RADIO Engineering

A Magazine of Technical Accuracy for the Radio Set Builder, Engineer and Manufacturer

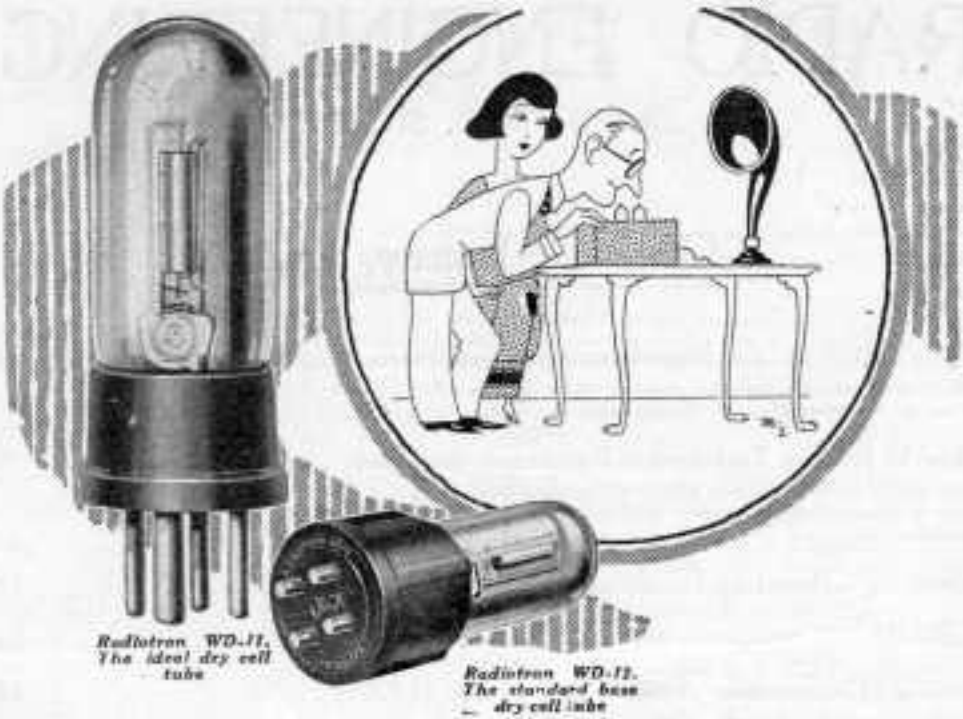
20¢
IN ENGLAND 1/-

Edited by
M.B.SLEEPER

JANUARY 1925

VOL. V NO. 1


No. 772
45-volt
large
vertical
Price
$3.75
EVEREADY
RADIO
"B" BATTERY
EVEREADY
No. 766
22½-volt
large
horizontal
Price
$2.00
EVEREADY
RADIO
"B" BATTERY
Dry "B" Batteries
are more economical
and more dependable
than any other
source of plate
current!
Cut your
operating cost
THIRTY years' experience in the manufacture of dry batteries has enabled us within the past two years to steadily and greatly improve "B" Battery quality. Eveready "B" Batteries are now from two to three times better than ever before.
Eveready "B" Batteries will long outlast any others, and are the most economical and dependable source of plate current. These are strong statements, but they have been proved by tests in our own and in independent laboratories. Check them for yourself on your own radio set. Get Eveready "B" Batteries.
There is an Eveready Radio Battery for every radio use.
Manufactured and guaranteed by
NATIONAL CARBON COMPANY, Inc.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Ltd., Toronto, Ont.
EVEREADY
Radio Batteries
–they last longer



Radiotron WD-11. The ideal dry cell tube

Radiotron WD-12. The standard base dry cell tube

Get a good detector

Radiotrons WD-11 and WD-12 are the same tube but with different bases.

Radiotron WD-12 has a standard navy-type base. Use it to change your set to dry battery operation. Ask your dealer today.

