

RADIO ENGINEERING

*A Magazine of Technical Accuracy
for the Radio Engineer, Dealer, and Manufacturer*

Edited by M. B. SLEEPER

HOW TO BUILD THE BROWNING-DRAKE RECEIVER

A non-radiating four-tube set—with
radio frequency amplification.

Using die-castings to speed up pro-
duction and reduce costs.

Assembly of the Melco Supreme tuned
R. F. construction kit.

Special equipment for the rapid test-
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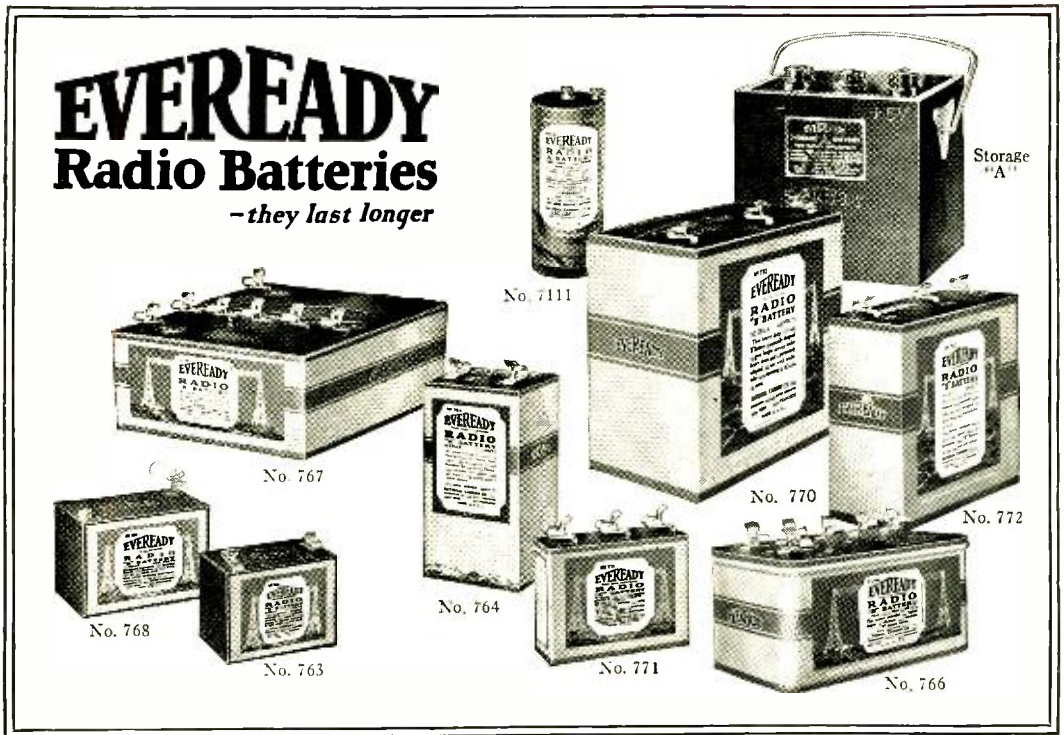
NOVEMBER, 1924

Vol. 4

No. 19

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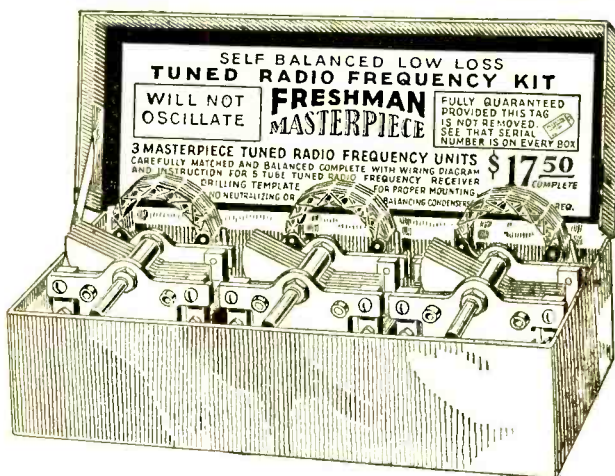
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Technical Publisher

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**Modulation Plus Regeneration
In the New Ultradyne**

To the "Modulation System" of radio reception, R. E. Lacault has successfully applied the use of regeneration in the new Model L-2 ULTRADYNE.

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The use of the loop also increases selectivity and decreases static and other interference.



**How to
Build
the New
Model L-2
Ultradyne**

This 32 page illustrated book gives latest authentic information on drilling, wiring, assembling and tuning the new Model L-2 Ultradyne. This book explains the "Modulation System" in detail and also deals with the application of regeneration to this new system of radio reception.

It is edited by R. E. Lacault, inventor of the Ultradyne Receiver. Price 50c.



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**Model L-2 Ultradyne Kit is
Ready**

This is the new Model L-2 Ultradyne Kit which contains one low loss tuning coil, one low loss Oscillator Coil, one special low loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers. The Ultraformers are new improved long wave radio frequency transformers, especially designed by R. E. Lacault, inventor of the Ultradyne. As a precaution against substitution, R. E. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed so long as this seal remains unbroken.—Adv.



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Ultradyne performance is the envy of the radio industry.

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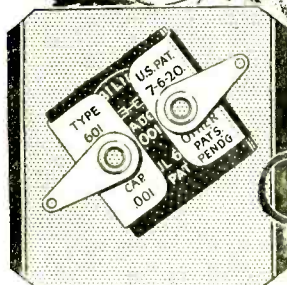
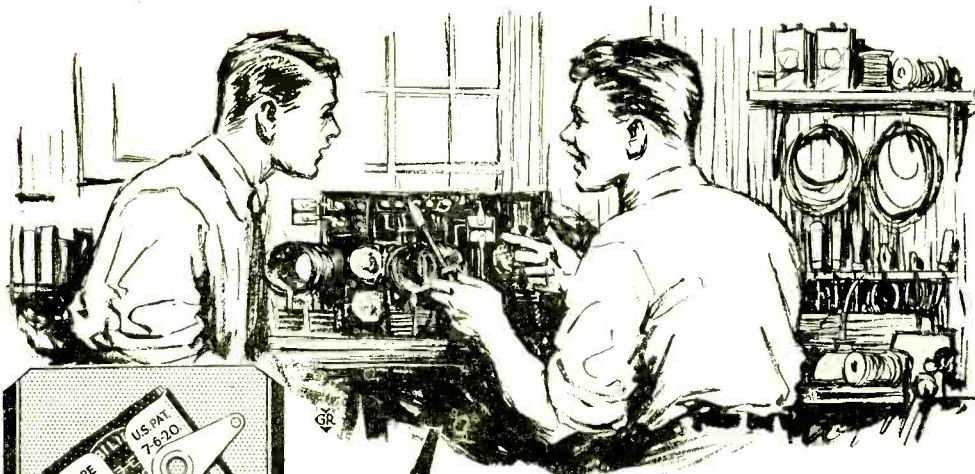
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ULTRADYNE

MODEL L-2





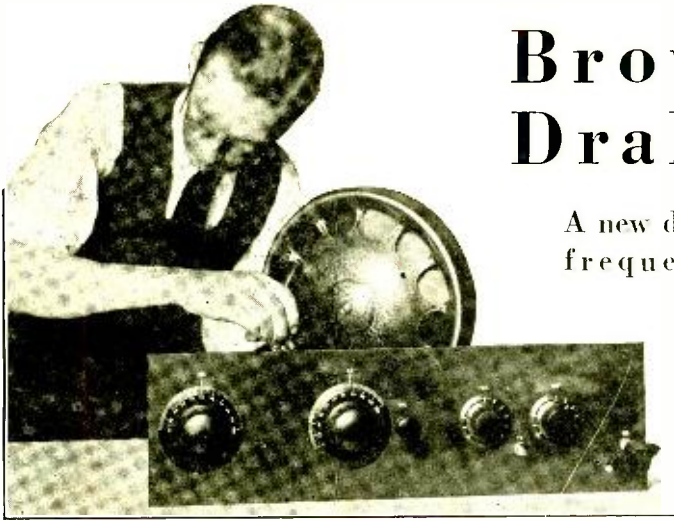
A MICADON *-it's the condenser*

The Micadon is the standard fixed condenser of radio! Extremely accurate because only the very best materials are used and because Dubilier condenser craftsmen assemble and inspect them. Simple to install because equipped with extension tabs for soldering and eyelets for set-screw assembly. Different capacities for different requirements. More than 90% of all sets made—by manufacturers and amateurs—use Dubilier Micadons.

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CONDENSER AND RADIO CORPORATION



Browning-Drake Set

A new development in radio frequency amplification which sets a much higher standard of efficiency than has been achieved before.

THE Browning-Drake receiver illustrated in the accompanying photographs and drawings, is not only interesting and unusual in its design and operation but almost unique in the method by which the circuit and the constants were worked out. Messrs. G. H. Browning and F. H. Drake, who are responsible for this outfit, undertook to develop at Harvard University a receiver equivalent to the super-heterodyne in selectivity and sensitivity, operating on not more than four tubes.

Comparisons are so dangerous to make that comparisons with the super-heterodyne would be left to those who built this set. It is certainly true that the outfit is unusually sensitive and selective, simple to operate and construct, and an all-round good receiver which will be appreciated equally by experimenters and broadcast listeners.

In the special notes which appear farther on, a more detailed account of the development of the circuit is given. At this point it is sufficient to say that the possible amplification from a tuned radio frequency transformer was determined mathematically, and curves plotted to take into account the value of the primary inductance in the R. F. transformer and the coupling between the primary and secondary coils. The curves showed that maximum amplification was obtained when a particular relation existed between the primary inductance and the coupler.

On the basis of the data thus obtained, a transformer was assembled and tested under actual operating conditions. In practice, the calculations did not seem to hold good for the amplification was far below that indicated by the curves. It was only after several months of experimenting and

testing that the source of the difficulty was located—the capacity between the primary and secondary coils, which is responsible for the rather low amplification obtained from R. F. transformers, was introducing losses. Accordingly, the construction of the transformer was changed as indicated by the sketch in Fig. 6. Thereupon an actual amplification equal to 90 per cent of the theoretical value was obtained.

A very interesting fact was brought out in this experimental work. It was found that the UV-199 tube was equivalent to the UV-201-A as an R. F. amplifier, which accounts for its use in this receiving set.

Subsequent development work showed that the high R. F. amplification obtained could be increased three or four times by using a regenerative detector, altering the constants of the circuits to take account of the decrease in resistance of the secondary as a result of the feed-back action.

For neatness and simplicity of design, the arrangement of the type 6600 Browning-Drake Receiver is hard to im-

prove upon. To be sure, this is largely a matter of good luck, for some types of circuits come out in such a way that it is practically impossible to work out an orderly design and to get the leads as short as they should be while keeping them properly spaced apart.

There are several excellent features in this outfit. The National condensers are equipped with angle brackets so that the condenser can be set up on a table or base board. These are employed to support the tube panel at one end, while a mounting pillar holds the panel in place at the other extremity. The new Benjamin sockets are used for this outfit, as you will see from the illustrations. They are exceedingly well

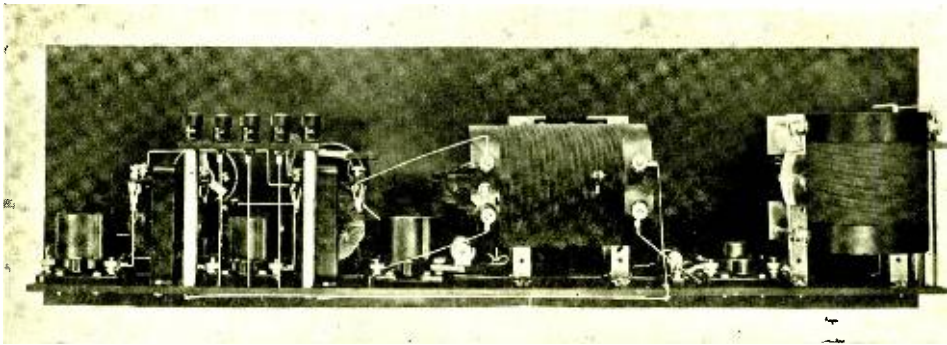


Fig. 1. One reason for the high efficiency of this set is that the parts are arranged in the exact sequence that they come into the circuit, making possible the use of short leads well separated.

designed, both electrically and mechanically, and have the advantage of a spring mounting to absorb vibrations without making the construction clumsy. General Instrument rheostats, with their fixed moulded dials, improve the appearance of the controls on the front panel. Their action is particularly smooth and the design of the shaft lock makes them easy to install. Another feature is the vernier dials. In appearance, they are exactly like solid bakelite dials. By means of a very clever reducing arrangement under the knob, a reduction of 6 to 1 is obtained.

The panels for this set are of mahogany celeron. This is a perfect reproduction of mahogany grain, for the outer sheets of paper of which the panels are formed are printed with the real grain, obtained by photographing a mahogany board. As a matter of fact, it is difficult to tell without examining the edges of the panel, whether the material is wood or celeron.

On the front of the panel there are five adjustments, two condenser dials, two rheostats, and a Walbert filament lock switch. With the lock switch at the middle position, which lights the filaments, the detector and A. F. amplifier rheostats are adjusted properly. No control is needed for the UV-199 as that is regulated automatically by an Amperite.

Then the two dials are set at about 30 divisions and the tickler coil rotated until a slight roaring sound is heard in the phones. To bring in a station, tuning is done roughly with the R. F. condenser, altho the secondary condenser should be kept at about the same setting as the other dial. As soon as a station is heard, the R. F. condenser should be left alone and the secondary condenser adjusted for maximum signal strength. Then the R. F. dial is set accurately and, if necessary, the tickler coupling increased slightly.

When the set is tuned in this way, it does not oscillate or radiate. Consequently, there are no objectionable squeals in the loud speaker nor is any interference caused with other receiving sets in the neighborhood. There is very little tendency to put the set into oscillation by using too much tickler fee-back, as is the case with ordinary regenerative receivers, because, just before the tickler is turned enough to make the set oscillate the signals become fainter. Turning the tickler farther makes the signals strong again but badly distorted. The exact way to handle the tickler control is easily understood when the set is in actual operation.

You will notice that, while the adjustment of the secondary condenser seems rather broad while a transmitting station is being located with the R. F. dial, when the R. F. dial is set exactly, the secondary control becomes very sharp. This is a little trick in the operation of the outfit that helps greatly in tuning in one station after another.

Following is a list of the Standard Parts Required parts actually used in this set. While other things equally good can be substituted, it is not advisable to change the mechanical design of this set for the reason that, as the original model was actually built, it is self-neutralizing. If any change is made in the parts or layout, it may be necessary to use a neutralizing condenser, as shown in Fig. 4, the schematic wiring diagram.

Two panels are required, of mahogany celeron if you prefer this finish or of Formica or Bakelite if you favor the black color. The front panel measures 7 by 24 ins., and the tube panel, $3\frac{1}{2}$ by 23 ins. It is well to get the base panel $24\frac{1}{2}$ ins. long so that the two strips for mounting the binding posts can be cut from it. The longer strip measures $3\frac{1}{2}$ by $\frac{3}{4}$ in. and the other $1\frac{3}{4}$ by $\frac{3}{4}$ in. All are $\frac{3}{16}$ in. thick.

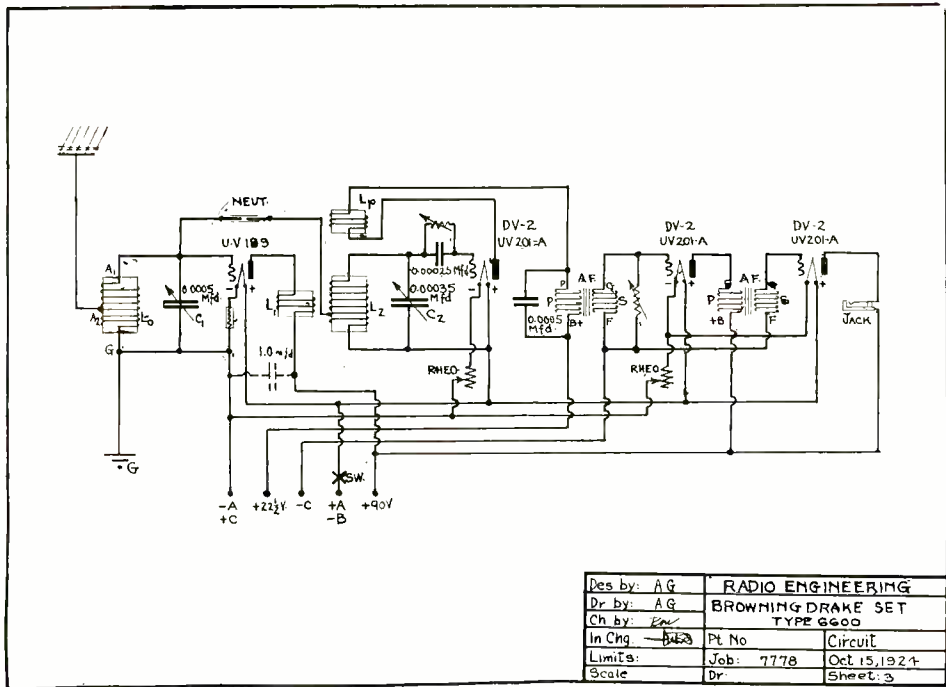


Fig. 2. This diagram shows the circuit system of the Browning-Drake set. However, it is advisable to follow the picture wiring diagram in making connections.

The key instruments are the National secondary condenser and transformer unit, and the R. F. condenser and transformer unit. These condensers are supplied with vernier dials 4 ins. in diameter. The other parts required are three Benjamin sockets for standard-base tubes, one Benjamin UV199 socket, an UV-199 Amerpette, one Amertran of the 1 to 5 ratio, one 1 to 3 1/2 ratio, a 30-ohm General Instrument rheostat, and another of 10 ohms, an Electrad variohm, a B. M. S. Tri-jack, a Walbert filament lock switch, one New York Coil condenser of 0.0005 mfd., and another of 0.00025 mfd. with gridleak clips, a Turn-it variable grid-leak and seven binding posts of the Eby or Marshall-Gerken type. Since there is not enough room on the binding post mounting strips for engraving the terminal markings, it is well to use engraved posts.

For hardware, four panel support pillars, 3-3/8 ins. long by 3/8 in. diameter, threaded 6-32 at each end, are needed, one coil mounting pillar, 11/16 in. long threaded 6-32, and one angle bracket.

Because of the space required to show one-half scale drawings of the panels, the usual layouts are not given, altho a set of full size panel pattern blue

prints* can be obtained by those who want to follow the exact arrangement. The blue prints can be put directly on the panels and the centers for the holes marked through with an automatic center punch. All sizes for the holes are shown on the prints.

The mahogany celeron is furnished with a high-polish. If, however, you prefer to have it dull, the polish can be taken off by rubbing the panels with No. 0 sandpaper. Be very careful not to rub too hard for you will go through the outer layers on which the grain is printed. After sandpapering, a little oil will make the grain show up again. If the set is to be used in a mahogany cabinet, it is well to finish the panel to match the finish of the cabinet.

Engraving adds greatly to the appearance of the set. It is not expensive, and the cost is well worth the professional touch that it gives to the panel. If you are going to send the panel out to be engraved, drill your holes first, and send with the panel the full size blue prints on which the engraving is already shown. In this way you will pro-

*Set of six full-size blue prints for the Browning-Drake set, \$1.50. Order from Blue Print Dept., M. B. Sleeper, Inc., A-52 Vanderbilt Ave., New York City.

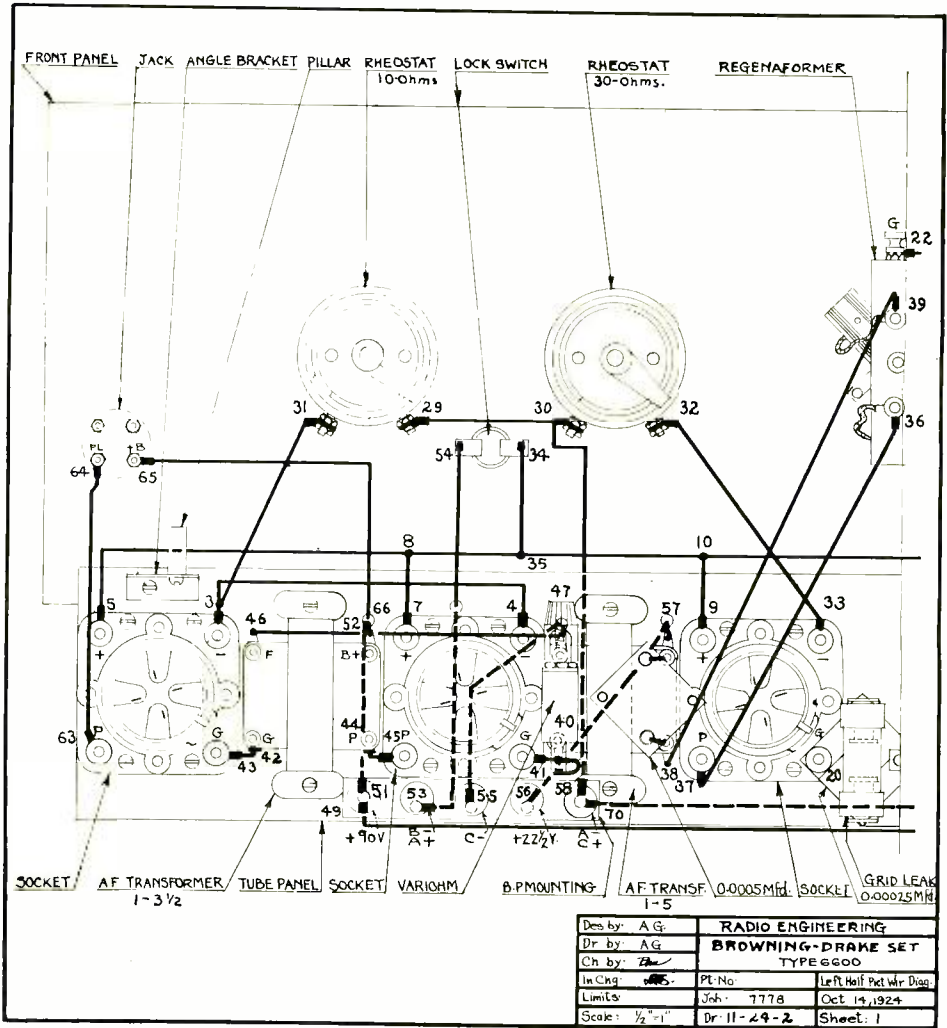


Fig. 3. Picture wiring diagram, showing the connections as they are actually made.

protect yourself and the engraver against the misinterpretations which come about frequently because of rough sketches.

