eye St., Modesto, Calif.
W. J. Weiskopf, Armour & Co., Cincinnati, O.
George Friend, P. O. Box 587, Colorado Springs, Colo.
Norrin Stephens, Glen Essex, 8 Ashland St., Methuen, Mass.
T. F. McElcay, Box 556, Ivine, Ky.

NEW ENTERPRISES

Batesville, Ind.

Forrest Shook and Arthur Rudolph have announced the opening of a radio shop. They will handle Crosley radios and accessories. They will have their machines on display in the Geo. J. Mehlon Tailor Shop on East Boehringer street.

* * *

New Orleans, La.

Two competent radio men of years' experience have established in the radio, electrical supplies, and repair shop of Johnson Brothers, at 1609 Dryades Street, one of the most complete small radio shops in New Orleans.

Louis M. Johnson and Henry A. Johnson, joint owners of the firm, have been closely associated with the radio industry.

* * *

Lorain, O.

"The Fixit Shop," general electrical and radio repair shop has been opened at 126 Ninth St., by Paul Leschorn and Henry Meyers.

* * *

Waterbury, Conn.

Leslie Strauss, who is the manager of the Strauss Hardware of 375-377 East Main Street felt the need of establishing a radio department in connection with his already well established household, hardware and automobile accessory business due to many calls he had, for tubes, batteries, sets, etc.

Mr. Strauss stated that the radio business just seems to work in with his other line of merchandise and he is very happy to have started the department.

TRADE NOTES

Talion, O.

Paul Wilson of 216 Harding Way West, has leased the room in the Longstreth block at 134 Harding Way West, where he opened a radio store completely equipped for testing all types of sets.

ENGINEER IN NEW JOB

Peoria, Ill.

Harry A. Mackley, radio engineer and technical expert and well-known to Peorians as one of the pioneers in the field of radio science, announces a new commercial venture in the formation of the Mackley Radio Repairing and Service Company. He has resigned his position as technical adviser and radio engineer for the National Electric and Auto Supply company to devote his entire time to the new business.

A NEW MANUFACTURER

Cambridge, Mass.

The plant of the Sterling Knit Goods Co. on Memorial drive, between Stiles and Akron streets, has been sold to G. B. Olmstead, of Melrose, who plans to use the building for the manufacture of radio accessories. The building is of concrete, and contains three floors and a basement. It is 172 feet long by 48 feet wide and contains about 3,300 square feet of manufacturing space.

DAVEGA BRANCHES OUT

Davega, Inc., has bought the retail store of Schoverling, Daly & Gales Company, Inc., at Broadway and Duane St., N. Y. City. Radio and sport good apparatus will be added to the stock.

AT YOUR SERVICE

This department is conducted by Robert L. Eichberg, director of the Extension Division of the Federated Radio Trade School, 4464 Cass Ave., Detroit, Mich. All questions regarding the construction, repair, selling, merchandising and advertising of radio apparatus should be sent direct to Mr. Eichberg at that address, where they will be promptly answered. The answers to questions of general interest will be printed here. All others will be answered by a personal letter from Mr. Eichberg. By a special arrangement RADIO WORLD *is able to offer this service free to all readers.*

Many sets, particularly those which use the older types of small transformers or those which contain the improper resistance and condenser values, if resistance coupling is used, will distort.

This is annoying, as you strain the faculties and the nerves in trying to understand the program and the announcer. To get rid of this distortion we must discover in which of the stages it originates before we can take measures to correct it.

Inter-Stage Test for Distortion

A simple piece of apparatus to make these tests is a milliammeter. It may be anywhere from 0 to 10 to 0 to 50 mils. Your first step will be to disconnect the plate lead of the detector tube at the socket and then connect the meter in this lead with its negative terminal to the plate of the tube and is positive terminal to the positive B battery, in other words, to the lead which you have disconnected. If the needle of the meter rises to a point and remains at it steadily, it indicates that there is no distortion in that stage, so reconnect the wire. The same procedure is then followed with the succeeding stages, until the offending stage is located.