RCA

This symbol of quality is your protection

What will Radiotron WD-11 or WD-12 do as detectors? These are the same—but with different bases. First—they are sensitive to weak signals—superlatively sensitive, as remarkable distance performances show in thousands of one-tube sets. Second, they are good "oscillators"—and that is important in regenerative circuits. And third, they are quiet in operation—add no electrical noises to the music, or speech. Radiotrons WD-11 and WD-12 are famous as audio and radio frequency amplifiers—too—and have made possible the hundreds of thousands of dry battery receivers that are in use today. They mean clear, true reception—over big distances—with dry batteries! Be sure you get a *genuine Radiotron.*

Radio Corporation of America

Sales Offices:

233 Broadway, New York 10 So. La Salle St., Chicago, Ill.
28 Geary St., San Francisco, Cal.

Radiotron

REG. U. S. PAT. OFF.

RADIO ENGINEERING

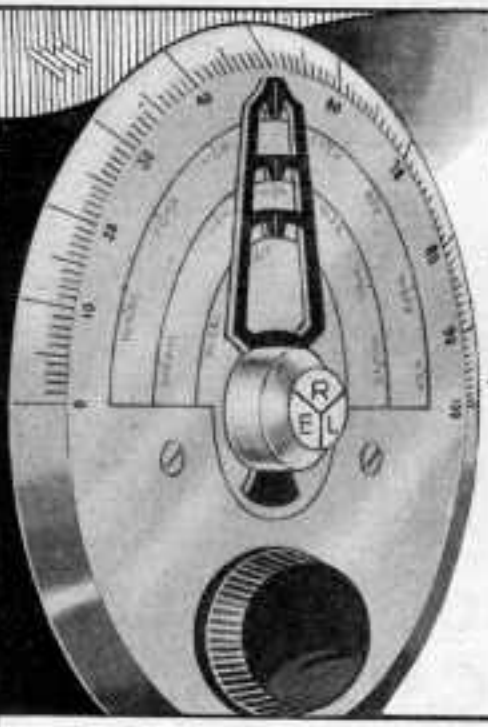
Edited by M. B. SLEEPER

Fifth Year

Vol. V, No. 1

Contents—January, 1925

Radio Engineering, January, 1925. Vol. 5, No. 1. Published monthly by M. B. Sleeper, Inc., Publication office, Lyon Block, Albany, New York. Editorial and General offices, 52 Vanderbilt Ave., New York, N. Y. Printed in U. S. A. Yearly subscription $2.00 in U. S. and Canada; ten shillings in foreign countries. Application for entry as second-class matter at the postoffice at Albany, New York, N. Y., pending.



The Station You Want Is Marked on the Dial

Designed by ROBERT E. LACAULT
Made by HAMMARLUND MFG. CO.,
Expressly for
PHENIX RADIO CORPORATION

Direct Tuning

Designed by R. E. Lacault, B.E., A.M.I.R.E., inventor of the famous Ultra-tune circuit. This monograph seal (R.E.L.) is your assurance of Lacault design.

Stop fishing for your favorite station. *Select* the program you want—get it lightning-quick. Replace your old dials with ULTRA-VERNIER Tuning Controls. Then, when you have tuned in a delightful station, pencil-record it on the dial. Never again need you guess or fumble for that station, or bother with wave-lengths. Simply turn the finder to your pencil-mark, and you hear it!

Should you move—or a station discontinue or wave-lengths change—erase the marks, leaving the dial beautifully clean and new. Thus, you may now have all the joy of radio, with none of the discouragements. Moreover, the ULTRA-VERNIER is a single vernier tuning control.

At your dealer; otherwise send purchase price and you will be supplied postpaid.