The following step-by-step assembly instructions have been worked out very carefully so that, as the parts are put together, it will not be found necessary to take off something already put together in order to get at a difficult connection. You will save yourself much time and trouble, and assure yourself of the success of the final results if you follow each step in order.

Do the soldering with a good electric iron, if you can get one. For the joints

use either Kester rosin core solder or soft solder and Nekorosin paste. Be sure to apply enough heat so that the solder flows freely. Much trouble can be saved by tinning each lug thoroughly before it is put in place. The directions in which the lugs should point are indicated by the heavy lines on the picture wiring diagram in Figs. 3 and 4.

1. Mount the four sockets on the tube panel, putting the terminals in the positions shown in the picture wiring diagram. Use 1/2-in. 6-32 R. H. screws and nuts. Mount the Amperite next to the 199 socket, fastening it with a 1/2-in. 6-32 R. H. screw and nut,

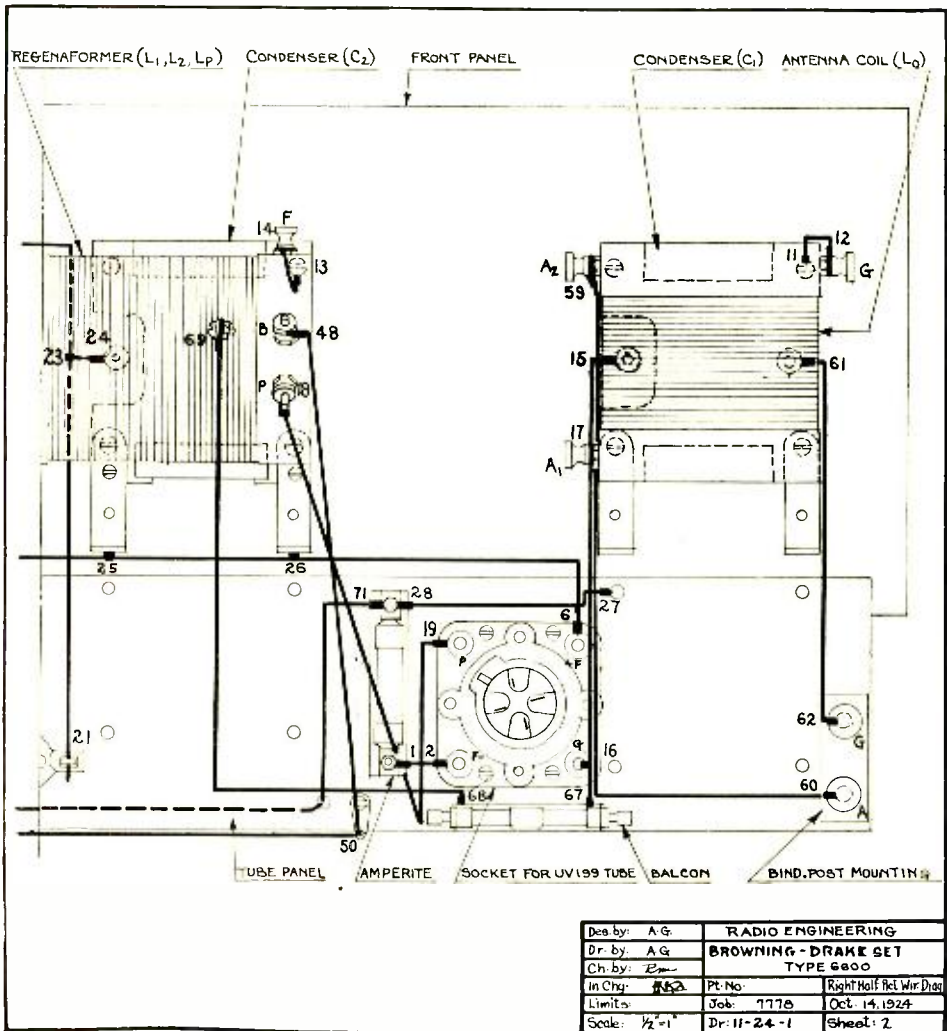


Fig. 4. The tube panel is tipped down so that you see the rear of the front panel and the top of the tube panel.

2. Connect 1 to 2, 3 to 4, and 5 to 6. Keep this wire on the level with the upper surface of the tube panel and about 1/8-in. away from the edge. Connect 7 to 8, and 9 to 10.

3. Mount the secondary and R. F. transformer condensers, with their respective coils, on the front panel. It is necessary to remove the dials from the condensers. First loosen the set screw which holds the knob to the shaft. Then take out the three R. H. screws which fasten the dial to the gear box, remove the four screws which hold the gear box to the condenser mounting posts, and undo the set screw on the

collar which fits over the condenser shaft. You will find three washers on each condenser mounting post. Take off all but one from each post. Put the condenser behind the panel and put in the screws which go through the gear box and thread into the mounting pillars, put back the three screws holding the dial to the gear box, and, finally, fasten the knob in place by tightening the set screw in it. Turn the condenser plates so that they are totally interleaved, loosen the set screw on the collar over the condenser shaft, set the dial so that the 100 division line coincides

with the line on the panel and tighten the set screw again.

4. Connect 11 to 12. 11 is a lug on the screw fastening the condenser end plate to the post. Connect 13 to 14. 13 is a lug on the screw which holds the condenser end plate to the post.

5. Turn the mounting feet on the variable condensers so that the feet point to the rear. Fasten these feet to the tube panel with $\frac{1}{2}$ -in. 6-32 R. H. screws and nuts.

6. Connect 15 to 16. 15 is the binding post of the fixed plates and 16 the grid contact on the socket. Connect this wire also to 17, the bottom binding post on the coil. Connect 18 to 19. It is well to insulate this wire with M-R varnished tubing so that it will not accidentally touch one of the filament circuit leads.

7. Remove one of the Fahnestock binding posts on the fixed condenser, and put the condenser terminal over binding post 20.

8. Connect 21 to 22, and connect this wire at 23 to 24, the binding post on the fixed plates. Solder wire 5 to 6 to the mounting feet of the R. F. condenser at 25 and 26. Put a lug under the screw holding the left hand forward leg of the secondary condenser and connect 27 to 28.

9. Fasten the two rheostats to the front panel.

10. Connect 29 to 30, 31 to 3, and 32 to 33.

11. Mount the filament lock switch.

12. Connect 34 to 35, and 36 to 37.

13. Mount the 1-5 A. F. transformer using $\frac{1}{2}$ -in. 6-32 R. H. screws. Have the secondary terminals to the left, looking at the set from the rear.

14. Connect 38 to 39. 38 is the P post on the transformer. Connect 40 to 41. 40 is the G post on the transformer and 41 the G post on the socket.

15. Turn the terminals of the 0.0005

mfd. condenser to the side and bend them around so that they can be slipped over the P and B+ binding post of the transformer. Mount the 1 to $3\frac{1}{2}$ ratio transformer.

16. Connect 42 to 43, and 44 to 45. 44 is the P post on the transformer and 45 the P post on the socket. Connect 46 to 47. 47 is the F post on the 1 to 5 ratio transformer.

17. Mount the three inside binding posts on the longer terminal strip, putting lugs on each binding post. Thread the shanks of the two outer binding posts into the ends of panel support pillars. Fasten the pillars to the tube panel with $\frac{1}{2}$ -in. 6-32 R. H. screws, putting two lugs under each one of these screws.

18. At terminal 50 you will see that a screw is put through the tube panel, held in place with a nut, with a lug above and below the panel. This is to support the next wire.

19. Connect 48 to 49, soldering this wire at 50 to hold it in place. 49 is one of the lugs under the tube panel on the terminal support pillar. Connect 51 to 52. This wire is run from the other lug on the support pillar underneath the tube panel and up through a hole in the B+ binding post on the transformer. Connect 53 to 54. This wire is run from the lug on the binding post down through a hole in the tube panel and up through another hole to the lock switch. Connect 55 to 47. Connect 56 to 57, and 58 to 30. This wire should be insulated with M-R varnished tubing where it passes along the underside of the tube panel. Connect 59 to 60, and 61 to 62.

20. Fasten the angle bracket to the tube panel, and fasten the angle bracket to the front panel by means of a coil support pillar. $\frac{1}{2}$ -in. 6-32 screws should be used. Mount the tri-jack on the front panel with the binding posts in the positions shown.

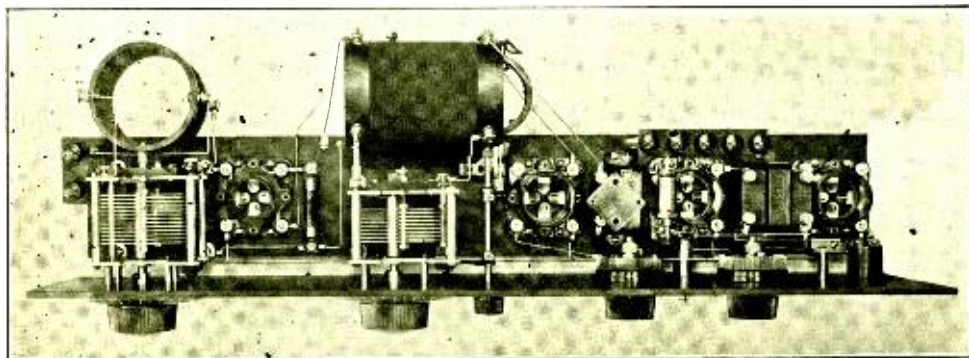


Fig. 5. Looking down on the top of the set. Check your assembly against the illustrations as you put the parts together and make the connections.

21. Connect 63 to 64, and 65 to 66, a connection made to the wire running from 51 to 52. Connect 70 to 71. 70 is the other lug on the panel support pillar.

22. If you use a Balcon for neutralizing, mount it directly behind the UV-199 socket and connect 67 to 16, and 68 to 69, a lug put on a screw passing through the small loop in the secondary winding.

This completes the wiring of the set.

Testing
and
Operating

The picture wiring diagram shows the connections for the batteries. Looking at the set from the rear, the left-hand binding post is for the + terminal of a 90

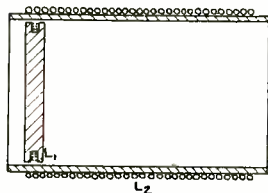


Fig. 6. Sectional view of the R. F. transformer, showing the primary and secondary windings.

volt B battery, while the next binding post to the right is for the — terminal. This same terminal takes the — post of a 22½ volt battery with the + going to the next to the last binding post to the right. With a UV-199 Amperite, 6 volts can be put on the filament of the R. F. amplifier tube. Therefore a 6 volt storage battery should be used, connected on the — side to the right-hand binding post and on the + side of the first binding post to the right. The C battery is connected from the right-hand to the center binding post, the positive terminal going to the right. With this combination of A and B batteries, two 4½-volt Eveready 3's are required. This not only reduces the plate current to a minimum but prevents distortion. For the detector and A. F. amplifier tubes UV 201A's, DV 2's, or C 301A tubes can be used. In tests made on this outfit, excellent results were obtained with 3 DV 3's for the detector and A. F. amplifier stages, but the ¼ ampere tubes made the volume.

You will note that an Audiohm is connected across the secondary terminals of the first A. F. transformer. It is advisable to use this control to cut down the volume on powerful stations. During the tests made at the Darien laboratory, the tubes were overloaded, in spite of the fact that 9 volts of C battery were used, on the New York stations, Springfield, and the new Grebe station, WAHG. However, the Audiohm used had a tendency to reduce the strength of weak signals even when it was set for

maximum resistance. Therefore the spring connection was not fastened securely on the transformer binding post but merely hooked around it so it could be disconnected easily. The resistance of the grid leak is important. For that reason, a Turn-it is suggested, although some experimenters prefer to try different values of fixed grid leaks. The grid leak is exceedingly important in this set. If you hear disturbing noises, test the grid leak at once, for it exercises a very important control. A faulty grid leak will entirely spoil the results.

If, for any reason, signals do not come in properly, test the coils for open circuits,

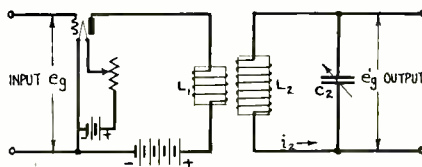


Fig. 7. Theoretical circuit of the R. F. amplifier as it was considered in the mathematical development.

test the transformers for opens or shorts between the windings, test the fixed condenser across the primary of the first transformer for short circuit, and test the jack for open circuit. At one of these points you will find your trouble unless you have made a mistake in the connections.

The results obtained with this set at the Darien laboratory were so unusually good that we hesitated to list the results for fear of discouraging those whose sets may be equally good but do not work as well because of their location. We shall be greatly interested, however, in hearing from those who build the Browning-Drake circuit as to the results they obtain.

It was not found necessary to neutralize this receiving for, as is often the case, the peculiar arrangement causes the circuit to neutralize itself. If, however, you find that the set is radiating, as indicated by whistles at various points, when the secondary condenser dial is rotated, a neutralizing condenser can be mounted on the set and adjusted in the following manner:

Turn the tickler to a point where placing a moistened finger on the grid side of the condenser C_2 gives a pluck in the phones. Of course, the antenna and ground must be connected, as well as A and B batteries, and the tubes lighted at their proper brilliancy. Turn back the tickler until this pluck just disappears. Then rotate condenser C_1 , and if, at any setting of C_1 touch-

ing, the grid side of C_2 should give a pluck, the set is not neutralized. Change the capacity of the neutralizing condenser until this test is satisfactory. If no value of capacity is found, reverse the leads to coil L_1 and repeat the test.

Mathematics of the Tuned R. F. Transformer

For those who are technically inclined, it is thought advisable to give some of the mathematics of the radio frequency transformer. A paper has already been presented before the Northeastern District Convention of Electrical Engineers, in which the theory and experimental data have been completely taken up, so that this is merely a summary of that paper.

Referring to Fig. 7, the radio frequency voltage impressed on the grid of the amplifier tube is e_x while the radio voltage impressed on the detector tube is e_r . Therefore, as we desire to find the amplification of the system we must solve the circuit for e_r/e_x with these abbreviations:

- L_1 inductance of the primary.
- L_2 inductance of the secondary.
- $W=2\pi f$ where f is impressed frequency.
- i_2 current in secondary circuit.
- M mutual inductance between L_1 and L_2 .
- R_p plate resistance of the tube.
- C_2 capacity of condenser.
- μ Amplification of the tube.

$$W_0 = \frac{I}{\sqrt{L_2 C_2}}$$

$$\eta_1 = \frac{R_p}{L_1 W}$$

$$\frac{W_0}{W} = \theta$$

$$t = \frac{M}{\sqrt{L_1 L_2}}$$

$$\eta_2 = \frac{R_2}{L_2 W}$$

The equation for the amplification of the system is:

Equation 1:

$$\frac{e'_r}{e_x} = \frac{\mu \sqrt{L_2/L_1}}{\sqrt{\frac{1}{2} + (1-\theta)^2} \left\{ \eta_1 + \frac{t^2 \eta_2}{\frac{1}{2} + (1-\theta)^2} \right\} + \left[1 - \frac{t^2(1-\theta)^2}{\frac{1}{2} + (1-\theta)^2} \right]^2}$$

When C_2 is tuned for maximum signal, equation 1 becomes:

Equation 2:

$$\frac{e'_r}{e_x} = \frac{\mu t \sqrt{L_2/L_1} \sqrt{\eta_1^2 + 1}}{\frac{1}{2} (\eta_1^2 + 1) + t^2 \eta_1}$$

It is seen that equation 2 has a maximum with respect to t . This maximum occurs when

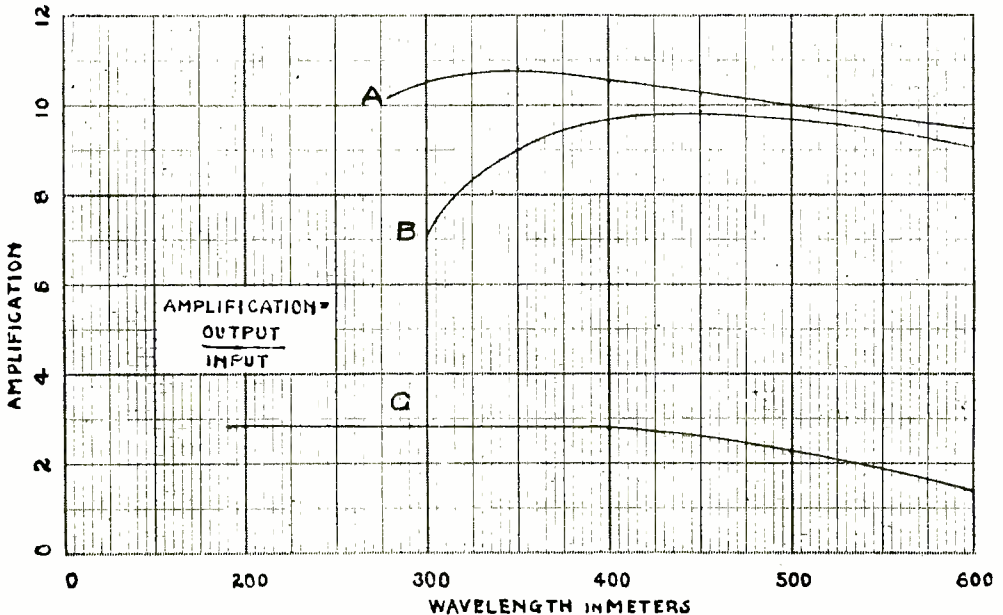


Fig. 8. A most unusual set of curves, showing at A the theoretical amplification, at C, the actual amplification first obtained by applying the mathematics to practice, and at B, the amplification obtained after the kinks had been ironed out.

Equation 3:

$$t = \frac{\eta_2}{\eta_1} (\eta_1^2 + 1)$$

With equation 3 substituted in 2, we obtain:

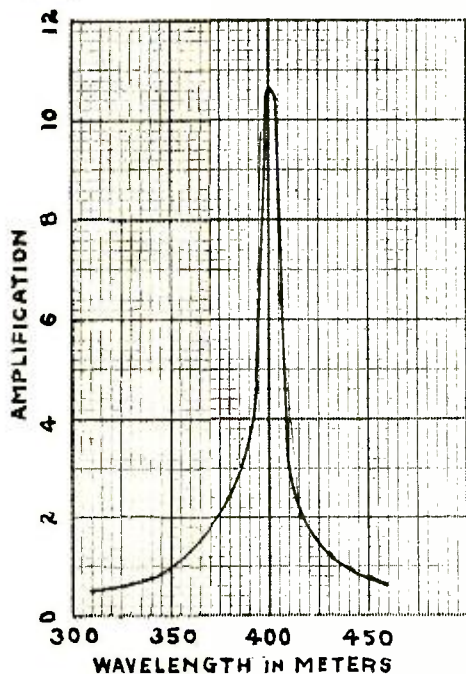


Fig. 9. Resonance curve, indicating the sharpness of tuning at 400 meters.

Equation 4:

$$\frac{e_2'}{e_3} = \frac{\mu \sqrt{L_2/L_1}}{2 \sqrt{\eta_1 \eta_2}}$$

This at once shows that L_2 should be made as large as possible consistent with

tuning to the lowest wave length desired. Therefore, L_2 was at first made a .4 millihenrys, but later reduced to .3 millihenrys, in order to bring in lower wave length with great volume.

An experimental curve was taken to find what value of η_2 could be easily obtained, and the average value to be .008. R of the UV 199 tube was found to be about 20,000 ohms so that with $t = .52$ which was a value which could be obtained, L_1 must be .13 millihenrys. With these constants, and the form of winding shown in Fig. 6, the theoretical curve, A, shown in Fig. 8, was plotted and the measured curve shown at B was taken.

With regeneration η , was found to be reduced by one-third and consequently the other constants of the transformer were changed accordingly.

In the original papers, the tendency of the input tuning system to break into oscillation, when the transformer was tuned, was taken up and several interesting facts brought out which will not be considered here.

The reader may see that this equipment was not made up by a cut and dry proposition, but was carefully designed on the basis of theoretical and experimental data which was collected during a year's work.