Causes of Distortion

If, as is most often the case, the fault is caused by incorrect B and C battery voltages, it is easy to remedy. If when loud notes are received, the needle on the meter tends to jump toward the higher end of the scale, insufficient C battery is being used. If the needle tends to drop toward the lower end of the scale, the grid bias of the C battery is too great. A few moments of experimentation will show proper values to use to eliminate distortion. On the other hand, if you find it impossible to eliminate distortion in this manner, you must try out other tubes.

Sometimes a tube which has lost the thorium coating of its filament will be the cause of the trouble, if it will not emit enough electrons to maintain the proper B current flow. Now and then a tube in this condition can be successfully "rejuvenated" but it is usually wiser to invest in a new tube.

Before purchasing a new tube, however, it will probably be the part of prudence to see what can be done about changing the transformer characteristics.

What To Do To A Transformer

Distortion caused by inferior transformers can almost always be done away with by a slight expenditure of time and money, providing that you know what to do. You will find that a leak placed across the secondary of either the first or second audio transformer, or both, will almost always improve tonal quality to a marked degree. This is particularly true when a C battery is used. Of course, it is best to employ a variable leak so that you can get a maximum clarity and still maintain

(*Concluded on page* 24)

(*Concluded from page 23*)

good volume, but you will find that leaks anywhere from 0.2 to 0.5 meg. will do quite well. Sometimes no leak need be used, if a fixed condenser of about .0005 mfd. capacity is connected across the primary of the transformer. At other times the use of a condenser between the grid and plate posts, or filament and B+ posts of the transformers, will be found to give better results.

Resistance Coupling

In a resistance coupler, where the distortion is manifested by whistles, it will be found that by putting a high resistance of about 1 meg. on the **plate** side and a lower resistance, say about 0.1 meg., on the **grid** side, distortion will be eliminated. Another frequent cause of distortion which is usually heard as a more or less interrupted volume of signal strength is a fixed coupling condenser (sometimes called a blocking condenser) with defective dielectric. A good way to test a fixed condenser is to charge it from the B battery line and let it stand for ten or fifteen minutes, then discharge it by touching a screw driver on similar metal object with an insulated handle across the contacts. A condenser of .1 mfd. or greater capacity should show quite a spark when this is done. Of course, the condenser should not be connected in the set when this test is made.

* * *

QUESTIONS AND ANSWERS

MAY I take the liberty to ask your advice in regard to the enclosed circuit? Is it really worth the little extra cost of building, as I have nearly one-half the material on hand. It seems to embody all the requirements I am in quest of. That is, from extremely low, to the higher wavelengths, and from the originator's description and operation, it is very selective. I cannot, however, discover the man's name that developed the circuit.

Do you consider it necessary to use a vernier .001 variable condenser in the antenna circuit? Also is it a necessity to have the 400 ohm potentiometer across the filament? Would you leave out the amplifier diagram for two stages?—R. L. Hilton.

If you are going to use the circuit you sent me to cover a particularly broad band of frequencies, I would suggest that you use a honeycomb coil, shunted with a .0005 mfd. vernier condenser, or a 0 to 100 ohm resistance, instead of the variometer in the plate circuit. This should give you somewhat better control of regeneration on the various wavelengths. The set should be very selective, as the coil marked No. 2 on your diagram acts as a wave trap. The use of vernier condensers or condensers equipped with vernier dials, or shunted by midget condensers, will make tuning much easier. The potentiometer might be omitted, but I doubt if the results obtained would be as good as if it were used. However, if you do decide to leave it out, run the grid return to the positive side of the filament unless you are using a 300 or 300-A type tube as detector, when a negative filament return is better.

* * *

WOULD you mind telling me wherein the L2 Ultradyne differs from the Model L in that its oscillator condenser is .0005 instead of .001 as in the model L?