$2.50

At your Dealers

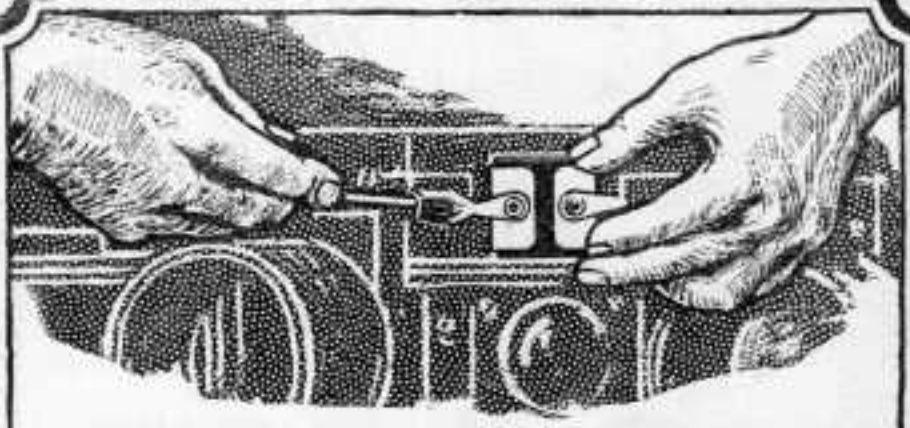
Made by the Hammarlund Mfg. Co., your assurance of quality and dependability—produced solely for the Phenix Radio Corporation.

ULTRA-VERNIER TUNING CONTROL

PHENIX RADIO CORPORATION

7 BEEKMAN STREET

NEW YORK CITY



Nine out of ten sets *use* MICADONS

NINE out of every ten sets made use Micadons — the standard fixed radio condenser. Set builders choose them for many reasons.

They know that the Micadon is a Dubilier product: hence supreme in quality and efficiency.

They know that Micadons can be obtained in accurately matched capacities and the capacity is permanent.

They know that Micadons are easily installed, equipped as they are with extension tabs for soldering and eyelets for set screw assembly.

They know that Micadons are made with type variations to meet every possible requirement.

For best results use Micadons

Dubilier

CONDENSER AND RADIO CORPORATION

Some Notes on The Manufacture of Variable Condensers

An account of the assembly methods employed in manufacturing condensers at the Hammerlund factory, with views of the important steps

A FEW years ago, all a man had to do to start in the manufacturing business was to rent a back room somewhere, get a few hundred dollars worth of machines together, hang out a shingle, and start work. Much water has gone under the bridge since then, for to-day we find the better class of radio manufacturers doing their utmost to increase the speed of production, accuracy of machining, and the quality of their products by using machinery of the latest types in accordance with up-to-date shop practice. Each step of manufacturing operation is carefully studied, plant layouts are considered and consulting specialists are called in on important problems of design and production. The industry is truly graduating from the one-man shop stage to the highly organized quantity production level, with a very beneficial effect on the trade as a whole.

Condenser manufacturing presents a very good example of this. A few years ago, really efficient condensers cost so much and were so hard to get that only the large laboratories used them. To-day, condensers comparable in efficiency to those used by the Bureau of Standards can be obtained at prices ranging from four to ten dollars, certainly within the means of most set-builders.

A very good idea of what is being done along these lines in the manufacture of variable condensers was furnished recently by a trip through the plant of the Hammarlund Mfg. Company. The factory is laid out so that the work progresses with as little handling and lost motion as possible. The stockroom is located in the center and the work starts at one end of the floor and travels progressively around to the different departments in a circle, finally ending up at the shipping room.

The front and back end plates are blanked out in power presses from specially tempered, hard aluminum sheets about 8 ft. long and as wide as the plates. Special compound dies are used here, to prevent bending or distortion of the plates. The bottom half of the die is mounted on heavy springs. When the cutter comes down and blanks out the plate, these springs are compressed. On

Fig. 2. The operator is assembling plates in one jig, another is being heated, while a third is cooling on the bench. Thus the soldering operations continue without delay.

the upward stroke of the cutter, the springs push up the die and automatically eject the blanked plate from the top. The dies are inclined so that the plates drop off to a receiving table. In the ordinary die, the stamped piece is pushed through by the succeeding pieces and is delivered at the bottom. This forcing action produces some distortion in the pieces.