Wavelength Calibration for the R. F. Tuning Condenser Dial

Wavelength in Meters	R. F. Condenser Divisions	Wavelength in Meters	R. F. Condenser Divisions
230	10.0	440	47.5
240	11.5	460	52.25
280	17.25	480	57.5
300	20.5	500	62.5
320	24.0	520	67.5
350	38.5	540	73.5
370	29.0	560	80.0
400	32.7	580	85.6
420	43.0	600	92.0

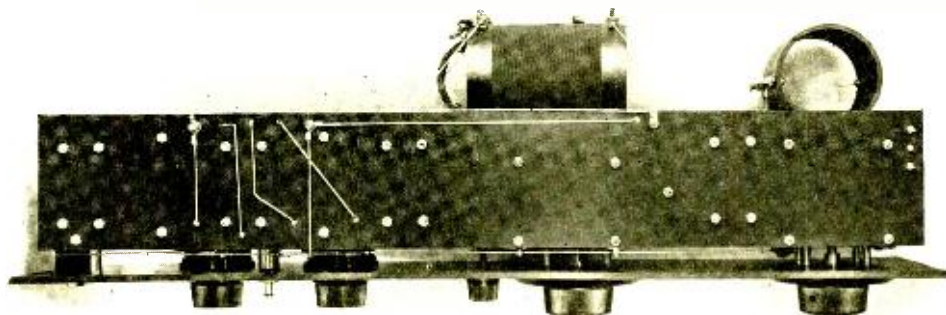
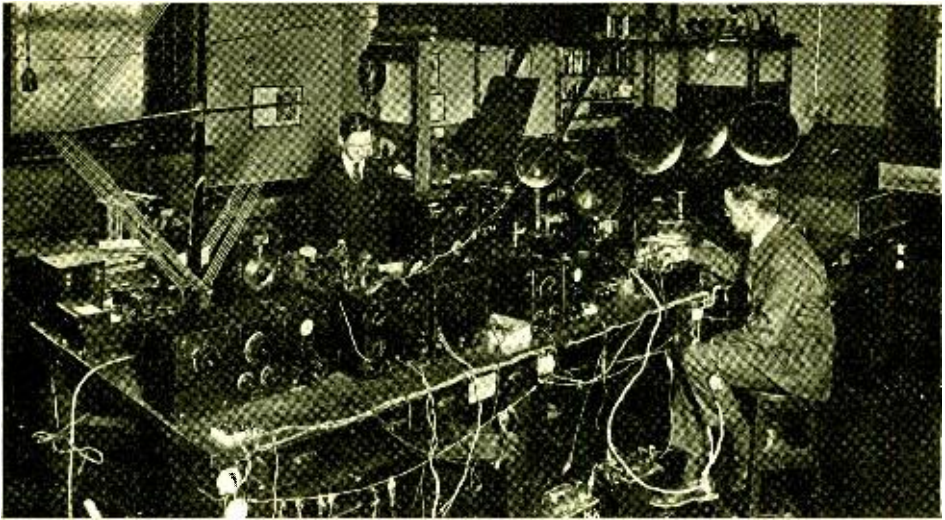


Fig. 10. Showing the wiring under the tube panel.



Notes on the Super Circuit

An understandable explanation of the super-heterodyne system and the intermediate frequency amplifier

How the Super Works

If you will keep in your mind a few of the essential points concerning the operation of a super-heterodyne circuit you will be able to proceed much more intelligently with the work of building this type of set. The circuit consists of a simple tuning arrangement connected to a detector, then to an intermediate frequency amplifier, to another detector, and finally to a regular audio frequency amplifier. In addition, there is an auxiliary circuit which sets up oscillations and is coupled to the tuning circuit of the receiver.

Since the advent of the super-heterodyne we have three types of amplifiers, the radio frequency or R. F. type operating on 500,000 to 1,500,000 cycles, the intermediate frequency or I. F. type for 30 to 50,000 cycles, and the audio or A. F. amplifier for 60 to 10,000 cycles. Each type of transformer is designed for one of these frequency ranges, and only allows the amplification of frequencies which come within its range.

The tuning circuit of a super-heterodyne set, whether it operates on a loop or an antenna and ground, is designed to cover a wavelength of 200 to 600 meters, corresponding to a frequency of 1,500,000 to 500,000 cycles. Following the tuning circuit in which oscillations of these very high frequencies are taking place is an intermediate frequency amplifier of three or four steps. It is obvious that something

must be done to these high frequencies in order to alter them so that they will pass through an amplifier designed for 30 to 50,000 cycles. It is at this point that the auxiliary oscillator circuit must be employed.

If a circuit carrying a frequency of 1,000,000 cycles has coupled to it a circuit carrying 1,050,000 cycles the actual frequency in the circuit is neither 1,000,000 cycles or 1,050,000 cycles but a frequency which is the difference of the two, in this case, 50,000 cycles.

The oscillator used in conjunction with the super-heterodyne set is designed so that its wavelength or frequency can be varied over the same range that the tuning circuit is designed to cover. In order to get a resultant or beat frequency of 50,000 cycles to pass through the intermediate amplifier the oscillator must be set to a frequency which differs by 50,000 cycles from the frequency of the incoming signals.

It is not necessary to calibrate the oscillator, however, for when the signals come through the set with the greatest volume it is obvious that the oscillator must be at the correct difference in frequency from the frequency of the incoming signals.

Altho it is hard to picture it in your mind, the high frequency oscillations of 500,000 to 1,500,000 cycles are broken up into little groups which occur at audio frequencies and, even tho the high frequency or carrier wave is altered by the oscillator

(Concluded on page 380)

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EDITORIAL

THE fall months bring with them the series of radio shows, one after another, from New York to San Francisco. At every show you will find subscription representatives of the various magazines. These men, working far from the home office, sometimes become overzealous in their claims and promises. Frequently emergency men are taken on who are positively dishonest, keeping money paid them and destroying the names of the subscribers.

Consequently, you must carefully consider the reputation of the publisher when you subscribe to magazines thru representatives. Radio Engineering knows the character of its men because they have been in the employ of the Company for four years. They are not permitted to take on emergency men. The publishers, consequently, stand behind every subscription receipt issued. If, thru a slip, your name or address is not recorded correctly, the Magazine will not reach you. However, when this does happen, tho it is rare, the subscription is re-entered correctly and any missing numbers forwarded as soon as the receipt and the right address is sent in. Moreover, as a protection to readers and advertisers, if anyone finds that Radio Engineering is not of sufficient value to be well worth the price paid, the full amount will be refunded upon request.

You will see that, starting with this issue, the scale drawings of instrument panels are omitted. The reason is just this: The construction articles are of value to many readers who do not actually build the sets described, or who make various changes of their own when they construct the out-

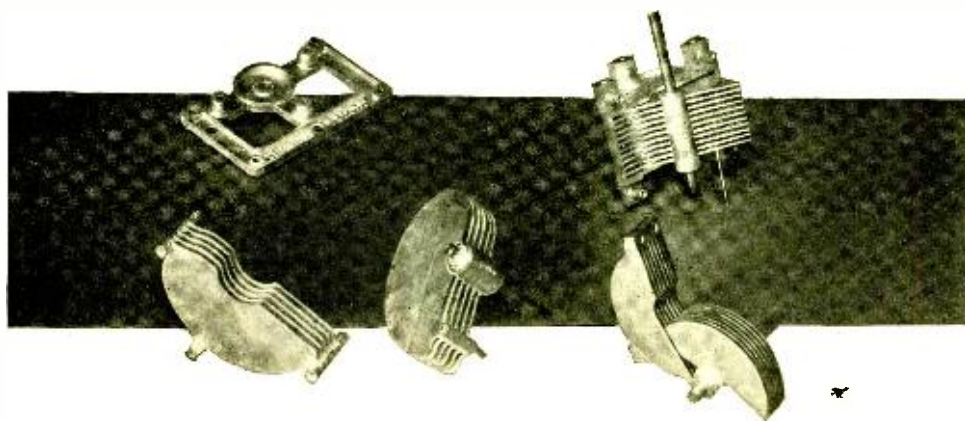
fits. It is hardly fair to those men to use the large amount of space occupied by these drawings for something of no real value to them. However, the panel drawings will be made up each month, and will be available to those who do want them in the form of full-size blue prints which can be laid directly on the panels and used as drilling templates, doing away with the necessity of scaling off from half-size drawings.

In September, 1922, Radio Engineering published the first "picture wiring diagrams." Until then, no one had ever thought of a better way to illustrate the wiring of a set than by the conventional schematic hook-ups. A list of newspaper radio sections and magazines now using picture wiring diagrams would include practically every one published. The last magazine to take it up apologizes editorially for its "picture diagrams" because they are plain enough for the novice to understand. It is our experience that they are of greatest assistance to the skilled set builder whose job is to turn out a set in the shortest time and with the minimum of wasted cut-and-try effort.

How is the radio business this fall?—It's hard to find out because every manufacturer is too busy to tell how far behind he is, even if he has had time to find out himself. Which is a suggestion to radio men who have their evenings free and want to capitalize on the enormous business in complete sets. Installation and Maintenance men are paid a dollar and a half an hour for their time. Get your name in the I and M Registry so that people in your city or town will know where to go for assistance when their sets go wrong. Practically all the S. O. S. calls come in the evening when the stores are closed, and, particularly if there is a special program, set owners are only too glad to pay the charges if they can get prompt assistance. Every set sold must be serviced. Can't you handle this work, too?

Have you noticed how the crystal detector is coming back? All kinds of sets are now designed with crystals in place of vacuum tubes. Particularly is this true since the advent of fixed crystal detectors. The adjustable types did not work out very well because the moment the contact was moved from a sensitive spot the set howled dreadfully. With the fixed types there is no howling since adjustment is unnecessary. As to their permanence—individual detectors vary. We have several in our laboratory which have been used rather roughly in experimental work where they were called upon to handle heavy currents, but they are still as sensitive as ever after almost a year's time.

M. B. SLEEPER, Editor.



Use of Die-Castings in Radio Manufacturing

Some suggestions for the use of die-castings to speed up production and to improve the quality and finish of special parts

TWO problems which all manufacturers have in common, and which are being solved with more or less success, are the reduction of manufacturing costs and the improvement in appearance and quality of the products. The experience of some of the leading manufacturers of high grade parts has shown that in many cases it is possible to go a long way toward overcoming production difficulties at one stroke by the use of die-castings. Others have found that the improvement in appearance alone, secured by this method, has enabled them to command higher prices for their products. Of course, it is not always practicable to use castings for in many cases, where sheet metal stampings or screw-machine parts can be used, the die-casting process cannot compete commercially. Its largest field is where costly assembling operations are done away with by its use, where it eliminates machining operations, or produces a part which meets the requirements demanded of it better than if it were made some other way.

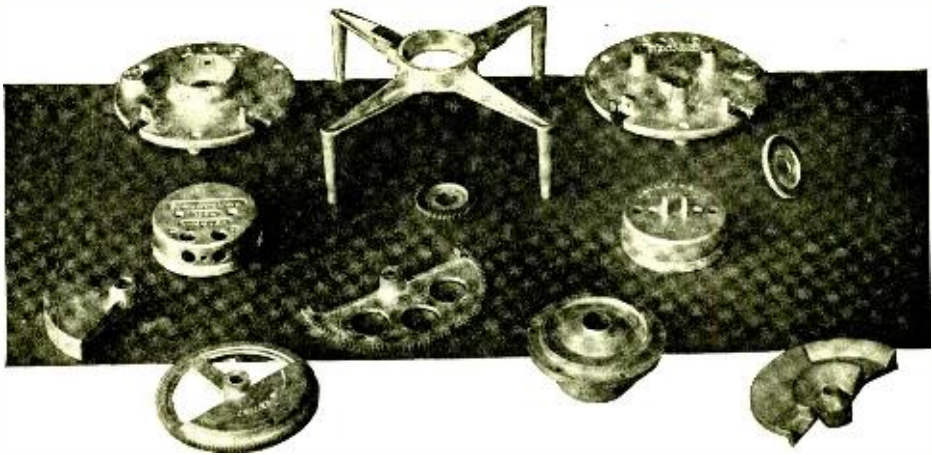
The term die-casting, as defined by the Doehler Die-Casting Company, the largest manufacturer of die-castings in the United States, applies to metal castings made by forcing molten metal, under pressure, into a metallic mold or die. The mould must be properly designed and constructed so as to be capable of receiving the molten metal under pressure. The metal must be a suit-

able alloy that will form a casting meeting exact specifications as to physical dimensions, and free from imperfections.

It is easy to make die-castings very accurate in size. The exact limits vary with the composition of the alloy used, but for most of the zinc base alloys employed for castings in radio work, the limits are approximately plus or minus .002 in. per inch. The surface is very smooth so that practically no grinding is necessary. The metals which can die-cast successfully are the various zinc base alloys, aluminum base alloys, tin base alloys, lead base alloys, and some copper base alloys.

Another advantage of the die-casting process is that wall thicknesses as small as 0.10 in. on ordinary sized castings, and 1/16 in. on small castings, can be obtained. This accounts for the growing popularity of this system for producing variable condenser plates, since they can be made as integral units.

The quality or adaptability of a die-cast part is very often improved by the use of inserts of some other metal. They are very often used to provide greater strength or hardness at certain points in the casting. In general, any material which has a higher melting point than that of the alloy can be used for inserts. They may be used also to provide material of better anti-friction qualities at localized points in the casting. The outer surfaces of inserts are usually



cross-knurled, so that they are held more firmly in place.

Since all-steel cores are used in the moulds for die-casting, holes of very small diameter, approximately 0.031 in. minimum, can be cast. External threads up to about 24 per inch can be cast, but internal threads are usually cut by machine.

An important property of die-castings which makes them particularly suitable for radio work is the absence of imperfections and blow-holes. This not only improves the appearance considerably but means that the waste, due to defective castings, is reduced to below 2%.

The question of whether die-castings are cheaper than molded Bakelite has often been asked. Taking everything into consideration, die-castings are slightly more expensive than the other but in many cases the question of breakage and strength, or electrical conductivity makes die-castings more desirable. By enameling the part, an appearance similar to that of Bakelite can be obtained. The molds for die-casting cost about the same as those for Bakelite.

The cost of die-castings is controlled by a number of things. It depends on the alloy to be used, the accuracy required, the surface finish, the quantity required, and the size and shape of the part. The quantity is a very important factor as it determines the number of cavities in the die. If a small quantity of castings is called for, the expense of making the die is generally the predominating element of cost. Where the quantity is large, the die cost is widely distributed, and the number of parts produced per operation is increased by having a greater number of cavities.

The success and the ultimate cost of die-castings depends to a large degree on how well the molds have been designed. One

fundamental difference between the die-casting process and foundry practice is that in the latter, a core of any conceivable shape can be formed in sand, and when the casting has been made, the core can be broken out of the finished casting. In die-casting practice, since all-steel cores are used, means must be provided for removing the cores. This makes it very important that undercuts be avoided. Corners should be rounded and fillets or webs used. Inserts should be applied where special qualities are required. The proper alloy, having properties in accordance with the specifications of the work must be selected.

A few of the many applications of die-castings in the radio industry are shown in the accompanying illustrations. Among these are head-phone cases, loud-speaker ferrules and bases, vernier gears, condenser counterweights, panel support brackets, and condenser end plates, rotors, and stators.

It is predicted that many new applications of die-castings will be seen in the radio industry this season. The present struggle for the elimination of losses in variable condensers has already been aided by die-castings. Condensers with all of the stator plates in one integral piece, and all of the rotor plates cast as a separate piece have been the answer to the problem of eliminating resistance losses due to poor electrical joints between the plates. Condensers built in this way have brass shafts and steel bearings inserted in the castings to reduce friction to a minimum. The die-cast condenser is a good illustration of a case where both low cost and efficiency are secured by this interesting method, for the elaborate operation of assembling the many plates in the ordinary condenser is eliminated.

The Melco Inductance-Tuned R. F. Receiver

In this set the secondary and the two R. F. amplifying circuits are tuned by varying the inductances, while the condensers remain fixed

ONE of the most interesting developments resulting from the vast amount of research work carried on in the field of tuned radio frequency amplification, is the Telemonic tuned R. F. receiver, shown in the accompanying illustrations. This set represents a distinct departure from the usual methods of obtaining tuned R. F. amplification in that the R. F. stages are controlled throughout by varying the inductances instead of condensers.

The set employs flat D coils for the inductance units. By winding the coils in this form, the magnetic field is confined to each unit and interstage inductive coupling, with its consequent feedback of energy, is eliminated. The antenna is tuned by a variometer, indicated as A in Fig. 2, which is shunted by a small fixed capacity. The radio frequency amplifying transformer or variotransformer, is a combination of fixed primary inductance and variable secondary inductance. With this arrangement, when the inductance of the secondary is changed, the primary to secondary coupling is also varied. This makes it possible to reduce coupling and induc-

tance at short wave lengths so as to maintain a uniform amplification and selectivity over the whole range without introducing a capacity effect which will cause the set to oscillate.

The capacity feedback, caused by the capacity between the elements in the tubes, is eliminated by means of the compensating condensers connected across the grid and filament of the first and second tubes as shown in the wiring diagram. These condensers have three plates, the third plate performing an important function. As the compensating condenser is varied to increase its capacity and eliminate the feed-back which causes oscillation, the change in its capacity would upset the tuning of the secondary, without the third plate. This, however, adds capacity to the tuning circuit in accordance with the capacity decrease in the plate circuit, so that the tuning adjustments are not affected by neutralizing the capacity. A 0.5 mfd. fixed condenser is used to by-pass the radio frequency currents around the A and B batteries.

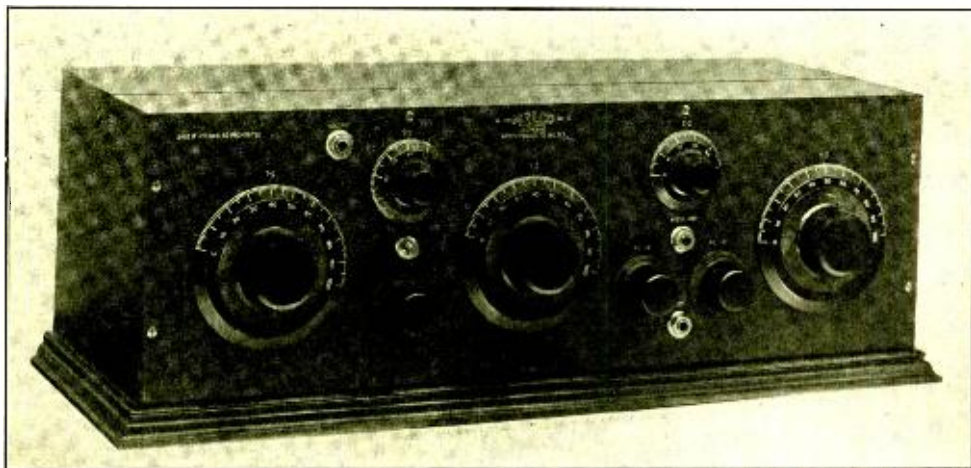


Fig. 1. It might seem as if this would be a difficult outfit to adjust, but, actually, only the three large knobs are used once the others have been set.

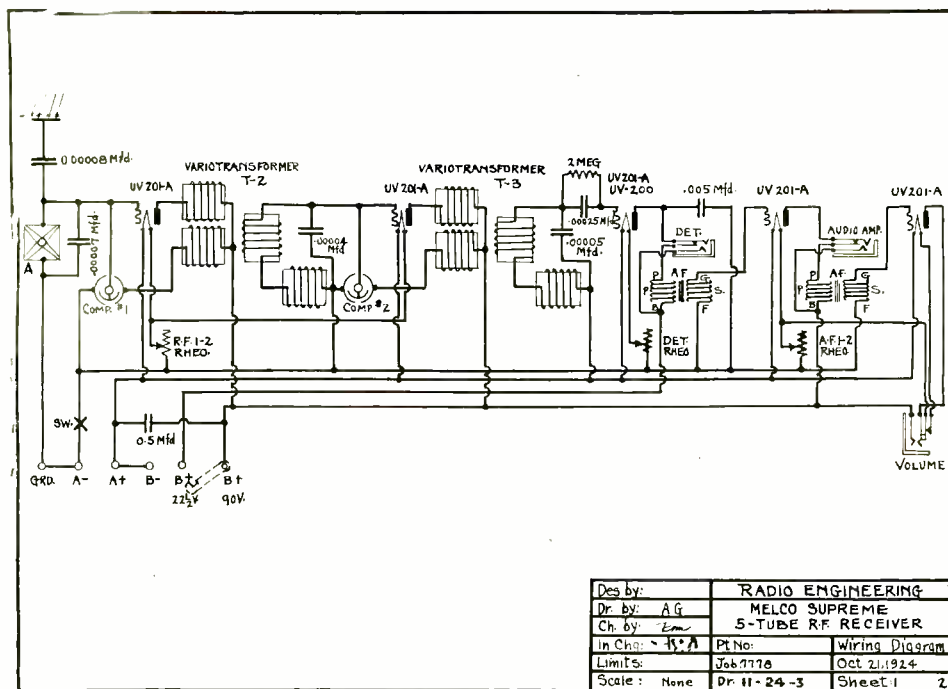


Fig. 2. Connections for the Melco set. Unit A is a variometer, while T-2 and T-3 are R. F. transformers in which the coupling and the secondary inductance are controlled simultaneously

This set provides two stages of tuned R. F. amplification, detector, and two stages of A. F. amplification using five tubes.

Design Details of the Set Fig. 1 shows a front view of the set when placed in the cabinet. The three large dials provide the wavelength control, the two small graduated dials are for setting the compensating condensers, and the three knobs below are for rheostats. One rheostat controls the two R. F. amplifying tubes, one is provided for detector tube, while the other controls the two A. F. amplifying tubes. Three jacks permit plugging in on the detector, first A. F. stage, or for full volume on the second A. F. stage.

A Formica panel 7 by 22 ins., 3/16 in. thick, supports the variometer and variotransformers, compensating condensers, jacks, rheostats, and the filament control switch. A baseboard 8 by 20 1/4 ins., 1/2-in. thick is fastened to the front panel, and has mounted on it the sockets, A. F. transformers, grid condenser and gridleak, and binding posts.

Standard Parts Required Parts required for this outfit are: A Telos variometer, two variotransformers, two com-

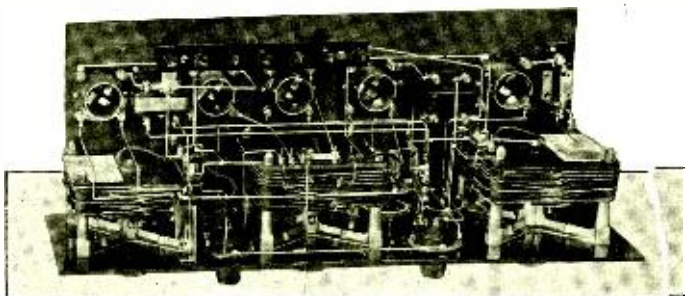
pensating condensers, a filament switch, three jacks, three rheostats, five standard base sockets, one 1 to 5 Amertran A. F. transformer, one United Manufacturing Company A. F. transformer, a 2-megohm gridleak and 0.00025 mfd. condenser, one 0.5 mfd. Federal by-pass condenser, seven binding posts and one 0.0005 mfd. New York Coil fixed condenser.