We want an SLF oscillator condenser in model L but cannot find one of .001 mfd. cap. Could a 3-gang .00035 be used with satisfactory results?

Again referring to the first question: Both models use a 3" form, L has 30 and 32 turns of No. 20 DCC wire, L2 has 35 and 43 turns of No. 24 DCC. Would this fact cause the difference in the capacity of the condensers used on the oscillator?—F. H. Webster.

You have answered one of your own questions. The difference apparently lies in the number of turns used on the oscillator coils. It accounts for the difference in the capacities of the condensers used. In order to obtain .001 mfd. capacity, you can use either a three gang .00035 mfd. or better, a two gang .0005 mfd. variable condenser. One connection should be run to the rotor plates, and the other, to all of the stator plates of that condenser.

COMPLETE DATA on "How to Build a DC A and B Eliminator," were given in the Dec. 4 issue of RADIO WORLD, by Lewis Winner. Lucid photos and diagrams accompanied this excellent article. Either send 15c for this copy, or begin your subscription with this issue. RADIO WORLD, 145 West 45th St., N. Y. City, N. Y.

Largest Class Is the Aim In Course on Government

National Broadcasting Chain to Present David Lawrence in Fourteen Talks, One a Week, on National Structure and Affairs

A giant class in Government will be started on Lincoln's Birthday by the National Broadcasting Company, which hopes to assemble the largest group that ever met at one time for the study of the functions of the Federal machinery.

"Eight minutes, please, for your Government," is the request that will come through the ether in a chain broadcast hook-up beginning on February 12 and continuing for 13 weeks.

David Lawrence, Washington correspondent and editor of "The United States Daily", a newspaper which prints non-partisan records of governmental activity, will be the speaker. He was selected because of his seventeen years of experience as a non-partisan writer on national affairs in the nation's capital. He has never been affiliated with any political party and in his talks he will not discuss persons or policies, confining himself to a simple exposition of the machinery of government, its remarkable growth in the last ten years, and its many important and little-known functions and their relationship with the individual. He will also explain the functions of certain departments which bear a direct relationship to business and to the welfare of the nation as a whole.

The broadcasts should prove popular.

The KH-27

(*Continued from page* 13)

Coupler grid (G) terminal **59A** to tube socket contact **59B.**

Wire No. 60—From second Twinchoke Coupler filament (F) terminal **60A** to tube socket contact **60B.**

Wire No. 61—From third Twinchoke Coupler plate (P) terminal **61A** to tube socket contact 61B.

Wire No. 62—From third Twinchoke Coupler grid (G) terminal **62A** to tube socket contact **62B.**

Wire No. 63—From third Twinchoke Coupler filament (F) terminal to C Battery Minus binding post **63B.** This wire passes through hole in sub-panel. Use flexible lead.

[*Next week—How to install and operate the Harkness KH-27 Receiver.*]

[*Part I of this article was published last week, issue of January 29, and Part III, the conclusion, will be published next week.*]

SCHOOL STARTS SESSIONS

Newark, N. J.

The Newark Auto and Radio School, located at 185 New Street, recently started its mid-year classes. The classes are called at 7 o'clock and continue until 10, during which time radio instructions are given by J. G. Divine, local radio engineer, who was at one time employed by the Marconi Company, where he gained wide experience in this field. The two classes to be held weekly on Thursday evenings will cover elementary and advanced radio.

FIND DEPARTMENT PAYS

Elgin, Ill.

The Plinke & Rakow Furniture store in the West Dundee business section have a radio department. They handle the Fada receiving set and other well-known radio material.

STATION INCREASES BUSINESS

Fort Wayne, Ind.