Assembly And Wiring Fig. 5 shows a picture wiring diagram of the set, in which the connections have been drawn exactly as they were arranged in the original receiver. The set can be put together without soldered connections by making loops or eyes in the wires, or by soldering the wires to lugs. Fill the lug with solder before putting it on the instrument. This will prevent damage to the parts from over-heating when the soldering iron is applied. Use either Kester rosin core solder or plain soft solder with Noko-rode paste, put on sparingly. Have the iron thoroughly clean and hot enough to make the solder flow freely.

The following instructions have been prepared in the proper sequence to make the wiring as simple as possible. Read through each step before as it may save time and extra work later on.

Des. by:	RADIO ENGINEERING
Dr. by:	A. G. MELCO SUPREME
Ch. by:	E. M. 5-TUBE R.F. RECEIVER
In Chg.:	J. A. Pt No: Wiring Diagram
Limits:	J. 66-7778 Oct 21, 1924
Scale:	None Dr. H-24-3 Sheet 1 2

Fig. 3. The transformers are made up of sections, alternately fixed and rotating, which carry D coils. As the coils are turned, aiding or opposing coils are brought together, thus varying the inductance.



1. Mount the five tube sockets on the base board, with the terminals in the positions shown. The picture wiring diagram, Fig. 5, is exactly one-fourth scale. By measuring on the drawing and multiplying by 4, the location of the sockets and other parts can be determined accurately. Mount the binding post strip on the baseboard. Mount the grid condenser and leak mounting on the baseboard. Put lugs on the terminals as you proceed. Have them point in the directions shown by the short heavy lines in the picture wiring diagram.

2. Connect 1 to 2, keeping the wire down near the baseboard but not touching

way around. Fasten the knobs so that the arrows appear on the left when the arms are turned all the way round to the left. Mount the filament switch, keeping the two binding posts in a horizontal line. Mount the three jacks in the positions shown in Fig. 5. The jack with the four lugs is mounted on the right hand side of the panel looking at the set from the rear. Next mount the two compensating condensers and put the dials on so that the fifty division marks on the dials coincide with the lines engraved on the panel when they are turned all the way to the left. Finally, mount the Telos variometer on the right

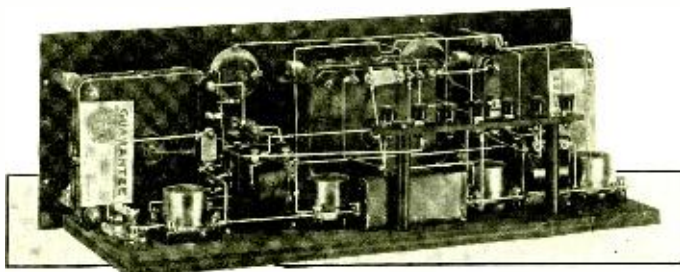


Fig. 4. Tiny fixed condensers mounted on the variometer and variotransformers furnish the capacities which, with their respective adjustable inductances, control the wavelength of the circuits.

it. Terminal 1 is the front F post on the middle socket. Connect 3 to 4. Terminal 4 is the G terminal on the left hand socket. Connect 5 to 6, to 7, to 8, to 9 using a single long piece of wire and soldering it to the lug at each connection. Put the 0.5 mfd. condenser in place so that it rests on the baseboard. Connect its lower terminal 10 to the A+ binding post 11 and to 12, which is on the wire from 7 to 8.

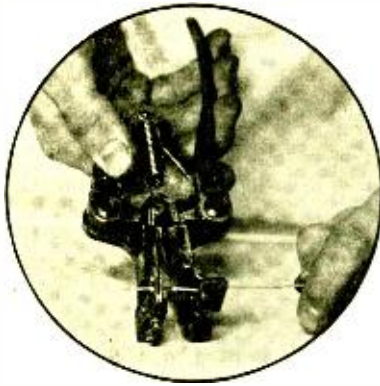
3. Fasten the lug on one end of the 0.00008 mfd. fixed condenser to the antenna binding post 13. Fasten two lugs on the other end with a short 6-32 screw and nut. Connect 14 to 15. 14 is one lug on the 0.00008 mfd. condenser.

4 Mount the three rheostats on the front panel, using the screws and nuts provided. Adjust the arms on the rheostats so they make firm contact with the wire all the

hand side, looking at the set from the rear, and the two variotransformers on the left, in the positions shown in Fig. 5.

5. Connect 16 to 17, and 5 to 18. 16 is the remaining terminal on the gridleak mounting, and 5, the lower right hand terminal on the socket on the extreme left. Connect 19 to 20. 19 is the G terminal on the middle socket. Connect 21 to 22. 21 is the P terminal on the second socket from the right. Connect 24 to 25 keeping the wire down near the baseboard. 24 is the P terminal on the middle socket. Connect 26 to 27, the left hand terminal of the rheostat on the extreme left. Connect 28 to 29, the two inside terminals on the rheostats. Connect 30 to 31. 31 is the front right hand terminal on the second socket from the left. Connect 32, the lower terminal on the left hand compensating con-

(Continued on page 364)



Tools for the Radio Shop

Describing some of the usual and unusual tools which are intended particularly for use in assembling radio apparatus

Various tool manufacturers have caught the radio idea and have designed some very clever and popular priced tools for the convenience of men who build their own equipment, and for production work in radio factories. Using the right tool for every job makes the building of the most intricate set a comparatively easy matter, making it possible to do a better job in less time than when makeshift equipment is employed.

The photograph above on the left, shows an insulation-stripper in action. The tool consists of two main parts, a sort of vise on the right hand side, which holds the wire, and a stripper on the left, which strips off the insulation without injuring the wire. When the two handles are pressed together, the jaws of the vise clamp the wire and the stripper moves out along the wire, cutting thru the insulation and pushing it off the wire. The tool has a gunmetal finish. Different holes in the stripper allow the choice of the right size to fit the wire, eliminating the possibility of cutting into the wire.

The photograph on the right shows a pair of Rance combination pliers in operation. These pliers perform the double duty of forming loops on wires and serving as cutting pliers. The cutting jaws are made of hardened steel to withstand rough usage. Each jaw carries a round steel pin on its end. For making loops, the end of the wire is held firmly between the pins and is then wrapped around one of them. One pin is for forming loops to fit over No. 6

machine screws and the other for No. 8 screws. The operation is so simple that anyone can make a perfect loop at the first attempt. The pliers are made by Kraeuter for the Rance Company.

Fig. 1 shows a special set of tools from the Smith and Hemenway Company. The first tool on the left is a radio screw-driver. This screw-driver is so constructed that the handle can not come loose from the blade. The tip is made thin enough to fit in the slots of very small screws; the shank is long enough to make it very easy to get at the out-of-the-way corners in a radio set. A ribbed handle is provided to give a good grip.

The next tool shown is a pair of round nose pliers, made with long jaws tapered down to close perfectly. Cutting jaws add to the usefulness of this tool. The handles are slightly knurled.

Then there is the pair of cutting pliers. These are made strong and husky to handle the heaviest work, with a close fitting box joint to keep the jaws in exact alignment.

On the right is a pair of adjustable pliers which can be used for removing or tightening nuts. They can be changed to take different sized nuts by merely sliding the bottom jaw so that the pin moves along the slot. The jaws are flattened so that they may be worked in tight corners.

In Fig. 2 at the left, is a Pawwood adjustable circle cutter. This is a tool which has long been sought for in radio work as it provides a simple means for cutting circles of any size in panels, without the

necessity of having a drill press. It is held in the ordinary brace and turned just like a drill. The drill makes a hole first and serves as a centering device or anchor while the cutting blade is in operation. One blade is for plain holes, the other for putting a bead around the hole.

The Nestor Bendright is a combination device for bending wires at any angle, and

is used in the ordinary hand brace. A $\frac{3}{16}$ in. hole must first be drilled in the panel for centering. The cutter is made in three sizes, $\frac{3}{4}$ -in. for peep holes, and 1-in. and $1\frac{1}{2}$ -in. for socket holes and bezels.

One of the most important tools in a radio factory or workshop is the soldering iron. A great many different types have been brought out during the last year,



Fig. 1. A special set of tools, from the Smith and Hemenway Company designed particularly for radio assembly and wiring. Every man who is familiar with tools will appreciate a screwdriver which does not come loose in the handle, pliers with firm grips and strong jaws, and cutters which close perfectly.

shaping eyelets in them. It has provisions for bending eyelets for No. 6 or No. 8 screws. The operation is very simple—the wire is held between a catch on the plate and one on the bending handle. As the handle is turned, the wire is bent around the pin to the angle desired.

many of which, particularly the low priced ones, are not suitable for this class of work. Because of the delicate nature of set wiring, the iron must, first of all, be so designed as to maintain the correct heat over a reasonable variation in line voltage. Cheaply built irons do not have this self-

Fig. 2. Pawood adjustable circle cutter, Nestor wire bending device, Clark and Tillson screw-driver with double-ended blade, and one of the Stevens panel cutters, all tools which have been brought out for the use of radio constructors and set builders.

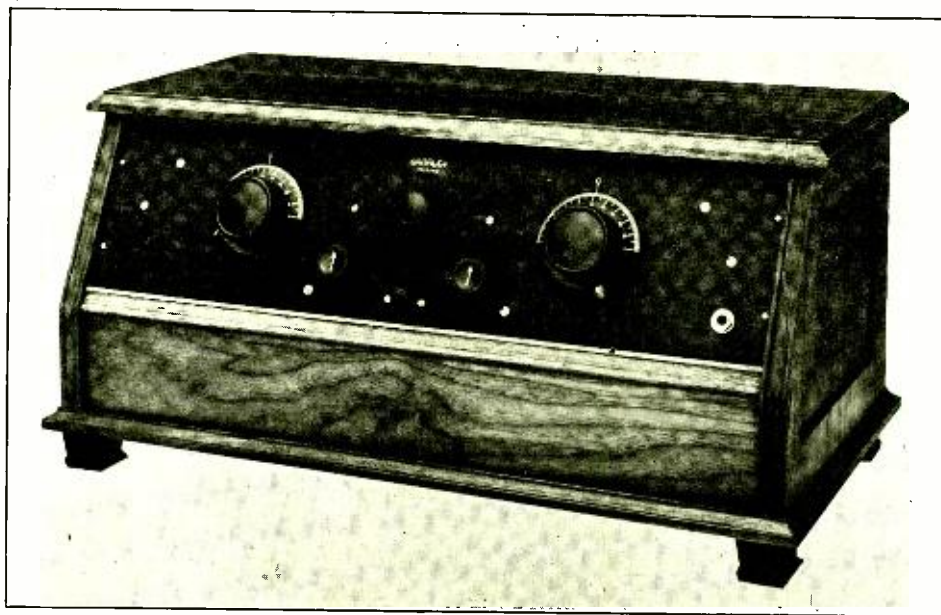


The Clark and Tilson screw-driver is a useful tool, particularly for adjusting set screws. The removable blade has two ends of different sizes, making it possible to use it on large or small screws. The body is knurled to provide a good grip, and the rounded knot at the top is made so that it rotates freely.

The Stevens panel cutter on the right is a very simple tool brought out to supply the need for a circle cutter for panels. It

regulating feature, and are as liable to be too hot or too cool as to be of the correct temperature.

Since the point must be small in order to get into difficult places, it has a tendency to burn out. Therefore, irons with screw-in tips are not recommended because, as a rule, by the time the point has been burned, it is usually impossible to unscrew it. Tips made of straight copper rods are to be preferred, for they are easy to renew.



The Crosley Trirdyn 3R3

A Popular Three-Tube Set Employing Tuned
R. F. Amplification, Regeneration, and Reflex

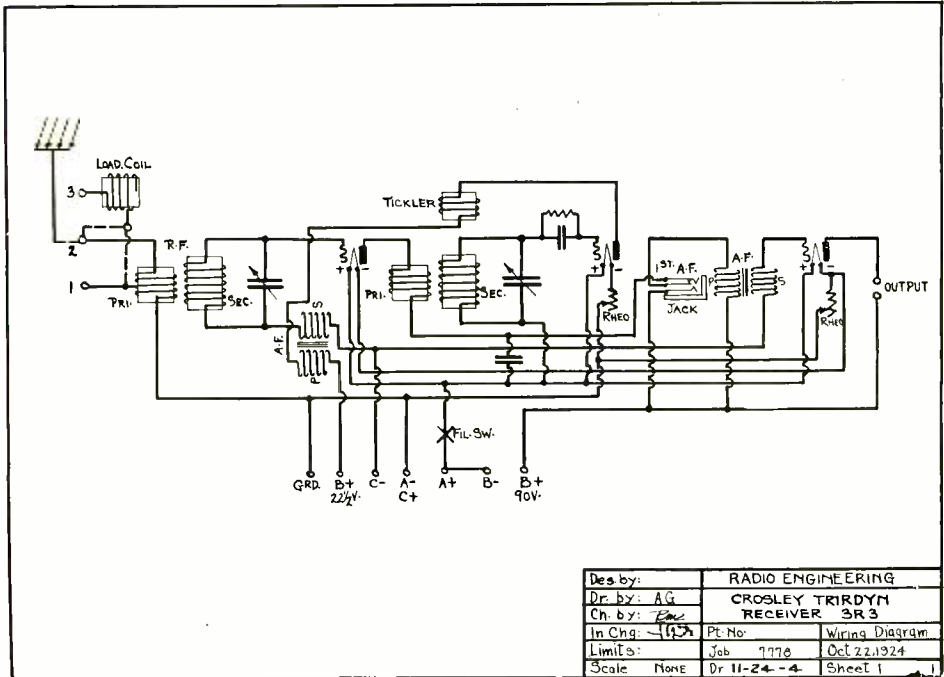
THE new Crosley Trirdyn represents a type of receiver which is fast becoming popular, combining as it does, one stage of tuned radio frequency amplification, regenerative detector of the non-radiating type, one stage of reflexed audio frequency on the R.F. tube, and one additional stage of straight audio on the third tube—all accomplished with only two controls. The set may be used either with an indoor or outdoor antenna, and is very selective.

Both the assembled set and an interior view are shown in the photographs. The controls on the front panel are grouped symmetrically. The two large dials are for tuning. The center top knob is for adjusting the tickler. The lower center knob is for the filament switch and the other two are for the rheostats. Jacks are provided for plugging in at medium and full volume. The set is constructed ruggedly and is interesting as an example of what can be done toward simplicity of wiring by proper arrangement of parts.

All of the inductances are of spiderweb design. A unique method is employed for supporting the sockets, antenna inductance coil, and binding posts. Mounting the two

A.F. transformers on the front panel makes it possible to employ a very narrow mounting strip for the tube sockets. Each socket is fastened to the strip by two screws, this making assembling simple. This leaves an open space between the tube panel and the front panel, so it is easy to get at the instruments on the front panel for wiring.

The antenna circuit is of the aperiodic or untuned type and makes simplified tuning possible. Taps 1 and 2 are provided on the antenna coil so that different degrees of sharpness of tuning can be obtained. For general tuning the antenna is connected to post No. 2. This puts the full primary in the circuit and gives maximum signal strength. For sharp tuning it is connected to post No. 1. For still greater selectivity, a tapped loading coil is provided. This can be connected either to post No. 1 or post No. 2, on the antenna coil, depending on the selectivity desired. The first stage of radio frequency amplification is tuned by the condenser on the left of the panel. Regeneration is accomplished by means of a tickler coil which is pushed in and out by the upper knob between the condenser dials, thus changing its coupling with the grid coil. A feature of this set, which is



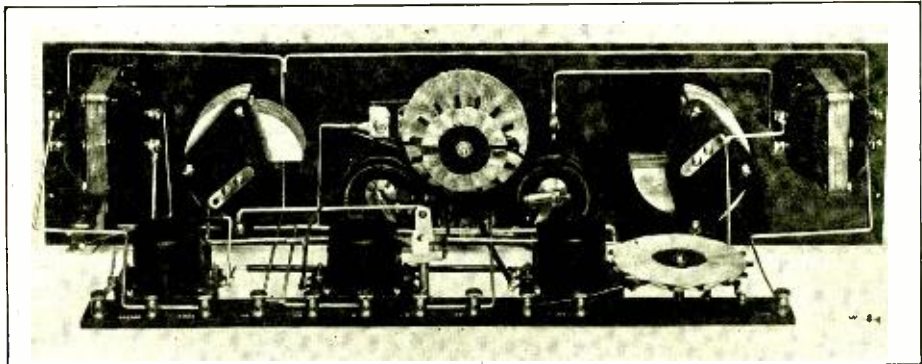
Schematic wiring diagram, showing the connections of the instruments in the Crosley Trirdyn.

important in these days of howling sets and interference, is the fact that it does not radiate when receiving. The antenna is very loosely coupled to the secondary circuit, and a non-oscillating radio frequency amplifier is employed before the regenerative detector as a barrier to prevent oscillations generated by the detector from feeding back to the antenna. The condenser at the right tunes the grid circuit of the detector tube.

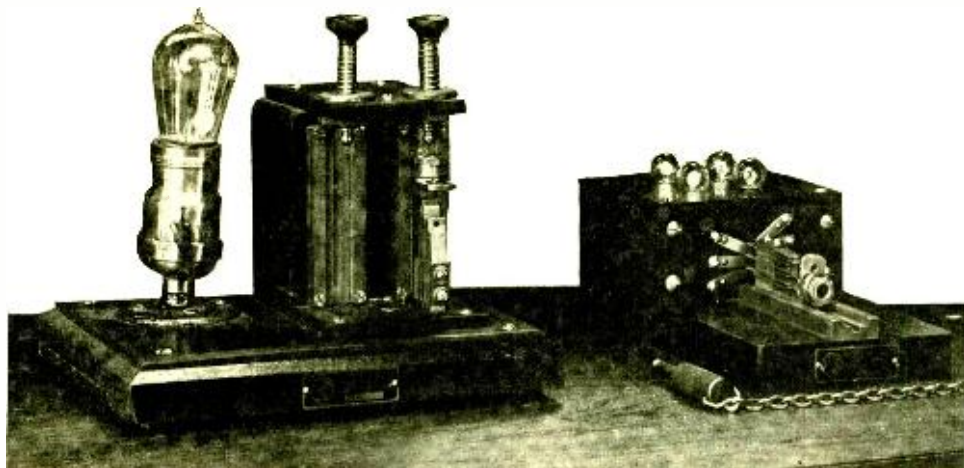
The jack arrangement employed, though not entirely new, has many points in its

favor. A jack is provided in the first A.F. stage, for plugging in the phones when tuning. The loud speaker is permanently connected to the output terminals of the second A.F. tube at the rear of the set. With this arrangement, when the station has been tuned in and the phone plug removed, the loud speaker is automatically connected in on the second stage. This eliminates one plugging operation and makes the use of only one plug necessary.

The filament control switch near the
(Concluded on page 362)



A rear view of the set. Many improvements and refinements are represented in this new type receiver.



A High Speed Method for Inspecting Telephone Jacks

The accuracy of the testing and inspecting is greatly increased by using lamps to give visual indication of open circuits for faulty insulation

HOW are my jacks? Are the contacts clean? Do the springs function properly? Are there any short circuits between the parts? These are the questions every set builder must answer for himself before the set he builds will operate satisfactory. A jack is a small thing but it can cause a lot of trouble in a set if it is defective.

Manufacturers are beginning to realize that the experimenters who buy parts, and the manufacturers of complete sets which use standard parts, demand that every unit purchased be absolutely dependable. No matter how thorough the shop supervision may be, there are always some defective parts which manage to slip thru, yet it is just as unfair to expect the purchaser of a radio part to test it before using it as it is to expect the purchaser of a new automobile to spend extra time and money to test a car for mechanical defects. When a man pays money for something closed up in a box he takes it for granted that the contents of the box has been tested and is in perfect working condition. He cannot rightfully be expected to think otherwise.

Mr. Wright, of the Pacent Electric Company, has devised a very ingenious test-

ing machine, which answers all of the above questions for every jack before it leaves the factory. This is an example of the growing tendency among radio manufacturers toward rigorous inspection and testing in the factories to insure the production of products which are uniform in quality. In fact, this is a phase in the development of the industry to be expected as a result of real quantity production on staple designs.

One of the machines in which Pacent jacks are tested for correct functioning of the springs is shown above. It consists of two steel guide blocks between which the jack is inserted in the position shown. Back of these blocks are springs which make contact with the individual lugs on the jack when it is pushed up against them. These springs are connected with the small incandescent lamps, and a 6-volt source of current in such a way that the exact operation of the jack when used in a radio set is duplicated, and the results made visible by the lamps. The tester at the right of the photograph, wired according to the diagram in Fig. 1, is designed for testing filament control jacks.

The testing operation is as follows: The

jack is slid in between the guide blocks and pushed back so that the lugs on the jack make contact with their respective springs on the tester. This lights white lamps 1, 2, and 3, as may be seen from the wiring diagram, indicating that the contacts are properly closed. Then a plug made of a solid piece of steel is inserted in the jack. White lamps 1, 2, and 3 now go out, and red lamp 4 lights up if the top contact is all right. This completes

ing jacks which have a lug connected to the frame. The mercury cup is so constructed on this side, that the frame lug does not dip into the mercury but fits into a pocket in the fibre back of the mercury, thus prevent contact between the mercury and this lug.

The testing operations are as follows: The jack is placed with its frame resting against and making contact with the guide block, the lugs dipping into the mercury.