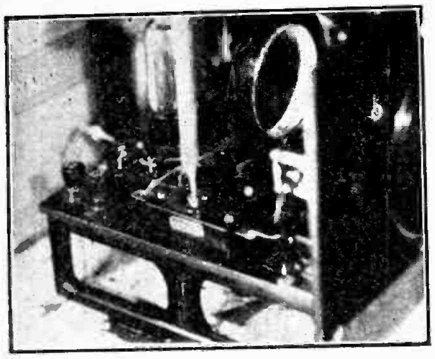
According to Clyde Durbin, vice-president of the Main Auto Supply Company, business in 1926 increased more than 20 per cent. over that in 1925. This increase is due to the use of their broadcasting station WOWO says Mr. Durbin.

STATIONS

(*Concluded from page 21*)

WPG—Alantic City, N. J., Municipality of Atlantic City ... 299.8
WPRC—Harrisburg, Pa., Wilson Printing & Radio Co. ... 215.7
WPSC—State College, Pa., Pa. State College... 261
WQAA—Parkensburg, Pa., H. A. Beale, Jr..... 220
WQAE—Springfield, Vt., Moore Radio News Station ... 246
WQAM—Miami, Fla., Electrical Equipment Co. 285.5
WQAN—Scranton, Pa., Scranton Times........ 250
WQAO—Cliffside, N. J., Calvary Baptist Church (WPAP used when Palisade Amusement Park Program is on) ... 361.2
WQJ—Chicago, Ill., Calumet Co. ... 447.5
WRAB—Yellow Springs, O., Antioch College....263
WRAF—Laporte, Ind., Radio Club, Inc.......... 224
WRAH—Providence, R. I., Stanley N. Read....235
WRAK—Escanoba, Mich., Economy Light Co.. 256
WRAM—Galesburg, Ill., Lombard College 244
WRAW—Reading, Pa., Avenue Radio & Electric Shop ... 238
WRAX—Gloucester City, N. J., Fexon's Garage..268
WRBC—Valparaiso, Ind., Immanuel Lutheran Church ... 278
WRC—Washington, D. C., Nat. Bdcstg. Co. of Amer. ... 468.5
WRCO—Raleigh, N. C., Wayne Radio Co..... 252
WREC—Whitehaven, Tenn., Wootens Radio & Elec. Co. ...254
WREO—Lansing, Mich., Reo Motor Car Co.....285.5
WRES—Wollaston, Mass., H. L. Sawyer...... 300
WRHF—Washington, D. C., Washington Radio Hospital Fund ... 256
WRHM—Minneapolis, Minn., Rosedale Hospital 252
WRK—Hamilton, O., Doron Brothers Electric Co. ... 270
WRM—Urbana, Ill., Univ. of Ill...........273
WRMU—Motor Yacht "MU-1", A. H. Grebe & Co. ...236
WRNY—Coytesville, N. J., Experimenter Pub. Co. ...373..8
WRR—Dallas, Tex., City of Dallas............. 246
WRRS—Racine, Wisc., Racine Radio Co.........360
WRSC—Chelsea, Mass., The Radio Shop........270.1
WRST—Bay Shore, N. Y., Radiotel Manufacturing Co., Inc. ... 215.7
WRVA—Richmond, Va., Larus & Bro. Co., Inc. 256
WSAI—Cincinnati, O., United States Playing Card Co. ...325.9
WSAJ—Grove City, Pa., Grove City College.... 229
WSAN—Allentown Pa., Allentown Call Publishing Co., Inc. ... 229
WSAR—Fall River, Mass., Doughty & Welch Elec. Co. ...322
WSAV—Houston, Tex., Clifford W. Vick.. 247.8
WSAX—Chicago, Ill., Zenith Radio Corporation. 268
WSAZ—Pomeroy, O., Chas. Electric Shop 244
WSB—Atlanta, Ga., Atlanta Journal Co...... 428
WSBC—Chicago, Ill., World Battery Co. 288
WSBF—St. Louis, Mo., Stix Baer & Fuller......273
WSBT—South Bend, Ind., South Bend Tribune..315.6
WSDA—N. Y. C., Seventh Day Adventist Ch. .. 263
WSEA—Va. Beach, Va., Va. Beach Bdcst. Co....516.9
WSIX—Springfield, Tenn., Tire and Vulc. Co...250
WSKC—Bay City, Mich., World's Star Knitting Co. ... 261
WSM—Nashville, Tenn., National Life & Accident Insurance Co. ... 282.8
WSMB—New Orleans, La., Saenger Theatres, Inc. ...319
WSMH—Owosso, Mich., Shattuck Music House. 240
WSMK—Dayton, O., S. M. K. Radio Corp....275
WSOE—Milwaukee, Wisc., School of Engineering of Milwaukee ... 246
WSOM—Woodhaven, N. Y., Union Course Club..288.3
WSRO—Hamilton, O., H. W. Fahlander 252
WSSH—Boston, Mass., Tremont Temple Baptist Church ... [illegible]
WSUI—Iowa City, Iowa, State University of Ia. 483.6
WSVS—Buffalo, N. Y., Seneca Vocational Sch. 218.8
WSWS—Batavia, Ill., S. W. Straus & Co.......275.1
WSYR—Syracuse, N. Y., Clive B. Meredith....352.7
WTAD—Quincy, Ill., Ill. Stock Medicine Brcst. Corp. ...236
WTAG—Worcester, Mass., Worcester Telegram 545.1
WTAL—Toledo, O., Toledo Radio & Electric Co. 252
WTAM—Cleveland, O., Willard Storage Battery Co. ... 389.4
WTAQ—Osseo, Wisc., C. S. Van Gordon........254.1
WTAR—Norfolk, Va., Reliance Electric Co. 261
WTAW—College Station, Tex., Agricultural & Mechanical College of Texas ... 270
WTAX—Streator, Ill., Williams Hardware Co. 231
WTAZ—Lambertville, N. J., Thomas J. McGuire ... 261
WTHO—Ferndale, Mich., Fernberg Radio Co....407
WTIC—Hartford, Conn., Travelers Insurance Co. ... 475.9
WTRC—Brooklyn, N. Y., 20th Dist. Repub. Club..239.9
WTRL—Midland, N. J., Technical Radio Labs...280.2
WWAE—Chicago, Ill., L. J. Crowley...........241.8
WWJ—Detroit, Mich., Evening News Association (Detroit News) ... 352.7
WWNC—Asheville, N. C., Asheville Bat. Co., Inc.254
WWPR—Detroit, Mich., Detroit Police Dept.....300
WWL—New Orleans, La., Loyola University.. 275
WWRL—Woodside, N. Y., Woodside Radio Laboratories ... 258.5
WWVA—Wheeling, W. Va., J. C. Stroebel......348.6