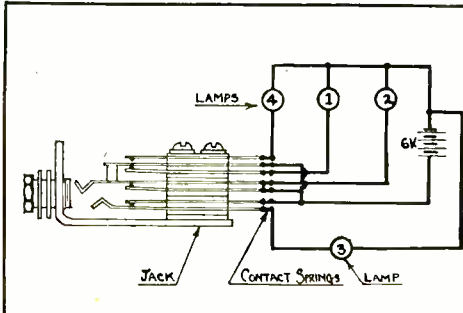


Fig. 1.

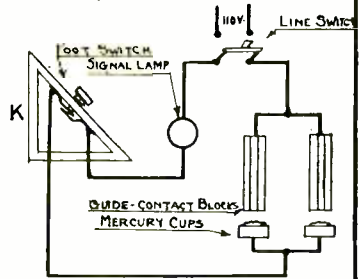


Fig. 2.

Des. by: J.W.	RADIO ENGINEERING	
Dr. by: A.G.	PATENT JACK TESTER	
Ch. by:		
In Chg:	Pt. No:	Wiring Diagrams
Limits:	Job: 7778	Oct. 1, 1924
Scale: No Scale	Dr: 10-3	Sheet:

Fig. 1, Left. Circuit for testing device which shows when contacts fail to close. Fig. 2, Right. Foot-controlled test for short circuits or faulty insulation.

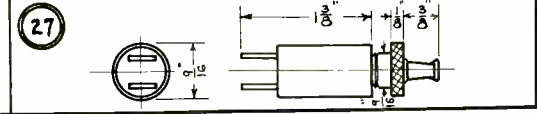
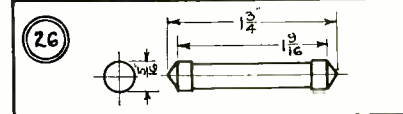
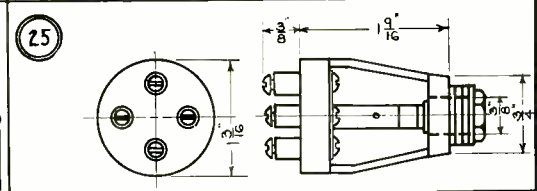
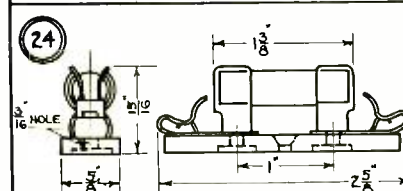
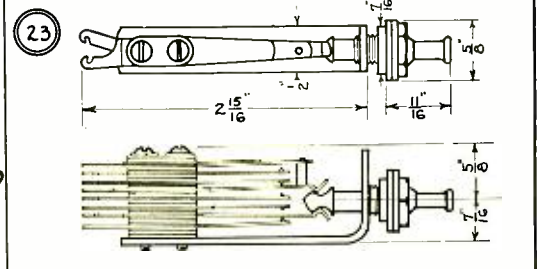
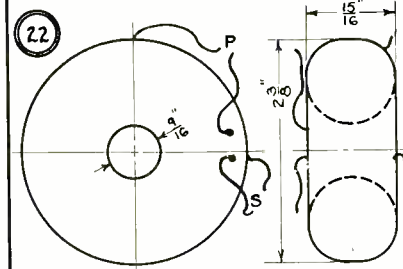
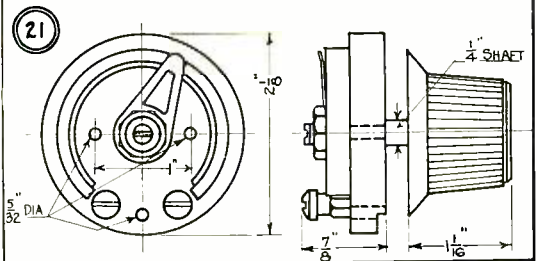
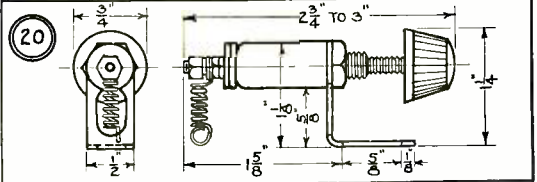
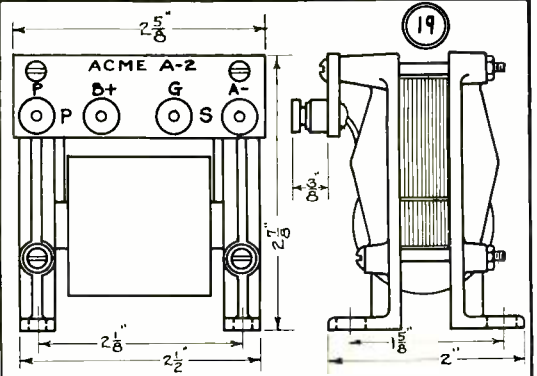
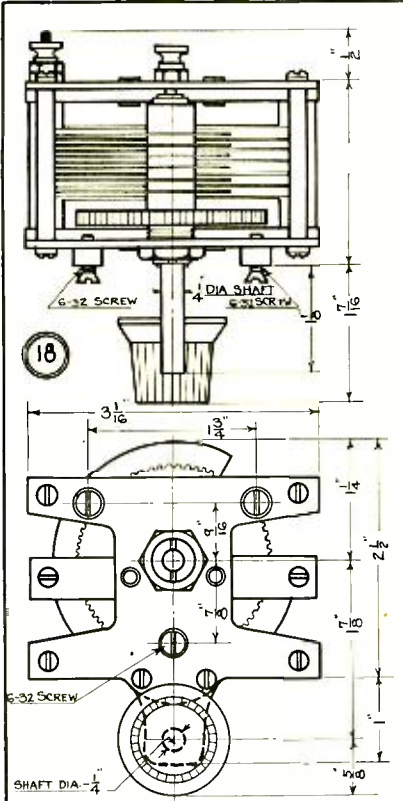
the operation test. By making the diameter of the plug of proper size, the diameter of the bushing hole in the jack is also checked in this operation.

Following out this scheme, testers for any type of jacks may be easily constructed by arranging the contact springs and the connections. In actual practice a separate machine is used for testing each type of jack.

If the jack has passed the first test satisfactorily, it is next tested for insulation between springs and frame on 110 volts. This is performed in the machine shown at the left of the photograph. This one machine tests all types of jacks. It is made up of a vertical steel guide block which makes contact with the frame of the jack, a cup of mercury into which all the lugs of the jack dip, an insulated plunger to hold the jack in position, signal lamp, and foot switch, shown in Fig. 2. The right-hand side of the machine is used for testing jacks which have no lug connected to the frame. The left-hand side is used for test-

Then the plunger is pressed down to hold the jack firmly in position. The foot switch is then closed and the signal lamp watched. If the lamp lights it shows that there is a short circuit between the frame and springs of the jack or insulation weak enough to break down on 110 volts. The foot switch is used so that the current is put on only after the jack has been finally clamped into place. This protects the operator from getting a shock by putting his hand across 110 volts while inserting or removing the jack from the machine.

These machines are built ruggedly with nothing to get out of order, and the testing operations are simple and rapid. It is very encouraging to see manufacturers devising tests like these to insure uniform quality of their products, for, after all, the place for tests on radio parts whether they be jacks, condensers, or transformers, is in the manufacturer's own plant, before the material is shipped out, and it is only thru such procedure that the products of any manufacture can be uniformly right.



Data Sheet No. 3

18. Veldar Vernier Condenser: This condenser is made in two capacities, 0.00025 mfd. and 0.0005 mfd. Dimensions are given for the parts which do not change in the different sizes. The dimension purposely omitted in the drawing, i.e., the distance from the rear of the panel when mounted, to the rear face of the rear end plate, is $2\frac{1}{4}$ ins. for the 0.00025 mfd., and $2\frac{1}{2}$ ins. for the 0.0005 mfd.

19. Acme A.F. Transformer: This drawing shows the overall dimensions and arrangement of the terminals and mounting holes for the Acme A-2 A.F. transformer. The turn ratio is 4.25 to 1. This transformer is not shielded.

20. Electrad Audiohm: The audiohm is made with a leg which is to be fastened directly to one of the secondary binding posts of the A.F. transformer, on which it is used. The spring is connected to the other terminal, this construction taking care of the difference in size and design of A.F. transformers now on the market.

21. Amsco Rheostat: These rheostats are made in sizes of 2, 6, 8, 10, 12, 15, 20, 30, and 50 ohms. The dimensions given are the same for all types. Two mounting screws are provided.

22. Torroidal Coils: These coils are made for antenna coupling and for radio frequency units. The dimensions given apply to all types. The coils are doughnut shaped and have flexible leads for connection.

23. Saturn Battery Switch: This item comprises a battery switch made in jack form for panel mounting. The parts showing at the front of the panel are finished in polished nickel.

24. Rusonite Fixed Crystal Detector: The crystal and contact are sealed in a tube. Fahnestock clips are provided for connection and the entire unit is mounted on a hard rubber base.

25. Cico Jack: The jack springs are enclosed by a bakelite frame to keep out dust. The overall dimensions are quite small. Binding posts are provided for connection. Silver contacts are used on the springs.

26. Gotham Gridleak: These gridleaks are made in the usual resistance rating. The glass cartridges in which they are enclosed are all of the same size.

27. Walbert Filament Lock Switch: This is a compact filament switch provided with a key which may be removed when the set is not in operation. Only one hole is needed for mounting and the parts showing on the panel are nicked and polished. Soldering tabs are provided for connection.

NOTE: The drawings on the opposite page are of exactly one-half scale so that dimensions not given can be readily scaled off.

Each month there will be described on these pages new products of particular merit and standard items which are very widely used in various kinds of equipment. With this data available, experimenters and designers can determine without delay whether or not parts they want to use will fit into equipment which they are planning, without waiting to actually buy the parts and take off the dimensions.

This information will be found of great value and it is suggested that the data sheets be torn out from the magazine or the issues kept so that the working data will be available at all times.

Full size blue prints of the drawings can be obtained from the blue print department of Radio Engineering at a price of twenty-five cents each. It may be more convenient to work directly from the full size drawings rather than from those made at one-half scale. Moreover, the blue prints can be filed away for ready reference.

Eight-Tube Super-Heterodyne

Special oscillator and filter units are employed in this outfit, the appearance of which is particularly attractive in arrangement and design.

WHILE super-heterodyne sets are necessarily similar in general plan they vary as much in the carrying of details as they do in the results produced. Therefore, each outfit or different outfits made from the same plans depend for the results produced upon careful and intelligent planning and construction.

This receiver, using audio and intermediate frequency transformers, filter, and oscillator unit from the Radio Receptor Company, is designed for operation on a loop altho jacks can be used in the detector and first A. F. amplifier to cut down the volume if the set is connected to an antenna and ground.

In addition to the Radio Receptor equipment already mentioned, a Formica panel 36 by 8 ins., 3/16-in. thick, a terminal panel of the same thickness 8 1/2 by 11 1/2 ins., low-loss variable condensers of 0.001 and 0.0005 mfd., such as the Hammarlund, Malone-Lemmon, or General Instrument types, 8 Na-Ald sockets, three 10-ohm Amsco rheostats, two 6-ohm rheostats, and one 400 potentiometer, five 0.00025 Micadons, one 0.002 mfd., one 0.006 mfd., and two 1.0 mfd. by-pass condensers, Eveready 3 biasing battery, Pacent open circuit jack, Connecticut filament control switch, eight Eby binding posts, and two 1-megohm Daven gridleaks, complete the list of parts required.

In appearance, the oscillator coupling unit is very interesting. It consists of a bracket supporting a shaft on which two cross-wound coils are mounted. The strength of the oscillations is controlled by moving the smaller coil toward or away from the other. A similar arrangement is made for the tuned filter or input transformer. These coils, however, are wound with thread so as to bind them together solidly. Provision is made for mounting fixed condensers, across the primary and secondary, on the frame which supports the coils. Both intermediate and audio frequency transformers are similar in outward appearance, mounted in a shielded metal case with a top of insulating material which carries the binding posts. The terminals are marked with the same symbols that are given in the wiring diagram.

Always plan carefully for the assembly of a set, for so much trouble can be avoided by knowing just what you are going to do before you start doing it. The most satisfactory way, of course, is to make full-scale drawings of the front and base panels. That not only gives an accurate picture showing whether or not the parts will fit together but it can be used as a panel pattern by laying the drawing on the panel and marking through the paper with a center punch.

The wiring can be simplified considerably by mounting all the parts on the base panel and wiring them, making sure that nothing is put where it will be interfered with by the parts mounted on the front panel. The front panel should then be assembled and as much wiring done as possible. This much accomplished, the panels can be fastened together and the balance of the wiring done.

Of the various kinds of soldering paste in use Nokorode is generally accepted as being most satisfactory provided it is properly used. Any kind of flux spatters considerably when the heat is applied. Consequently the tiniest amount possible should be put on a joint and any excess removed after the soldering has been done by means of a fairly stiff brush dipped in alcohol.

Where soldering lugs are used, clamp five or six at a time in a hand vise and fill each lug with solder before you put it in place. That makes the work much easier when the wiring is put on and the joints can be made quickly so that very little heat is transmitted to the instruments themselves.

Rosin core solder is more satisfactory electrically, but unskilled workers do not get good results with it because they do not apply sufficient heat to let the solder flow on the joint. Using tinned wire and filling the lugs before they are put on to the instruments helps greatly. Care must be taken to avoid rosin joints, that is, connections where the rosin runs over the wire but the solder does not take hold because the connection has not been sufficiently heated. To those who have had experience with rosin core solder the Kester or Belden brands are recommended.

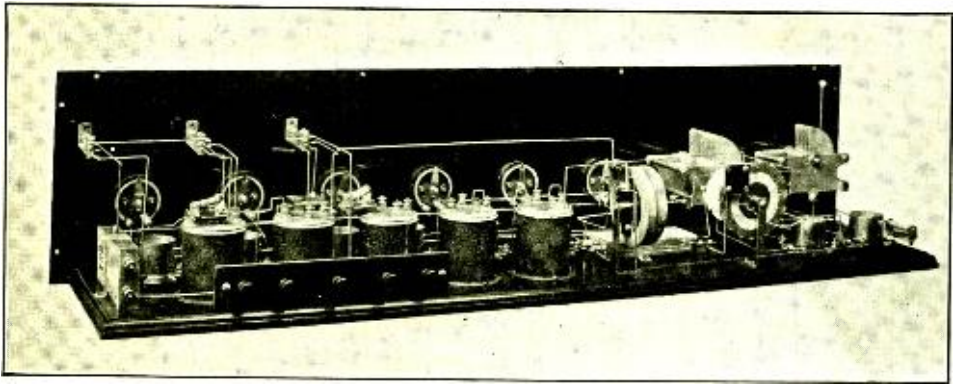
In the wiring diagram 0.00025 mfd. con-

condensers are shown across the primary and secondary of the filter or input coupler. Altho satisfactory results can be obtained with fixed condensers the use of two Grid-condensers is strongly recommended because they permit the adjustment of the filter to exactly the most efficient frequency of the intermediate amplifying transformers. The Grid-condensers can be placed on the rear of the front panel or on the base panel, mounted so that they can be reached easily when the preliminary adjustments are made at the time the set is first put in operation. It is not necessary to have the control knobs at the front since they need not be changed once they have been properly set.

You must watch out for the polarity of

range are equally distributed around the dial.

Some experimenters combine the use of a loop and an antenna and ground by winding three or four turns around the loop and connecting them to a short antenna and a water-pipe. If the antenna coil is of not more than three or four turns and the antenna less than 50 ft. long the tuning will not be made objectionably broad. At the same time the signals will be greatly increased in volume. Some of the directional effect of the loop is lost, of course, but that is not so important except in congested areas where interference cannot be cut out by adjusting the variable condensers alone.



Rear view of the Radio Receptor outfit showing the transformers and coil units.

the windings on the oscillator coil unit. The wiring diagram shows the three coils, A the moveable coupling coil, B the inside coil, and C the outside coil. The terminals are marked I for the inside or start of the windings, and O for the outside or end. If by any chance, you find that signals come in faintly but are not affected by the oscillator condenser, reverse the terminals of coil C. If the leads to the coils are wrong, the circuit will not oscillate and, in consequence, the outfit will not function correctly.

The loop tuning condenser for this set is of 0.0005 mfd., and a standard value, with which most commercial loops are designed to operate. If you make your own loop it will be necessary to experiment somewhat in order to determine the correct number of turns. The best way is to wind the loop first on a rough frame if it is of the box type, or on a piece of wall board, if it is of flat design. Then, when the set is in operation, you can take off turns until the settings for the broadcast wavelength

Because of the unusual efficiency of the super-heterodyne this type of receiver is frequently used for portable work or reception on small boats. Bear in mind when you construct a super-heterodyne for portable use that not only must the assembly be carried out in such a way as to assure the permanence of the mountings and connections, but the set must be adequately protected from moisture and dampness by a cabinet made as tight as possible. Equipment of this sort manufactured for use by the army and air service is frequently put in wooden boxes covered on the outside with canvas fastened to the wood with glue and well varnished on the outside. The same protection is necessary for the B batteries because the collection of moisture on the top of the batteries provides a leakage path through which current flows constantly, thus, decreasing the life of the batteries considerably. Precautions against this effect are particularly necessary when the installation is on or near the salt water.

A particularly convenient feature of the super-heterodyne type of receiver is that

Yesterday—an experiment Today— an accepted fact

ONLY yesterday it seems radio broadcasting was an experiment. Today it is an accepted fact, yet still a world's wonder.

Although radio as it is known and used today is only a few years old, it dates back to the invention of the 3-electrode vacuum tube by Dr. Lee De Forest. In 1906 that pioneer genius made modern radio broadcasting possible with his tube. This tube established his great reputation and must now be worthy to the full of the name it bears. And it is. Its un-

usual power to give the full depth and beauty of delicate sound is backed up by an ability to give continuously good, long service.

De Forest tubes are rigidly and regularly subjected, one by one, to three progressive inspections. Each is burned for many hours before leaving the factory. This regulation ensures the uniformly good condition of De Forest tubes, which great radio engineers have endorsed with enthusiasm. For experimental purposes there is not a better tube.



The DV-2 has a filament potential of 4½ volts and a filament consumption of 25/100 of an ampere.

There are two types, illustrated here—the DV-3 for dry batteries and the DV-2 for storage batteries. The DV-3 has an average mutual conductance of 460 micromhos; average amplification constant (or Mu) 6; plate impedance 13,000 ohms; a good radio and audio frequency amplifier and a good detector in standard regenerative circuits. It is remarkably non-microphonic. The DV-2 for storage batteries is made particularly for power amplifier work and is developed for all usual circuits. Conductance 720 micromhos; amplification constant (or Mu) 7.2; plate impedance 15,000 ohms.

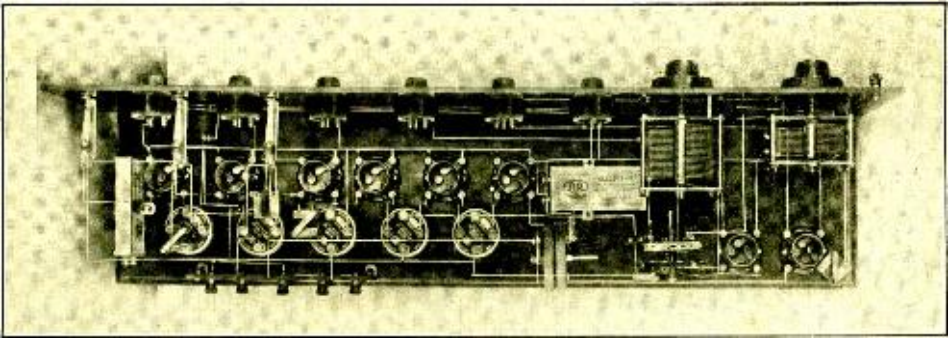
These tubes are sold by authorized dealers only and are made by the makers of the De Forest D-12 Radiophone, Loud Speaker and all Radio parts. De Forest Radio Company, Jersey City, N. J.



This tube, the DV-3, consumes a filament current of only 6/100 of an ampere. It operates at a filament potential of 3 volts.

DE FOREST TUBES

The "Magic Lamp" of Radio



A top view of the receiver illustrating the arrangement of the parts.

the controls can be calibrated for the different broadcasting stations. It must be remembered, however, that a change in the loop will alter the settings of the loop tuning condenser altho the oscillator condenser will not be affected.

This outfit is equipped with five rheostats so that separate adjustment can be obtained on the oscillator tube, each detector tube, the I. F. amplifiers, and the A. F. amplifiers. You must be careful in adjusting the filaments to go over each rheostat to make sure that the current is reduced as low as possible without affecting the strength of the signals. In this way the life of both A and B batteries can be greatly lengthened or shortened, according to the care or lack of care given to these controls.

It will be found that loop direction and loop tuning are not very critical, except for very distant stations, and are a help, rather than a difficulty in tuning.

After the loop has been adjusted to a station, it can be received at a number of points on the main condenser.

Obviously enough there is one pair of points, at the station's frequency, plus and minus the filter frequency, respectively, but the other pairs of points are due to harmonics of the station and the oscillator.

One of the points is usually strongest, and is selected for reception.

It seems to be best practice to reach all the points at which the longest wave stations are received, but a recent experimenter has obtained fine results using only a 23-plate condenser across the oscillator, working on the lower or intermediate harmonic points, receiving KYW, 536 meters, splendidly, in the city of New York, on a loop through the usual city dim of interference.

Selecting the best point or pair of points for a station, the loop adjustments being perfected, the station should be plotted on cross section paper.

If the wave lengths of a few stations are known, others may be pulled in with fair certainty, and the old ones always repeated

easily by using cross section sheets plotting each station, such as is supplied for notebooks, as follows:

At the wavelength of the station being received, count up and also down from zero, draw light horizontal lines with a fine pointed hard pencil.