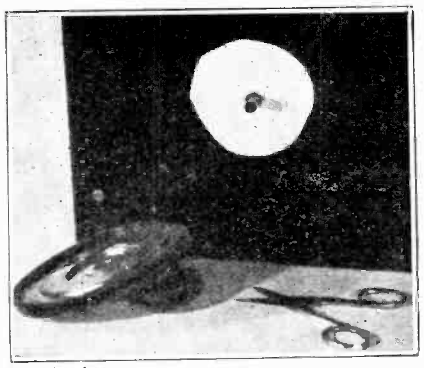
HANDY DOWEL



(Hayden)

NEUTRALIZING condensers may be mounted near the tube and tuning system to which they are connected. The neutralizing adjustment may be made simply by turning a sharpened dowel stick. It is obvious that space must be left so that the condenser is accessible to the tool.

STOPS SLIPPING



(Hayden)

TO PREVENT the dial from slipping, place behind it a piece of paper which nearly covers the entire circumference of the dial.

Blind Singer Gets Real Joy From Life

Pontiac, Mich.

Although fate has robbed him of perhaps the most valuable of all human attributes, sight, Harold Kean still looks upon life as a "great experience."

The "Sunshine Boy," as he is called when he sings from WJR, has almost entirely overcome his handicap of "defective vision," as he prefers to speak of his blindness, and gets more joy and happiness out of living than many who can see.

For, in reality, Harold can see. In his earlier days, before an accident blotted out his vision, he knew what it was to picture men and women and things, and even now after he has been blind for fifteen years, he is able to draw a mental picture of everything that takes place about him, from what people do say and react.

The "Sunshine Boy" has been independent all his life and attributes his success and independence largely to the fact that he has always shunned the company of others who were without sight and has constantly insisted that he be given only a normal "break" along with other men who did not have his handicap. It was this spirit which prompted him to withdraw from a school for the blind and to enroll in the public schools when a boy.

The "Sunshine Boy," who is a regular entertainer for WJR, has been a radio singer for more than three years now.

With his wife and baby he lives in Birmingham, Michigan, sixteen miles from the WJR station. Four or five times each week, Harold leaves his house, walks two blocks to the bus which brings him close to the hotel, where he goes without any difficulty and with little or no assistance.

And if you think Harold isn't versatile, listen to this! He can write feature stories at the rate of seventy-two words a minute on the typewriter, and is an all-around musician, playing the trombone, piano, trap drums and guitar.

The Sad Misadventure of An Unknown Fan

Told by Store Clerk to Use Smaller Tubes, He Buys Them and Has New Sockets Installed and Then Blows Out First Bulb Tested

Recently a fan went to a radio store and complained that his set did not give as much volume and distance as it had been giving. The clerk in the store promptly informed him that the tubes were old, which was true enough. But he also informed the fan that he would get much better results if he used -99 type tubes. The fan took the advice and purchased a new set of tubes of the small variety. It then occurred to the fan that some changes in the set might be in order before the substitution of the tubes could be safely made. On this the clerk imparted the information that the only changes necessary would be to substitute the X type of sockets. Consequently the fan bought a new set of sockets. The fan did not feel competent of making the changes himself, so he paid the clerk to do the work, with the fan looking on.

One of the old sockets was taken out at a time and the new replaced and the leads connected exactly as before. No other change necessary, said the clerk. When the job was finished the fan was completely satisfied that everything was correct, as he himself had seen the changes made.

Watch Filament Voltage

He went home and then for the first time he inserted one of the new tubes in a new socket, expecting to get greater distance and greater volume from his set than he had been getting with his —01A tubes. The tube burned out the instant he put it in.

The substitution of one type of tube for a different type cannot always be made by merely changing sockets. The filament voltage must also be attended to. The receiver in question had been designed to operate on a 6-volt storage battery while the new tubes only require 3 (or for CX-299 or CX-220, use 3.3 volts) on the filaments. They will not stand a 100% overload without burning out. To adapt a set designed for 5-volt tubes to operate on 3-volt tubes it is either necessary to change the voltage of the filament battery or to insert resistors in the filament leads. The fan ultimately got the set adjusted so that it could be operated on the small tubes without burning out the rest of the tubes. But he had to pay a service man for doing the job right, one who knew the practical aspects of radio.

The fan was not satisfied. The receiver was not even as sensitive nor as voluminous with the small tubes as it had been with the old, but large tubes. He was keenly disappointed. He had been led to believe that the small tubes would considerably widen the reliable reception range of his set, and instead of expanding it the substitution contracted it.

Small tubes of the type referred to have an amplification factor of about 6.5, while the large tubes which had been discarded have an amplification factor of 8. If the circuits associated with the tubes are operated for maximum output in each case, the larger tubes will amplify about 25% more than the smaller, and that amplification will amount to a great deal in a multitube set. For example, in a 3-tube set the larger tubes will amplify in the ratio 8x8x8 and the smaller in the ratio 6.5x6.5x6.5, the set employing the larger tubes will amplify about 85% more than the set equipped with the smaller tubes.

Other Points of Difference

Due to differences in the impedances of the two types of tubes it is possible that the substitution of one for the other will not exactly follow the ratio of the amplification factors, but this deviation may either favor the smaller tubes or the larger. On the average the larger tubes will amplify much more than the smaller.

But this fact is not particularly against the smaller tubes. They require much less filament current and less plate current.

WITH THE AMATEURS

Hartford, Conn.

By handling more amateur radio messages than any other amateur operator for three consecutive months, Frederick E. Best, radio 1BIG, of 13 East Crescent Street, Augusta, Me., has been awarded a silver trophy testifying to his ability as the premier amateur operator of the United States. The trophy, a silver plaque elaborately engraved, was donated by a retired business man whose hobby happens to be amateur radio, and was awarded under the terms of a contest conducted by the American Radio Relay League of this city, the national association of amateurs and experimenters.

The accomplishment of Mr. Best in winning the coveted award is no mean one, since the terms of the contest stipulated that in order to win it, an amateur must for three consecutive months turn in the largest message total of any operator in the United States or Canada. So keen has been the competition that the trophy had been posted for nearly two years before being won by Mr. Best. At various times some operator would manage to win two legs on the prize, but would find it impossible to maintain the pace during the third month. In commenting on the award, F. E. Handy, Communications Manager of the League, stated that the performance of Mr. Best was unique in the annals of amateur radio, and indicative of the highest type of operating ability.

Not the least surprising fact in connection with the award is the transmittor used at 1BIG. This is a low-power short-wave transmitter, constructed in the usual amateur style, and utilizing only a single five-watt amplifier tube for supplying energy to the antenna. The entire transmitting equipment occupies a space considerably less than two feet square. While built for message-handling primarily, the set has established an enviable record for distance, and has frequently been heard in England, South America, and on the West Coast of the United States. During the summer of 1926 a regular schedule was maintained three times a week with a station in Florida, and this schedule did not fail on a single instance.

Mr. Best, a member of the American Radio Relay League, and in charge of its traffic activities in the Maine territory, first became interested in short-wave amateur work in the Navy, in 1923. While still in the Navy he became a member of the League, and immediately upon receiving his discharge he built the station which won him the trophy.

London.

What is believed to be a record for daylight communication on short waves was established recently when M. Samuel, operating British amateur station 5HS, of this city, communicated in broad daylight with Lyndon Farwell, operating station 6ZAT, at Los Gatos, California, U. S. A. For half an hour the two amateurs talked with each other over the 8,000-mile gap, reception at each end being reported unusually satisfactory. The transmitters, which were home-made, consumed about 200 watts, and were operated at a wavelength of 20 meters.

Amateur Gets Real DX Messages at 3 and 5.30 A.M.

Winnipeg.

What is considered to be a new record for long distance radio communication between amateurs was established when R. C. McLean, of Winnipeg, a radio operator in the radio department of the Canadian National Railways, engaged in the train service, held conversations with two amateur stations in Australia, 7BQ and 2MH.

Mr. McLean, call 4FZ, operates a 7½-watt transmitter, series-Colpitt circuit on a wavelength of 39 meters. He first picked up 2MB at about 3 A. M. and talked with the Australian station for about an hour, during which time he accepted a message for delivery to a person in Montebello, Alabama. At about 5.30 A. M. Mr McLean was successful in connecting up with station 7BQ and was in communication with it with much more volume than the previous station.

WGL, on 442 Meters, Latest N. Y. Station

New York's newest broadcasting station, WGL, wavelength 442 meters, and located atop the Hotel Majestic, opened with a formal dinner and other ceremonials.

For several weeks the construction of the station had been in progress.

Krazy Kat Feature Radioed by Eveready

Two striking examples of modern American music of the lighter type were featured in the latest Eveready Hour through station WEAF, of New York, and its network of affiliated stations.

"Catnip Blues", a part of John Alden Carpenter's jazz pantomine called "Krazy Kat", played by the Eveready Orchestra, was the first of these numbers.