At the best loop condenser setting draw a vertical line downward. These two will give a point showing the loop tuning for this station at any time.

At all the points on the oscillator condenser, at which you get the station, erect perpendiculars to get points on the upper line.

Repeat this for a few stations and it will soon be seen that the points run in pairs and are also on curves, which with a "straight line" condenser are almost straight, but usually are curved slightly.

It will usually be found that the lower pair of receiving points for a station will fit the curve at just half the wavelength, being due to the "second harmonic," and this will help in drawing in the curves.

When the curves are fairly well pointed up, a new station is received as follows:

1. Look up his wavelength and his operating time—reduced to your time.

2. Point the loop toward him and set the loop condenser as nearly as you can to his wavelength from the loop condenser curve.

3. Run the potentiometer back and forth close to the oscillating point, and move the oscillator condenser very slowly, by means of the gear, past one of the points where the station should come in according to its wavelength and the main condenser curve.

In New York, under very unfavorable conditions, with a small and imperfect loop, it is possible to tune into such stations as KFKX, Hastings, Nebraska, WOC, Davenport, and KDAF, Kansas City, without even having the set oscillate to find them. KFI is reported from Philadelphia using a one foot loop, and West Coast stations from a favorable part of New York City with a loop only.

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REMEMBER, IF YOU WANT YOUR STOCK CLERK TO FILL YOUR ORDERS ACCURATELY, THAT YOU MUST WRITE OUT YOUR ORDER CAREFULLY, GIVING TYPE NUMBERS, NAMES, AND PRICES.

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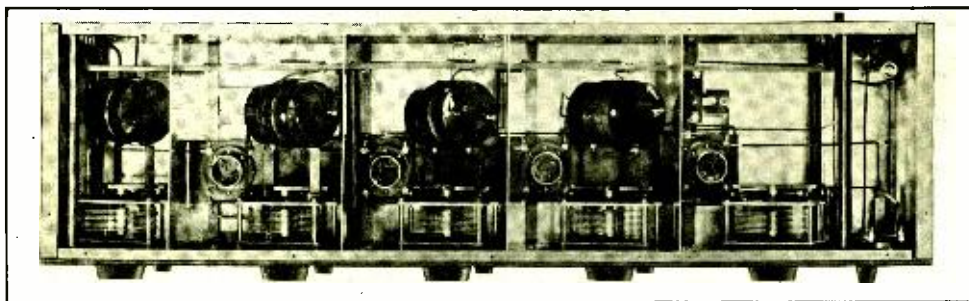
Get-It-to-Me Quickly Mail Service

And remember that DURRANT can send you your supplies more quickly than the manufacturer who makes them, for DURRANT carries in stock at all times the supplies called for in the Standard Parts Lists in Radio Engineering. If you are in New York, call at the DURRANT office

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C-52 Vanderbilt Avenue New York City

About the Manufacturers



A NEW book has been published by the Phenix Radio Corporation describing their type L-2 ultradyne receiver. The latest system represents a considerable improvement over the original model.

An attractive feature of the new line of rheostats brought out by the General Instrument Corporation is a stationary dial of molded bakelite, into which the controlling knobs fits so as to give the appearance of a solid knob and dial. Smooth action between the knob and dial are secured by using the same screws to hold the dial that keep the reostat itself in place. Adjustment for any thickness of panel is obtained by holding the shaft to the switch arm with a simple collar and split bearing.

The Walbert Manufacturing Company now has a special type of Uni-vernier made particularly for use by manufacturers of complete radio sets. The construction is extra sturdy and the finish particularly attractive.

The Cabot circuit set, on the development of which the Acme Apparatus Company has been working for many months, is now ready for production. There are several interesting operating features, aside from its high efficiency, which will appeal both to experimenters and to broadcast listeners who are only concerned with the actual use of the set.

Several new items have been added to the Erla line, including a phone plug, semi-fixed detector, variable condenser, and a series of rheostats and potentiometers.

A newcomer in the panel field is the B. F. Goodrich Rubber Company. They have published a booklet "Rubber for More Perfect Radio Reception" which can be obtained by addressing this concern at Akron, Ohio.

Another contender for panel business is the Fibroc Insulation Company, one of the Bakelite licensees, which, although it has been manufacturing Fibroc-Bakelite for

several years, has not actively solicited radio concerns.

It was interesting to discover recently that the General Radio Company, the first concern to specialize in the manufacture of condensers with soldered plates, employs Nokorode paste as a soldering flux for this work. The excess paste is removed, after the plates have been soldered, by dipping in boiling water.

After selling Amplion loud speakers through an American agent for the last few years, the Amplion Corporation of America has been formed to handle this product, originated by Edward Alfred Graham, an English inventor and scientist.

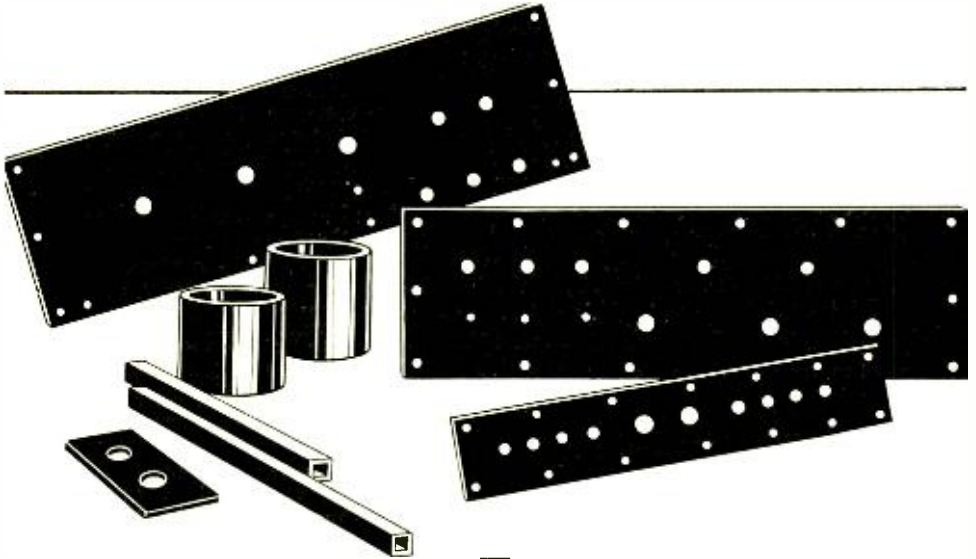
The Rauland Manufacturing Company is now distributing a very interesting book on radio set construction, in which the use of their various products is illustrated.

Although we have not had an opportunity to test them, it is in order to remark that the design of the Marshall-stat, made by the Marshall Electric Company, is most interesting in appearance, just the sort of instrument to fit into small places where large rheostats are not convenient to use.

No one can very well make mistakes if he follows the Richardson "self-evident" wiring diagrams furnished with their 9-tube super-heterodyne kit. The prints are pasted on the back of the front panel and the instruments assembled right over their pictures.

Stranded enameled antenna wire is now being made by the Belden Manufacturing Company. There may be some question as to the actual increase in efficiency through the use of enameled wire but the enamel does protect the copper against corrosion which inevitably starts as soon as the antenna is erected.

The set shown at the top of this page is a special 1,000 to 3,000-meter outfit developed by the Freed-Eismann Corporation for the Signal Corps. It is for communication between Washington and the Army posts.



Why is Formica the leading radio insulation?

THE demand for Formica for radio insulation has forced the building of the largest plant in the world for the production of laminated bakelite—and the only plant in the world devoted exclusively to this one product. This year 60,000 feet of floor space have been added to assure everyone prompt service.

This volume has been built up because Formica production under close laboratory control has provided the most uniform, best looking, and most easily worked material. It is used by 125 leading radio manufacturers who have tested all materials and know that Formica is best!

There are four beautiful finishes: Gloss black, dull black, walnut and mahogany. Formica will not sag under the weight of condensers and other instruments; it will not cold flow under the pressure of screws and binding posts; its insulating strength gets better with age.

It is being used by many manufacturers for front panels; base panels; terminal strips; transformer cases; condenser ends; for jack, head phone and loud speaker insulation.

Dealers: Formica advertising and sales promotion will be greater this year than before. No other product is so well known for quality.

THE FORMICA INSULATION COMPANY
4653 Spring Grove Avenue, Cincinnati, Ohio

Sales Offices

50 Church St., New York, N. Y.
422 First Ave., Pittsburgh, Pa.
1142 Granite Bldg., Rochester, N. Y.
419 Ohio Bldg., Toledo, Ohio
1210 Arch St., Philadelphia, Pa.
1026 Second Ave., S. Minneapolis, Minn.

585 Mission St., San Francisco, California
Whitney Central Bldg., New Orleans, La.
516 Caxton Bldg., Cleveland, Ohio
9 S. Clinton St., Chicago, Ill.
708 Title Bldg., Baltimore, Md.
47 King St., Toronto, Ontario

FORMICA

Made from Anhydrous Bakelite Resins
SHEETS TUBES RODS

Standardized Parts List

The materials used to make up the set described in this issue were supplied by the following companies. The manufacturers whose names appear below will be glad to send you bulletins describing other products which they make. Please mention RADIO ENGINEERING when you write them.

Type	Name	Price
	America Transformer Company, 173 Emmet St., Newark, N. J.	
AF-7	1-1-3½ ratio A. F. transformer	\$7.00
	Benjamin Electric Company, Chicago, Ill.	
	1-UV 199 socket.....	1.00
	3-standard base sockets....	3.00
	Brooklyn Metal Stamping Company, 718 Atlantic Ave., Brooklyn, N. Y.	
	1-Trijack telephone jack....	1.25
	Diamond State Fibre Co.	
	A-423 Broome St., New York City	
	1-Mahogany Celeron Panel, 7 x 24 x 3-16 in.....	3.94
	1-Mahogany Celeron panel, 3½ x 23 x 3-16 in.....	1.90
	H. H. Eby Mfg. Company, X-40 S. 7th St., Philadelphia, Pa.	
Ensign	7-Ensign binding posts.....	1.40
	Electrad, Inc.,	
	F-428 Broadway, New York, N. Y.	
	1-Audiohm Control	1.50
	General Instrument Corporation, 423-Q Broome St., New York, N. Y.	
40	1-20-ohm rheostat with dial	1.50
40	1-30-ohm rheostat with dial	1.50
	James Goldmark Company, E-83 Warren St., New York, N. Y.	
W	1-100 ft. coil of Wirit.....	.90
	Mitchell-Rand Mfg. Company, 18 F-Vesey St., New York, N. Y.	
7	1-Length special No. 7 tub- ing .....	.15

	National Company, Inc., Brookline St., Cambridge, Mass.	
	1-Antenna coil and con- denser with vernier dial	\$8.50
	1-R. F. transformer and condenser with vernier dial	11.75
	Mounting hardware for above	1.00
	New York Coil Co., 338 Pearl St., New York.	
	1-0.001 mfd. fixed condenser	.40
	1-0.00025 mfd. condenser with leak mounting.....	.45
	Pacent Electric Co., A-22 Park Pl., New York, N. Y.	
	1-Bal-con neutralizing con- denser .....	.35
	Radall Company, RE-320 W. 42nd St., New York, N. Y.	
UV-199	1-Ameriprite for UV-199.....	1.10
	Turn-it Radio Sales, Inc., 30 Church St., New York, N. Y.	
	1-Turn-it adjustable grid- leak	1.00
	Walbert Mfg. Co., A-931 Wrightwood Ave., Chicago, Ill.	
	1-Filament lock switch.....	.50
	MISCELLANEOUS PARTS	
	58 4-Pkgs. of 25 soldering lugs .....	.80
	185 1-Left hand nickeled angle bracket.....	.10
	14 1-Nickeled coil mount- ing pillar.....	.08
	151 4-Nickeled panel sup- ports	1.20
	62.1 Pkgs. of 10½-in. 6-32 F. H. nickeled screws....	.12
	63 4-Pkgs. of 10½-in. 6-32 F. H. nickeled screws....	.48
	49 3-Pkgs. of 10 6-32 nickeled nuts.....	.24
	Complete set of parts.....	\$53.11

Back Issues of Radio Engineering

If you have missed any issues of RADIO and MODEL ENGINEERING for this year, check over the following list and order those that you did not get so as to make your file complete.

January—Tuska Superdyne, 4-tube Monotrol, oscillating wavemeter..... 10c.

February—7-tube super-heterodyne set, Cockaday Receiver.

March-April—Portable tuned R. F. set using UV-199 tubes, Harkness circuit for Diode or crystal detector.

May—Improved Rasla reflex, the most successful 1-tube receiver ever built, 100-meter Sodian receiver.

June—Sodian reflex set using UV-201—A amplifier, the Bestone V-60, tuning filter for cutting out interference.

July—Resistance coupled amplifier, Tools for the radio model shop, Crystals that oscillate.

August—Construction of 4-tube No-Loss regenerative receiver, Description of the Boonton light four receiver, The R-A-R receiving circuit.

September—R-D-X maximum modulation 1-tube regenerative reflex receiver, Assembly of the Haynes tuner, Ware type T neutrodyne, Freshman Masterpiece receiver, Ultradyne type super-heterodyne receiver.

The price of these issues is 20 cents each. They will be sent promptly upon receipt of a check, money order, or stamps to cover the cost. Postage is prepaid.

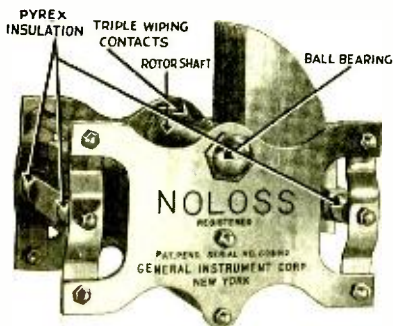
Made by the makers of Laboratory Equipment

NOLOSS

TRADE MARK

TYPE 51

PYREX INSULATION

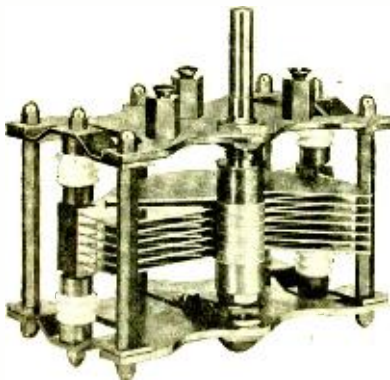


NOLOSS

TRADE MARK

TYPE 56

ISOLANTITE INSULATION



IT is now possible for the amateur to get results formerly reserved to laboratories.

The experimenter who requires every micro watt of energy to bring in heretofore inaudible signals must turn to General Instrument NOLOSS Variable Air Condensers.

They are constructed with laboratory methods, and insulated with laboratory insulations—Pyrex or Isolantite.

Products worthy of your purchase.

General Instrument apparatus costs a little more but is worth infinitely more.

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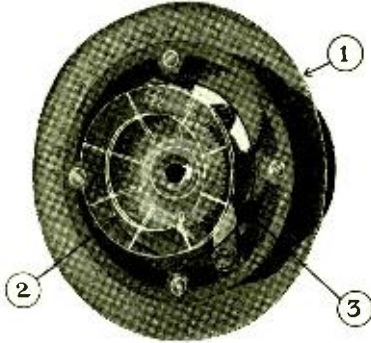
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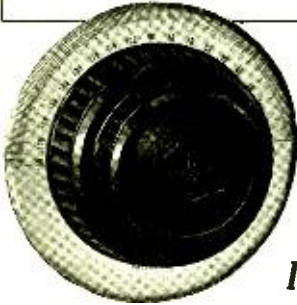
NEW YORK, U.S.A.

ACCURATUNE

MICROMETER CONTROLS



for close tuning



Geared
80-1
Ratio

Improved!

NO BACK LASH

No ordinary standards of tuning efficiency can be applied to the new improved Accuratune Micrometer Control.

Special construction of this new model offers these superior advantages:

1. Beautiful silvered etched metal disks, making a pleasing contrast between bakelite panel and dial, with finer graduations for finer tuning.
2. Eliminates all back lash—Gears and gear operation designed upon scientific engineering principles, producing quiet operation, eliminating all lost motion and back lash. The greatest advance in tuning devices. Increases the tuning efficiency over that of any known tuning device.
3. Flush Panel Mounting—Take all standard condenser shaft lengths and fit flush with panel. Eliminates the necessity of cutting off shafts before mounting dial.

Accuratune Micrometer Controls fit all standard shafts and mount to always operate parallel with panel.

Accuratune Micrometer Controls log station after station you never tuned in before. Indispensable on all Super-Heterodynes. Price, \$3.50. At your dealers, otherwise send purchase price and you will be supplied postpaid.

ACCURATUNE

80-1

MICROMETER CONTROLS

THE MYDAR RADIO CO.

9-E Campbell Street, Newark, N. J.

Canadian Representative: Radio Ltd., Montreal.

THE CROSLY TRIRDYN

(Continued from page 347)

lower edge of the panel at the center, is used to turn the tubes on and off and enables the operator to keep the filament rheostats set at the best operation position. There is one rheostat for the detector tube and one for the two amplifier tubes. The arrows on the rheostat knobs enable one to tell at a glance whether the rheostats are on or off without turning them to find out. The rheostats themselves present a departure from ordinary practice. The set is designed for use with either standard or dry-cell tubes and the rheostats are of the universal type known as Multistats. These permit operation on either type of tube. The contact arms of the rheostats are not of the usual blade type but consist of a cylindrical rod with a spring plunger which makes contact with the inside face of the resistance wire.

The binding posts in this set are not all grouped in one place as is the case on most other sets, but are separated and located in the positions which lend to simplified wiring and elimination of long leads. A 22½ volt B battery post is provided for supplying the best operating voltage to the plate of the detector tube, so that it is worked at its most efficient plate voltage.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF RADIO ENGINEERING.

Published monthly at New York, N. Y., for October 1, 1921.

State of New York } ss.
County of New York }

Before me, a Notary in and for the State and county aforesaid, personally appeared Francis A. Skelton, who, having been duly sworn according to law, deposes and says that he is the Business Manager of RADIO ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24th, 1912, embodied in section 443, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, M. B. Sleeper, Inc., 52 Vanderbilt Avenue, New York; Editor, M. B. Sleeper, Darien, Conn.; Managing Editor, Francis A. Skelton, 52 Vanderbilt Avenue, New York; Business Manager, Francis A. Skelton, 52 Vanderbilt Avenue, New York. 2. That the owner is M. B. Sleeper, Inc., whose stockholders are: Annie F. Sleeper, Darien, Connecticut, and Mae G. Murray, Halstead Ave., Harrison, N. Y. 3. That the known bondholders, mortgages, and other security holders owning or holding 1% or more of the total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of this company but also, in cases where a stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) Francis A. Skelton, Business Manager
Sworn to and subscribed before me this 31st day of October, 1921.

(Seal) F. N. BUNGER, Notary Public
Westchester County.

New York Co. Clerk's No. 852-A.
New York Co. Register's No. 4651.
Commission expires March 30th, 1926.

Special

One year's subscription or extension to *Radio Engineering*, \$2.00, and a set of six full-size blue prints \$1.50, for the Browning-Drake Receiver, including panel, panel patterns, at the combination price of

\$2.00

BLUEPRINTS for RADIO SET BUILDERS

ONE-TUBE SETS

3 CIRCUIT REGENERATIVE RECEIVER, the famous X-1900 type, sharply tuned and very sensitive. 150 to 600 meters. Type X-1900, 3 sheets 75c.

REINARTZ RECEIVER, one of the most popular models ever described in *Radio Engineering*. A splendid set for all around broadcast work. Type 3300, 4 sheets.. \$1.00

ONE-TUBE REFLEX RECEIVER, using an Aeme R-2 transformer and a crystal detector, Type 4200, 3 sheets 75c.

TC CIRCUIT SET, a 2-control regenerative receiver exceptionally sharp and sensitive. Particularly adapted for indoor antennas. Type X-4000, 3 sheets..... 75c.

IMPROVED RASLA REFLEX, unusually attractive in design as well as in the results produced. This set is also intended for a small antenna. Type 5900, 3 sheets..... 75c.

HAYNES TUNER, known as the "One Thousand Miled for Fifteen Dollars" set. 2 sheets..... 50c.

R-D-X REFLEX, brings in local stations on a loud speaker and distant stations with surprising volume. Type 6400, 3 sheets..... 75c.

TWO-TUBE SETS

TUNED RADIO REFLEX, using fixed couplers tuned by variable condensers for maximum amplification. Type 5100, 3 sheets..... 75c.

NO-LOSS REGENERATIVE RECEIVER, with condenser control for feed back. Equipped with 1-step AF amplifier. Type 6300, 3 sheets 75c.

FOUR-TUBE SETS

DX RECEIVER, because of its high efficiency, owing to the use of tuned RF, this is one of the most popular sets ever described in *Radio Engineering*, Type 5300, 6 sheets. \$1.50

PORTABLE TUNED RF RECEIVER, similar in design to the Type 5300 set, but very compact and built for UV-199 tubes. Type 5800, 3 sheets 75c.

4-TUBE REFLEX, with the standard Aeme circuit in an improved design. Can be used with the Run-A-Radio battery substitute. Type 6500, 5 sheets \$1.25

AMPLIFIERS

2-STEP AF AMPLIFIER, designed for use with any type of receiving set where additional amplification is required. Type 3100, 3 sheets 75c.

4-TUBE AMPLIFIER, with one stage of transformer coupling and three stages of resistance coupling. Gives tremendous undistorted amplification. Type 6200, 3 sheets. 75c.

HAYNES AMPLIFIER, two stages AF. Can be used with any set, although it is designed particularly for the Haynes tuner, 2 sheets. 50c.

DEPENDABLE DESIGNS for RADIO SETS

M. B. SLEEPER, Inc. Technical Publisher

A-52 Vanderbilt Avenue

New York City

THE MELCO RECEIVER

(Continued from page 342)

denser, to 33, and 34, the left hand screw, to 28.