"Krazy Kat" is a musical version of the newspaper comic strip which has been running under the same name for a number of years. In a sort of symphonic jazz arrangement, "Catnip Blues" tells an incident in the feud between "Krazy Kat" and "Ignatz Mouse". Ignatz, knowing the curiosity that is a dominating influence in the lives of all felines, is discovered burying some mysterious object while "Krazy Kat" watches him from a place of concealment. Ignatz walks off and "Krazy Kat" sneaks up and proceeds to uncover Ignatz's buried treasure. Kat finds it is a bag and as he opens it the insidious and mischievous perfume of catnip floats out of the bag and lays hold upon the senses of the investigator. "Krazy Kat" falls completely under the spell. He waltzes, he careens, he turns somersaults and, after rapidly working up to a climax of frenzy, he collapses, utterly exhausted and unconscious. Ignatz returns gleefully to the scene, walks around his prostrate enemy to make certain that the latter is entirely helpless. Then Ignatz takes careful aim and the familiar brickbat sizzles through the air and crashes against the cranium of "Krazy Kat" with all its accustomed "pow!"

This "Krazy Kat" jazz pantomine is a droll, curious thing in itself, but all the more curious because the composer, Carpenter, is not a professional musician, but a merchant. Writing music—and unusual music, at that—is his hobby. Among other interesting compositions of his is "Sky-scrapers" which is being done at the Metropolitan Opera House in New York as a ballet number.

"Muddy Water", the other feature number of this Eveready Hour program, was another orchestra number and a very odd, unusual thing. It was a sort of mixture of negro spiritual and "Black Bottom", which literally oozes the pungent mud of a Mississippi mud flat on a Summer's day.

The program included also two special vocal numbers. One of these, "The Blue Room", from "The Girl Friend", was sung by the Eveready Revellers, and the other, "A Tree in the Park", from "Peggy Ann", was sung as a duet by Franklyn Bauer, tenor, and Betsy Ayres, soprano.

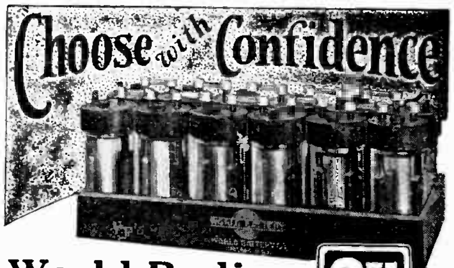
The Eveready Orchestra presented a special medley of children's tunes arranged by Nat Shilkret.

Weekly Spanish Talk Is Given Over WGN

Roberto Brenes-Mesen, Associate Professor of Romance languages at Northwestern University, is now conducting the weekly Spanish lesson given over WGN, Chicago, every Tuesday afternoon between 5 and 5:30 o'clock. Prof. Brenes-Mesen took up the work on Tuesday, January 25, and on February 1 made his second appearance before the microphone.

In taking over the work of the Spanish radio course, Prof. Brenes-Mesen will bring all of the latest devices of pedagogy for instruction in a foreign language. He is a corresponding member of the Real Academia-Espanola, and was formerly minister of public instruction and minister of foreign affairs of Costa Rica.

The Spanish class at WGN now numbers nearly 2,000 pupils, with the list constantly growing.



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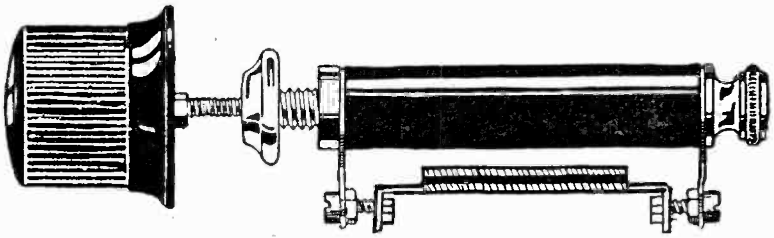

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FEB - 3

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

THERE'S an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical—we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps.

Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

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