6. Mount the Amertran A. F. transformer with the terminals in the positions shown. Connect 35, the lug on the G terminal of this transformer, to 36. Connect 37 the B+ terminal, to 38, the lower lug on the detector jack. Connect 39, the P terminal, to 40, the middle lug on this jack. Connect 41, the P terminal on the left hand socket, to 42, the upper lug on the detector jack.

7. Spread out the soldering tabs on the 0.005 mfd. condenser and solder the tip of one of them to 29, and the tip of the other to the wire running from 42 to 41. 42 is the upper lug on the detector jack and 29 is the left hand terminal of the rheostat on the right. Connect 37, the B+ terminal of the transformer, to 43, the right hand B+ binding post. Connect 44 to 45. 44 is the lower lug on the upper or audio amplifier jack. Connect 46 to 47. 46 is the upper lug on this jack and 47 is the P terminal of the second socket from the left. Connect 48, the F terminal on the transformer to 49. 49 is on the wire from 34 to 28. In making this connection, put a small loop in the end of wire 48 to 49, so that it can be hooked around wire 34 to 28 to give a good strong joint. All connections of this kind should be made in that way. Connect 50 to 51. 51 is on wire 48 to 49 and 50 is the upper right hand nut on variotransformer T-3.

8. Connect 52 to 53. 52 and 53 are the upper ears on the frames of the compensating condensers. Connect 54, a point on this wire, to 55. Connect 56, the right hand screw on the compensator, to 57. Connect 58 to 59. 58 is the right hand terminal on variotransformer T-2 and 59 is the lower lug on the compensator. Connect 60 to 61. 60 is the left hand terminal on the rheostat and 61 is a connection to wire 1 to 2. Connect 53, the upper ear on the frame of compensator No. 1 to 62, the right hand binding post on the filament switch. Connect 63, the left hand post to 64 on the variometer. Connect the other lug on 64 to the grid binding post 65. Connect 66 to 67. These are terminals on variotransformer T-2 and the variometer. Connect 68 to 69. 68 is a connection on wire 30 to 31, and 69 is the second lug from the right on the vol. jack. Make a bend in the wire where it crosses wire 54 to 55 so as to clear it. Connect 70, the right hand lug on the jack, to 71, the F terminal on the right hand socket. Connect 72 to 73. 72 is the second lug from the left on the jack

(Continued on page 366)

27 New Ones

How FIL-KO-LEAK Improves Reception

On a Neutrodine set at Harrisburg, Pa. equipped with Fil-Ko-Stats (Scientifically Correct Radio Rheostats) a Fil-Ko-Leak was added. This set had a ready "logged" 150 stations from the Atlantic to the Pacific. Previously it had a fixed one meg. leak. With the calibrated Fil-Ko-Leak, in two nights 27 new stations—never heard before—were added at the following readings in megohms.

WFAA	...	Dallas, Texas	...	.5
WMBH	...	Cincinnati, Ohio	...	2 1/4
WMBH	...	Atlanta, Ga.	...	.5
WSB	...	Chicago, Ill.	...	.2
WSB	...	Chicago, Ill.	...	.2
WGN	...	Cincinnati, Ohio	...	1
WWSA	...	Cincinnati, Ohio	...	1 1/2
WIG	...	Kansas City, Mo.	...	3
WJW	...	Cincinnati, Ohio	...	3 1/4
WLD	...	St. Louis, Mo.	...	4 1/4
WHD	...	Zion, Ill.	...	5
WTAS	...	Evansport, Iowa	...	5 1/2
WOC	...	Oakland, Calif.	...	5
KGO	...	Los Angeles, Cal.	...	2 1/4
KFI	...	Philadelphia, Pa.	...	1 1/2
WBAK	...	Dartmouth, Mass.	...	1 1/2
WMAZ	...	Springfield, Mass.	...	1
WBAF	...	New York	...	1
WBAF	...	Philadelphia, Pa.	...	1
WOO	...	Newark, N.J.	...	3 1/2
WOR	...	Detroit, Mich.	...	1
WMA	...	Cleveland, Ohio	...	2
WOS	...	Jefferson City, Mo.	...	2
WOS	...	Oak Park, Ill.	...	3/4
WTAK	...	Pittsburgh, Pa.	...	3/4
KDKA	...	Chicago, Ill.	...	3/4
KYW	...	Worcester, Mass.	...	3/4
WPHH	...	Shenandoah, Iowa	...	3/4
KPNF	...	Chicago, Ill.	...	3/4
WJG	...	Kansas City, Mo.	...	1 1/2
WDAF	...	Cleveland, Ohio	...	1 1/2
WHK	...	Cleveland, Ohio	...	1 1/2

*Stations heard before very weakly.

\$2.00

In
Canada
\$2.75



Stations You Never Heard Before

YOU can "log" your FIL-KO-LEAK just as you do your other tuning units. You will get stations you never heard before. You will clear up distortion on nearby broadcasters and increase volume of weak, distant stations and get them with crystal clarity. You read FIL-KO-LEAK resistance in exact terms of the megohm through a peephole in the panel. (It's also equipped for baseboard mounting.) Resistance element is constant and accurate, and is not affected by atmospheric conditions, wear or jarring.

Every FIL-KO-LEAK is guaranteed to be perfect electrically and mechanically, and to be accurately calibrated over the operating range for all tubes (1/4 to 5 megohms). This calibration is doubly checked. Send 2c stamp to Dept. R E 1124 for literature on improved reception.

DX Instrument Co.
Harrisburg, Pa.

FIL-KO-LEAK

SCIENTIFICALLY CORRECT

INDIVIDUALLY CALIBRATED IN
MEG OHMS

Haynes-Griffin

250 W. 49th St.
New York

RADIO SERVICE, Inc.

41 W. 43rd St., New York City

MAIL ORDER DEPARTMENTS

111 S. Clark St.
Chicago



A. J. Haynes, Assoc. Inst. Radio Engineers, designer of the "Knock-out" Amplifier.

Mr. Haynes has prepared a complete booklet of instruction, which contains all necessary diagrams and photographs. This booklet on the "Knock-out" Amplifier is furnished free upon request.

Parts Required for the "Knock-out" Amplifier

1	10 ohm rheostat.....	75c.
1	20.....	75c.
3	Haynes-Griffin panel mounting sockets.....	\$1.00
1	Haynes-Griffin audio frequency transformer—Type 91.....	5.50
2	Daven Resisto Couplers.....	1.25
4	Daven Coupling Resistors as specified.....	50c.
2	.006 mfd. Micadon Condensers.....	75c.
1	.00025 mfd. Micadon Condenser.....	35c.
1	Haynes-Griffin Single open circuit jack.....	60c.
1	Haynes-Griffin Double circuit jack.....	80c.
6	Binding Posts.....	20c.
	All necessary nail washers, bus-bar wire, etc.....	80c.
1	7 x 10 Bakelite panel—drilled and engraved.....	\$3.00

All of the above listed parts furnished at a combination price of \$20.00 per set. 7 x 10 Mahogany cabinet—\$3.25 extra. "Knock-Out" Amplifiers also furnished completely assembled in mahogany cabinet ready for use at \$35.00 each.

Prompt shipment made by our Mail Order Departments from either our New York or Chicago stores on any of the above items. Order directly from this list.

HAYNES-GRIFFIN RADIO SERVICE, Inc.

250 W. 49th Street, N. Y. City
111 S. Clark Street, Chicago

A "Knock-out" Amplifier

Audio Frequency and Resistance Coupled Amplification combined in one ideal circuit

Here at last is a real amplifier providing absolutely distortionless loud speaker reproduction.

One stage of audio frequency for volume and two stages of resistance coupled amplification to eliminate the last trace of distortion.

The new "Knock-out" Amplifier makes your loud speaker a real musical instrument. Piano music sounds like a piano—every note played by a symphony orchestra is distinguishable.

Radio fans everywhere are demanding quality of tone reproduction above all else. Here is the final answer to the most troublesome problem in radio.

New Radio Publication ABSOLUTELY FREE

"Radio Dispatch" is a radical departure from all other radio catalogs because it is always up to the minute.

Every thirty days an entirely new issue of "Radio Dispatch" brings you details of the newest radio developments—what they are, why they are better, what they cost, and how to obtain them as quickly as though you lived next door to the largest radio stores.

"Radio Dispatch" is sent free every month to everyone interested in radio. No subscription, no obligation. Mail the coupon now to our nearest store.

Put my name on your mailing list for Radio Dispatch.

Send me a copy of Mr. Haynes' booklet on the "Knock-Out" Amplifier.

Name

Address

RE-11

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GRIFFIN,
RADIO
SERVICE, Inc.
250 W. 49th St.
New York City.
111 So. Clark St.
Chicago

THE MELCO RECEIVER

(Continued from page 364)

The Concentrated Cream of Three Years' Research!

FOR three full years the Telomonic principle of tuned R. F. has remained basically unchanged. It has thoroughly proven its efficiency, and experienced users call it "the most sensitive, and most perfectly stabilized set on the market."

But while its basic goodness is still the same, developments and refinements have been added of vital interest to every true radio fan.

For now Telos gives you 3 stages of tuned R. F.—perfectly and automatically stabilized—with resistance-coupled A. F., *super-imposed* on the R. F. tubes. You can use 5, 6 or 7 tubes in countless variations—and run the whole thing on dry cells. And all the essential parts now come in the new Telos Kit!

But it's impossible to tell here one-tenth of the good things you can do with Telos. Use the coupon below for your copy of "The Kit of a thousand Possibilities."



Telos Radio

Danziger-Jones, Inc.
25 Waverly Place, Dept. R.,
New York, N. Y.

Send me at once your profusely illustrated folder—"The Kit of a Thousand Possibilities"—free!

Name

Address

and 73 is the P terminal on this same socket.

9. Mount the second A. F. transformer on the right hand side of the baseboard with the terminals arranged in the position shown.

10. Connect 74 to 75. 74 is the grid terminal on the transformer and 75 is the G terminal on the right hand socket. Connect 44 to 76. 44 is the lower lug on the audio amplifier jack where one wire has already been connected. 76 is the lug, which points down, on the B+ terminal of the A. F. transformer. Connect 77 to 78. 77 is the middle lug on this same jack and 78 is the P terminal on the A. F. transformer. Connect 79 to 80, also soldering this wire to 81. 79 is the left hand terminal on variotransformer T-2, 80 is the left hand B+ binding post, and 81 is a point on wire 44 to 76. Connect 82 to 83. 82 is the upper lug of the 0.5 mfd. condenser and 83 is a point on wire 80 to 81. Connect 62 to 84. 62 is the right hand binding post on the filament switch and 84 is the F— terminal on the A. F. transformer. Connect 85 to 86. 85 is on wire 66 to 67 and 86 is on wire 62 to 84. Connect 87 to 88. 87 is the left hand lug on the vol. jack and 88 is the lug which is turned upward on the B+ terminal of the A. F. transformer.

11. Connect 14 to 23. 14 is one lug on the 0.00008 mfd. condenser and 23 is one of the lugs on the upper terminal of the variometer. Connect the flexible lead on compensator No. 1 to the other lug at 23. Connect the flexible lead on compensator No. 2 to the remaining lug at 20 on variotransformer T-2.

This completes the wiring of the set. Testing When the set has been wired And go over each connection, Operating checking it against the picture wiring diagram. Connect a 6-volt A battery across the A+ and A— binding posts. The A+ terminal on a storage battery is usually painted red. Insert the five tubes in the sockets, pull out the knob on the filament switch, and turn the rheostat knob marked FIL 1-2 part way to the right. This should light the second and third tubes from the right, looking at the set from the rear. Repeating this with the rheostat knob marked FIL-3 should light the left hand tube. Turning the rheostat marked FIL-4 should light the two remaining tubes when the loud speaker is plugged in on the jack marked volume. Disconnect the A battery.

(Continued on page 368)

Music is Immortal

The earliest history of man was told to the strumming of primitive melody. His wars, defeats and triumphs are written in our symphonies today.

Music will outlive our present system of radio a hundred—a thousand years from now. But, until then, the *Resistance Coupled Amplifier*—the only system that does justice to the qualities that make music live—will be first among fans of discrimination.

Amplification truly without distortion—reproduction that is auditive perfect—is the distinctive achievement of the *Daven Super Amplifier* illustrated below.

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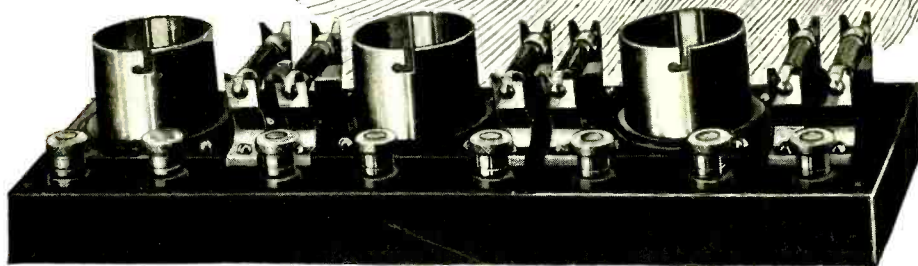
Without sockets and condensers	
3-Stage	\$8.00
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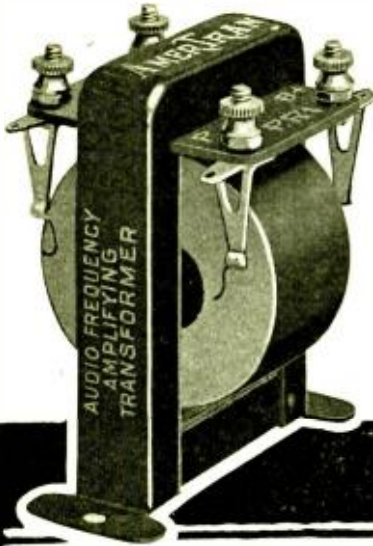
(Continued from page 366)

Now, to test the B battery circuit, leave the rheostat and filament switches in the last position and connect the positive terminal of the A battery to either of the B+ binding posts, keeping the small jumper between the two posts closed, and connect the negative terminal to the B— binding post. If the set is wired correctly, none of the tubes should light.

To put the set into operation connect the aerial to the ANT post and the ground to the GRD post. Connect the positive terminal of the A battery to the A+ post and the negative terminal to the A— post. Connect the negative terminal of the B battery to the B— post. If the same voltage is to be used on both the detector and amplifier plates, close the jumper between the two B+ posts and connect the B+ terminal of the 90-volt B battery to either of the posts. If different plate voltages are to be used on the detector and amplifier tubes, open the pivoted jumper and connect the +90V terminal of the B battery to the left hand B+ post, and the +45V tap on to the right hand B+ post.

Pull out the knob of the filament switch, turn rheostats FIL 1-2 and FIL 3, three-fourths to the right and plug the phones into the jack marked DET. The loud speaker may be plugged into the jack marked AUDIO AMP at the same time and it can be operated by merely removing the phone plug from the DET jack, provided rheostat FIL-4 is turned on. Adjust dials C-1 and C-2 until oscillations as evidenced by a whistling sound, disappear. Set dials T-1 and T-2, as indicated on the dial setting card accompanying the kit, for any particular wavelength. For example, if you are using UV-201-A tubes for R. F. amplifier and detector and wish to receive 360 meters, dials T-2 and T-3 should be set at 40. Tune with T-1 until the desired signal is received. Now, re-adjust T-2 and T-3. If the signal is too loud, turn the rheostats FIL-1-2 and FIL-4 back a little bit while finding the last settings for T-2 and T-3. If a local oscillation appears when increasing FIL-1-2, re-adjust C-1 and C-2 a few degrees in either direction. Re-adjust the rheostats for best tone and volume, burning the tubes as low as is consistent with good reception. For occasions where great volume is desired, plug the loud speaker into the jack marked VOLUME. This cuts in all five tubes.

Tests which have been made on vacuum tubes show that, for every increase of 5% in the filament current above the rated value, the life of the filament is cut in half. This indicates the importance of burning the tubes low.



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Write for booklet giving useful amplifier information.

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The equipment for a complete radio testing laboratory is so expensive that many manufacturers find that their use of such apparatus is too intermittent to justify the investment required. Until now, the Bureau of Standards has been the only laboratory available to the general public, but, because of the enormous amount of scientific investigation which the Bureau is called upon to handle, their service has been too slow for practical requirements.

The new and enlarged Radio Testing Laboratories maintained by RADIO ENGINEERING, heretofore used exclusively for the development of instruments and sets to be described in the Magazine, are now opened to the general public, so that manufacturers and experimenters can have coils and condensers

measured, sets tested, and wavemeters calibrated—and they can have this work done quickly at a small cost. Following is a schedule of charges:

RADIO TESTING LABORATORIES

The Radio Testing Laboratories are for the personal information of manufacturers, and experimenters. Reports will be made directly to clients, and all data kept confidential. None of the information will be published or used in Radio Engineering Magazine. In cases where special data is required which cannot be handled by the Radio Testing Laboratories, the client will be so informed, and the remittance refunded. All checks and money orders should be made payable to M. B. Sleeper, Inc., and equipment for testing forwarded to A-52 Vanderbilt Avenue, New York City, N. Y.

FIXED CONDENSERS: Capacities of 0.00005 to 1.0 mfd., tested at 1,000 cycles.....	\$50
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FIXED INDUCTANCES: Inductance measured at radio frequencies75
DISTRIBUTED CAPACITY: Inductances measured at radio frequencies.....	1.00
R. F. RESISTANCE: Of Inductances at radio frequencies, per setting.....	.75
D. C. RESISTANCE: Of coils or resistance elements50
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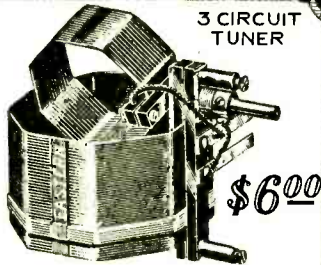
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Clumsy pliers simply can't do the work of Spintites. Pliers *slip*; Spintites *grip*. Yes, even in the closest quarters Spintites reach right down and take hold of the smallest nuts, enabling you to spin them on *as tight as if soldered*, in less time than it takes to tell it. Tight joints, as you know, put an end to losses and noises due to leaky connections.

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Set of 3
Spintites
in most
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Sizes (round
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Run Your Radio Direct from the Light Socket

Get All A B & C
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The Whole Story of Run-a-Radio In Ten Questions

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2. Q. Will it work with either dry cell or storage battery tubes?
 - A. Yes. More volume is obtained, of course, with storage battery tubes.
3. Q. How does it work?
 - A. You simply connect Run-a-Radio to your set, and plug it into the light socket. Turn on your radio as you turn on your light. There are models for both A C and D C current.
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 - A. About as much as one electric light.
5. Q. Is it cheaper than batteries?
 - A. Its cost is a little more than regular battery equipment at the start, and it saves you about fifty dollars a year thereafter.
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7. Q. Will my radio work just the same?
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8. Q. Will it work on any radio set?
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This transformer makes the construction of a radio frequency set an easy matter, assuring best possible reception with widely varying types of circuits, including reflex.

Built and guaranteed by Kellogg Switchboard and Supply Company.

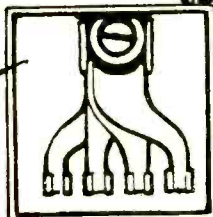
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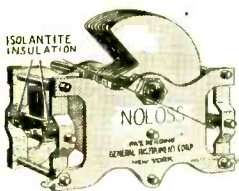
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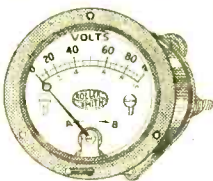
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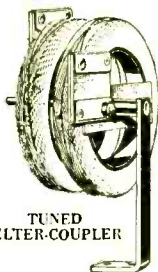
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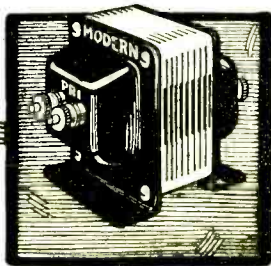
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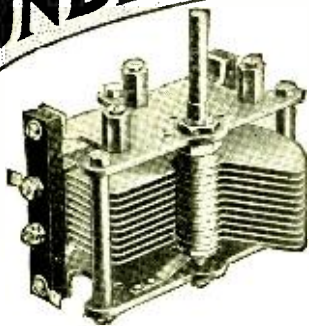
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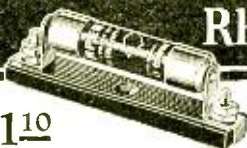
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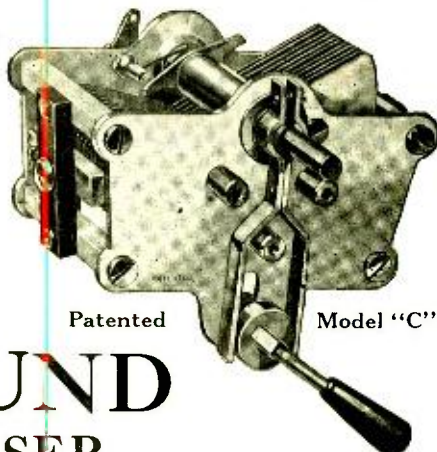
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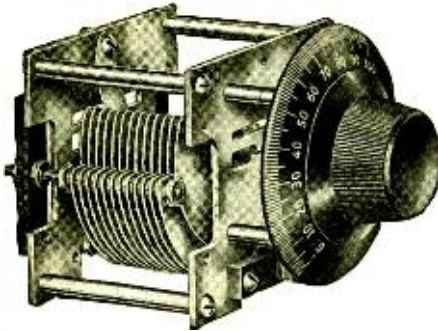
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Sockets
Twinadapter, etc., etc.



DON'T IMPROVISE - PACENTIZE

REASONS
not arguments have
 popularized National
VELVET
VERNIER
 Condensers and Dials



EFFICIENT

Sets using Nationals have received signals between Buenos Aires, S. A., and Hartford, Conn., 5200 miles.

DURABLE

Two National Condensers and Velvet Vernier Dials ran 324,000 Revolutions during the recent Radio World's Fair without showing the least sign of wear.

DEPENDABLE

Used in Marine and Radio Compass Work. Write for Bulletin 104.

The National Regenaformer for the Browning-Drake Receiver

The Performance of this set will surprise you.

The National Regenaformer Kit

Consisting of Regenaformer, Coil, Condensers and Dials, ready to hook up \$22.00
 Regenaformer and Coil, only 7.50

Write for Bulletin 105

Manufactured by

National Co., Inc.

110 Brookline St., Cambridge, Mass.

(Continued from page 336)

to a beat note of 50,000 cycles the identity of the audio frequency groups is still maintained. Of course, 50,000 cycles from the intermediate amplifier is too high a frequency for the ear to recognize. Therefore, it must be passed through a detector before it becomes audible. That is the function of the second detector employed in the super-heterodyne amplifier outfit. After the detector an audio frequency amplifier of one or two steps can be added to give greater volume.

It seems, offhand, that this is a long process to go through, and that the oscillator, the extra detector, and the intermediate frequency ought to be unnecessary. Actually, they serve a purpose sufficiently useful to justify their connection with the receiving set.

We use radio frequency amplifiers to increase the receiving range of an outfit and to amplify the signals without amplifying the audio frequency static disturbances. In practice, unfortunately, there are definite limitations to the results that can be obtained from the ordinary R. F. amplifier. In the first place an R. F. amplifier is not nearly as efficient as an A. F. amplifier. In other words, the increase or amplification per step is lower. It is difficult to control R. F. amplifiers if very many stages are used and, when they are of the untuned type, the wavelength range is somewhat limited. On the other hand, a tuned R. F. amplifier, altho efficient at all wavelengths does amplify static considerably and adds another very sharp tuning control for each step.

Again, there are limits as to the usefulness of the A. F. amplifier because it not only amplifies the signals but, in addition, it increases the volume of static disturbances and noises which may come from the tubes themselves, leaks in the insulation, and from irregularities in the filament current supply or the plate voltage supply.

Therefore, the most satisfactory amplification must be done at a frequency above audibility so as not to amplify static or local noises, and at a frequency sufficiently low that the amplification be done efficiently. Hence the choice of the intermediate frequency of 30,000 to 50,000 cycles.

As has been explained, the oscillator is necessary to set up with the incoming frequency an I. F. beat note. While in most sets only three or four steps of intermediate frequency are employed the number can be increased if there is any necessity for doing it and the connections made to additional stages in the same manner employed for the others. Usually, however, sufficient volume and distance can be obtained with the smaller number of steps.

**AMERICAN BRAND
CONDENSERS**
with the
~100 to 1~
**Worm Drive Vernier
Finest Condenser Made**
and the
**Greatest Radio Value
Offered the Public**
23 PLATE, only \$5⁰⁰ In Canada \$7⁰⁰
AMERICAN BRAND CORPORATION
NEWARK, N. J.



ANT **SPEAKER +** **SPEAKER -** **A BAT +**
LONG ANT **A BAT -**
SHORT ANT **B BAT +**
LOOP **B BAT -**
PHONE **C BAT +**
GND **C BAT -**
INPUT **H. H. EBY Mfg. Co.** **B AMP +**
A+ BAT B- **Phila., Pa.** **B DET +**
+ **-**

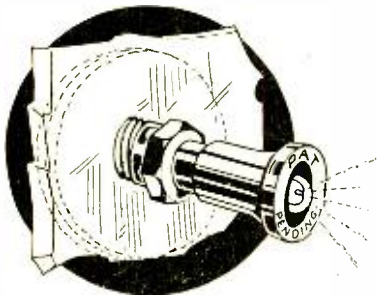
**Tops Don't Come Off
25 Different Markings**

Make Your Radio Joy A Sure Thing

YOU are going to give a "radio party," or you are going on a hunt for "DX". You get yourself set for a "large" evening. Then some little unavoidable thing happens and you blow all your tubes. Money, fun and everything is lost.

The quickest way to spend \$20 is to accidentally drop a screw-driver in a five-tube set. Zip, and your money is gone as well as your fun—until the radio store opens.

Either style of KANT-BLO means protection against blowing out tubes.



**A NECESSITY—
NOT AN ACCESSORY**

The KANT-BLO is not an extra accessory to your set. It is designed as a B battery Binding Post or as an A battery filament switch. Post Style and Switch Style—are at all the best radio stores. If your dealer is out of stock send us \$2 for a KANT-BLO Binding Post Style, or \$3 for the Switch Style, and we will ship any number of KANT-BLOS direct to you, charges prepaid.

Kant-Blo
SWITCH SIGNAL BINDING POST
"Lights on any Short Circuit"

Manufactured by
GANIO-KRAMER CO., Inc., New York
Sole Distributors
**APEX RADIO CO., Inc., 503 Fifth Ave.
New York**

BAKELITE

TRADE MARK REG. U. S. PAT. OFF.

Mahogany Panels

Bakelite Radio Panels are produced in a fine Mahogany finish that enhances the appearance of a radio set and harmonizes with the most luxurious surroundings.

In addition to their beauty, Bakelite Panels are permanent. They provide strong, stable insulation which does not deteriorate with age and use.

Improve the appearance of your own set by means of a Bakelite Mahogany Panel.

Send for our Booklet "I".

Send for our Radio Map

The Bakelite Radio Map lists the call letters, wave length and location of every broadcasting station in the world. Enclose 10 cents to cover the cost and we will send you this map. Address Map Department.

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street



BAKELITE
Condensite
REDMANOL

are the registered
Trade Marks for the
Phenol Resin Products
manufactured under
patents owned by
BAKELITE
CORPORATION

THE MATERIAL OF A THOUSAND USES

SILVER SUPER SPECIALS



Type 101

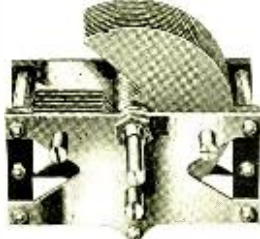
Silver Coupling Unit. 150 to 600 Meters.
Small, Compact and Ultra-Efficient—for use as an Oscillator, radio frequency transformer, or antenna coupler—with any standard tubes—ideal for super-heterodyne circuits. Maximum Selectivity. Price \$2.50.

DIRECT
or from your Dealer

Circulars upon Request

lead the field for Quality, Perfection and Maximum Efficiency. They are constructed under the supervision of McMurdo Silver, Assoc. I. R. E., and are backed by the S-M unconditional guarantee. That Guarantee covers the Types here illustrated as well as the:

Silver Tuned Output Transformer No. 201.....	\$3.50
Silver 5-Gang 199 Socket No. 501.....	3.00
Silver Tapped Loop No. 601.....	6.50



Type 301

Silver Low Loss Condenser. Capacity .000009 to .0005. Practically immeasurable loss—rotor plates grounded to frame—stator plates mounted within frame and supported by highest grade insulating material—sturdily constructed—embodies latest developments in condenser design. Price \$4.50.

Type 401
Silver Transformer Unit. 50 Kilocycle. The ORIGINAL—Employs two interstage and 1 filter transformer—1½ to 3½ times the amplification of similar types on the market—Provides undistorted speech amplification over narrow wavelength band of approximately 50 kilocycles—Used with standard tubes in any Super-Heterodyne or other circuit requiring a sharply-tuned, long wave amplifier. Tested, matched and sealed in metal container. Price \$14.00.



Eastern Distributor—Twentieth Century Radio Corp., 102 Flatbush Ave., Brooklyn, N. Y.

Silver-Marshall, inc.

105 S. WABASH AVE.,

Dept. J

CHICAGO.

Browning-Drake Parts: \$52.00

Do you want a better set?—The best four-tube outfit you can make, not only in results produced but in ease of operation and the attractiveness of its appearance.

The parts included in this construction kit are exactly those in the Standardized Parts List, making up every item, exclusive of tubes, phones, and batteries, which is needed to build the new Browning-Drake set.

Remember that this set, altho it employs regeneration, does not radiate, or interfere in any way with other receiving stations.

Vulcawood Mahogany Cabinets

An entirely new idea in radio cabinets — Vulcawood is made of fibre veneered on both sides with mahogany celeron. The finish is equal to the finest polished wood, yet these cabinets are indestructible. Vulcawood cabinets come neatly packed, thoroughly protected from shipping. Note that the prices are lower than for good wooden cabinets.

7 x 10 ins.	\$7.95	7 x 21 ins.	\$10.40
7 x 12 ins.	8.10	7 x 24 ins.	10.40
7 x 14 ins.	8.10	7 x 26 ins.	10.55
7 x 18 ins.	9.40	7 x 30 ins.	11.15

All Vulcawood cabinets measure 7 ins. in depth inside.

DURRANT RADIO, Ltd.
AS NEAR AS YOUR MAIL BOX
A-52 Vanderbilt Avenue New York City

Eliminate Soldering with this new RADIO TOOL

GET away from the mess of soldering. Use the Rance Radio Pliers with its specially designed pins. This new feature forms wire ends into perfect loops that fit accurately over standard binding posts, and make cleaner, better connections. Sets wired in this efficient way look neater and work better. Electrical and radio experimenters find these pliers indispensable in their workshops.



The Rance Combination Pliers made to our specifications by KRAEUTER, maker of fine tools. Nickel dreadnought steel. For a lifetime of hard use. Price \$2.50.

Descriptive Folder R 6 gladly sent free on request. Or send us \$2.50 for your pair of the Rance Combination Pliers. Complete instructions with each pair.

Dealers and distributors will be interested in our sales plan

RANCE CORPORATION

41 E. 42nd Street

New York

KESTER *Radio* SOLDER



Oh boy! it sure is
Safe & Simple

Here's the solder that contains the flux recommended by radio engineers! The pure rosin core inside of Kester Radio Solder is a natural flux and can leave no harmful chemical or electrical action on delicate parts or joints. It requires only heat.

In developing radio frequency, it was found that all fluxes, except rosin, spatter, fume and run over delicate parts and joints. This causes leakage and makes the best insulation as poor as a grid leak!

Solder with Kester Radio Solder. You will have no need to go over and wipe away surplus flux. Leave what rosin may remain — it is a good insulator!

There you have it: Kester Radio Solder is a safe and simple solder with which your set can be quickly, neatly, safely and substantially soldered. Get a handy can of Kester from your dealer.

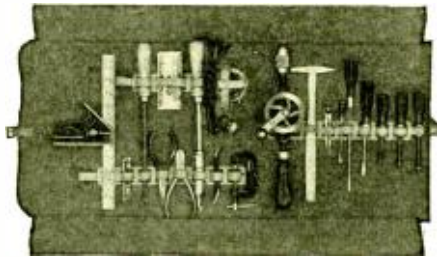
CHICAGO SOLDER COMPANY
4224 Wrightwood Ave.
Chicago—U. S. A.

INSTALLATION MEN *and* MANUFACTURERS

How many hours do you lose each month looking for a mislaid tool? How many times has the absence of some particular tool from your bag caused an extra trip to complete an installation or repair job.

The "Gnome Brand" Radio Tool Kits

contain everything you need in the most compact and portable form. They are becoming recognized as an essential part of the well equipped laboratory, shop or service station.



"GNOME BRAND" TOOL KITS

Just what you need to build the type of hookup mentioned in editorial and all other sets and equipment

Every tool guaranteed perfect in material and workmanship

RADIO KIT No. 1—22 Tools \$16.00 each
(as illustrated)

RADIO KIT No. 3—16 Tools..\$8.00 each

Tools may be purchased individually if desired. Also Carpenters' Tools in sets for home and general use.

Send for circular No. 287

HAMMACHER, SCHLEMMER & CO., Inc.
New York, since 1848 4th Ave. & 13th St.

I^a_nd M REGISTRY


A REGISTRY OF RADIO INSTALLATION and MAINTENANCE SERVICE MEN WHO
INSTALL, MAINTAIN, and REPAIR RADIO EQUIPMENT

The men whose names are listed below are prepared to handle all emergency work, take care of batteries, and replace tubes. Their charge is \$1.50 per hour, not including travelling time except to unusual distances.

The charge for listing in this section is 50c. for one month, \$2.00 for six months, \$3.00 for twelve months, payable in advance. The * indicates that we have received letters from six set owners stating that the man after whose name the * appears has handled their I and M work satisfactorily.

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White Bridge. Tel. Nor. 2724
- Ill., Oak Park—F. H. LESTER
1155 Wisconsin Ave. Park 975
- Me., Bangor—JOHN FOX
120 Essex St. Tel. Ban. 7591
- Md., Baltimore—OTTO U. JAHELKA
3710 No. Rd., Walbrook. Tel. Liberty 1202
- Mass., Boston—H. A. NICKERSON
201 Devonshire St. Tel. Cong. 5156
- Mich., Detroit—R. J. McLEOD
7725 Kellog Ave. Tel. Bal. 9525
- Mich., Detroit—WM. MILLIGAN
6543 Woodward Ave. Tel. Northway 5691W
- Minn., Minneapolis—GEO. A. BECKER
4709 Wentworth Ave. Tel. Locust 6291
- Mo., Kansas City—J. K. O'BRIEN
2116 Penn St. Tel. Okl. 9533
- N. J., Newark—J. DUNN
13 Freeman St. Tel. New 3128
- Neb., Omaha—W. J. F. SACKRIEDE
2622 Jaynes St. Tel. Kenwood 5628
- N. J., Trenton—F. C. SCOBAY
478 Stuyvesant Ave. Tel. Web. 7254
- N. Y., New York—PAUL FRANCK
317 West 119th St. Tel. Morningside 9140
- N. Y., Gloversville—H. E. HOTALING
14 Gold St. Tel. Glov. 2725
- N. Y., Buffalo—L. A. JEWELL
69 Leslie St. Tel. Lan. 9234
- N. Y., New York—J. ROEMISCH
841 Lexington Ave. Tel. Lex. 4420
- Pa., Scranton—J. J. MAHON
730 Capouse Ave. Tel. Bry. 2944
- Pa., Lewistown—S. T. ROBINSON
123 S. Main St. Tel. Lew. 723
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Little Wonder!!!
SOLDERLESS LUG



Holds Bus Wire Like
Clip! Connect or Dis-
connect Wires Without
Disturbing Terminals!
Price 10 for 5c. Ask
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Distributors Wanted

Manufactured by
PAUL GLAMZO
203 Lafayette Street New York

A Complete

**CONSTRUCTION and
REPAIR SERVICE**

*offering you technical accuracy, expert work-
manship, attractive prices and prompt ship-
ment to all parts of the world.*

*We build anything from a one-tube set
to an 8-tube Super-Heterodyne—from our
high grade parts or yours*

"Radio Engineering's" Models a Specialty

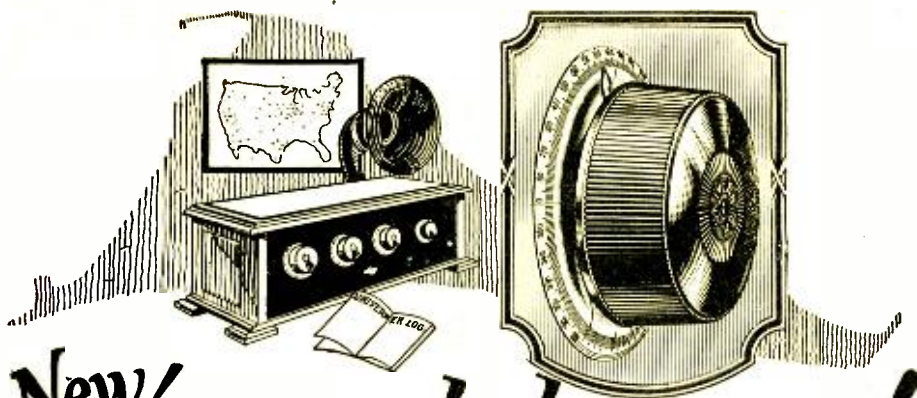
*Put your building, repairing and testing
problems up to us. Correspondence invited.*

H. E. ERICKSON, A. M. I. R. E., Vice-President.

BROADCAST SERVICE COMPANY

ONE UNION SQUARE, NEW YORK CITY

"Old-Timers in Radio"



New!

tripled my log!

of stations "heard" on the second day
thru using the



50c

Don't worry any more about someone meddling with your radio set while you are away. Simply remove key from Walbert Filament Lock Switch and take it with you just as you'd take the ignition key from an auto. Sturdy, compact, efficient. Shell and key handle insulated from circuit.



75c

The Walbert Safety Rim Socket is guaranteed not to break at the slot. Special heavy bakelite design decreases inter-element capacity thereby utilizing all available grid voltage for producing signals. (New tubes have bakelite bases for same reason.) Soldering lug and double-spring contact integral. The most attractive socket on the market.

Members of
R. M. A. and
N. R. T. A.



WALBERT
Parts with a Purpose

ALL WALBERT PARTS PROTECTED BY PATS. OR PATS. PEND., U. S. AND FOREIGN

WALBERT
UNIVERSNIER
Micro-Selective Tuning Control

THAT is what the UNIVERNIER did for A. H. Klingbeil of Ashtabula, O. Tripled his entire log in a single night! "Last night," writes Bishop Francis of Chicago, "I put 3 UNIVERNIERS on my Neutrodyne and got 20 stations I never heard before!"

You can do the same. Tune-in those hard-to-get distant stations quickly, easily, clear and loud. Don't have to alter your set. Simply replace each of your dials with a UNIVERNIER, the original 12-to-1 ratio micro-selective tuning dial.

WHY A 12-to-1 RATIO IS BEST

Careful tests prove that a lower ratio is inefficient, a higher unnecessary. With higher-ratio dials the actual "searching" for stations is done with the coarse adjustment. The operator finds the vernier adjustment too slow and uses it only for "clearing-up" a

station after it has been detected with the coarse adjustment. Many stations are missed entirely with the latter. With the Univernier both "searching" and the final "clearing-up" are done easily and efficiently with the vernier adjustment. And a large knob helps do it!

COSTS NO MORE THAN A GOOD DIAL—

And does away entirely with the need for vernier condensers. Very attractive with new "dished" dial. More efficient with heavier gearing. Positive continuous vernier—No slippage! Pointer

rigid with shaft. A slight necessary amount of play in the knob prevents involuntary disturbance of vernier adjustments when the hand is removed.

Mahogany Knob and \$1.50
Gold-plated dial . . .

Black Knob and \$1.25
Silver-plated dial

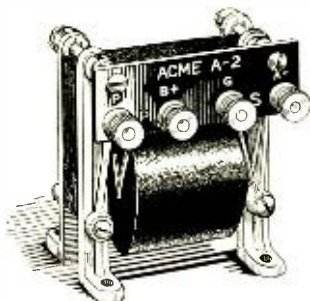
At your dealer or sent postpaid on receipt of purchase price.
(Please mention dealer's name.)

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THE WALBERT MANUFACTURING COMPANY
931 Wrightwood Avenue
Chicago, Illinois

FREE!
Send 2c stamp for
FREE copy of
UNIVERNIER
LOG BOOK.

Give your loudspeaker a chance!



ACME A-2
for volume

NO MATTER what loudspeaker you have it can't give you loud clear reproduction unless you have proper audio amplifying transformers.

If your audio transformers don't deliver clear, strong, undistorted energy, you can't expect your loudspeaker to correct the faults for which your audio transformers are responsible

The thing to do is to put ACME Audio Transformers in your set and *then* listen to your loudspeaker. ACME Audio Transformers will give your loudspeaker a chance to entertain you with all the thrills and enjoyment you expected and which you are entitled to.

Send 10 cents for 36-page book, "Amplification without Distortion," containing many practical wiring diagrams and many hints for getting the best out of your set.

ACME APPARATUS COMPANY
Dept. R.M. 11, Cambridge, Mass.

Transformer and Radio Engineers and Manufacturers

ACME

~ for amplification

ACME APPARATUS COMPANY, Dept. R. M. 11, Cambridge, Mass. Gentlemen: Enclosed find 10 cents for copy of "Amplification without Distortion."	
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"The Best That Money Can Buy"



"DEVEAU GOLD SEAL" HEAD SETS are electrically and mechanically,—as well as from a radio standpoint,—as perfect as the highest-priced Head Set on the market,—and yet, with all their perfection, they retail at only \$6.00 for 2200 Ohm and \$8.00 for 3200 Ohm.

The trade mark "DEVEAU" has stood for the highest quality in telephone apparatus for thirty years,—a guarantee that every known advantage in design and manufacturing has been taken into careful consideration.

Magnets are extra-heavy one-piece units; cups are of aluminum to keep down the weight but unlike other Head Sets, every exposed metal part of the set is finished in genuine 24-karat gold,—under a protective lacquer so that the finish will last for years; the terminals of each unit are concealed,—no contact possible with user's hands.

"DEVEAU GOLD SEAL" HEAD SETS are like a piece of fine jewelry in appearance, but with all the radio niceties that the most advanced radio enthusiast can desire. DEVEAU Units exactly match each other in

tone,—each has maximum sensitivity and perfection of tone quality.

The patent design of headgear is far ahead of any Head Set on the Market,—affording as it does, instant fitting to ears and head without "re-harnessing" and without binding or pressure—the latter an admitted nuisance with all other makes of Head Sets.

Caps are of genuine Bakelite—of scientific design, and comfortable to the ear; the Bakelite never loses its jet-black lustre or highly polished surface.

"DEVEAU GOLD SEAL" HEAD SETS are never found in the cut-rate market—they are only sold to jobbers who appreciate their value.

"DEVEAU GOLD SEAL" HEAD SETS are guaranteed to be electrically and mechanically perfect—our Guarantee protects every purchaser.

Order through your regular jobber or write direct for the names of authorized Distributors throughout the country.

Send for descriptive Bulletin of Deveau Radio Apparatus and Micrometer Adjustable Air-Gap Radio Loud-Speakers.

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