The end plates are then pierced with the necessary holes and the bearing support formed by dishing out around the bearing hole and cutting the thread. They are then scratched or brushed to produce a soft finish, and are cleaned of all oil and dirt. The three panel mounting pillars are fastened to the front end plates by eyeletting. These eyelets are spun over in a fast-operated press. The bearing is then screwed on each plate by hand, and the heavy lock-plate screws are inserted. The stator and rotor plates are punched out from hard brass sheets in the same way. It is very easy to appreciate the importance of getting these plates perfectly flat when we consider the small clearance between the rotor and stator plates of modern condensers.

A very ingenious method is used to test every rotor and stator plate for flatness. The tester slides each plate along a flat polished steel surface, turning the plate around in all directions. If the plate sticks to the steel as he slides it along he knows it is flat since a large surface is adhering to the steel. If the plate is warped, it slides along easily, and must be straightened with a peining hammer. This operation is a very delicate one and depends on the feel acquired by the tester after long experience.

The round brass rotor shafts are turned down accurately to size and are then held in a special jig while the slots for the rotor plates and pigtail are milled. All of the slots are cut in one operation. The stop plate is then fastened to the rotor shaft. The next operation is the soldering of the rotor plates to the shaft. The shaft is heated slightly in a Bunsen burner and Nokorode soldering flux applied to the slots. It is then held in a jig while the plates are inserted. The entire unit is clamped in the jig which also has slots in it to receive the plates and hold them in position. The rotor assembly and jig are heated to a temperature high enough to make solder flow freely, and the

Fig. 3. Completed condensers are carried in trays to the testing bench where, thru heavily insulated electrodes, 1,000 volts is applied to the terminals.

solder applied at the ends of the plates, running down around the entire joint between each plate and the rotor shaft, making a good electrical and mechanical connection. This is then set aside to cool until the rotor can be removed. The workman uses three jigs so that the operations follow one another in rotation without loss of time. While one jig is being loaded, one is heating and the other is cooling.

This is followed by nine dipping operations which free the plates and shafts from all grease, oxide, and soldering flux, giving the plates a special finish which resists the oxidizing action of the air. First they are boiled in a chemical solution for twenty minutes to remove the flux, grease, and oxide followed by rinsing in running water. Next a pickling solution loosens from the surface of the metal any impurities which were not affected by the boiling process. This is followed by washing in water to remove the pickling solution. They are then immersed in a bright dip acid to bring out the finish, and are washed in water again. This is followed by dipping in a potassium cyanide solution. The purpose of this is to give a good finish to the surfaces, and to retard oxidization. They are washed again in boiling water. This heats them so that they dry quickly without water mark spots when put on the air drying rack. The clock spring pigtails are then swedged into the pigtail slots of the rotor shaft by a press. This insures a perfect connection which cannot oxidize, since all air is excluded from the contact surfaces.

The brass stator posts are cut off the proper length, and slotted in a milling machine. Here again an ingenious time saving method has been worked out. A jig holding sixteen posts placed side by side is fastened to the table by a very simple clamp which also squeezes the posts together tightly and lines them up in the jig. This clamping operation takes but a few seconds. The milling is started and the operator loads up a second jig while the first is being milled. The miller has an automatic attachment which returns the table to the starting position after the operation is finished, so that the jig and the operator's hands are away from the cutter while he removes the jig. A simple movement of the clamp releases both the jig and the stator posts. Experience has shown that if sixteen posts are milled together the cutting time and the loading time are so proportioned that when the machine has done the cutting, the operator has just had time enough to load up the second jig. This keeps the milling machine doing actual cutting 75% of the time.

The stator posts are then drilled in high speed ball bearing drill presses run-

(Continued on page 44)

Transformer-Resistance Amplifier Unit

Here is a compact A. F. amplifier, combining transformer and resistance coupling, which will make any one-tube set operate a loud speaker

THE FINAL answer to the resistance-transformer audio frequency amplifier controversy seems to be a compromise between the two. Transformer coupling gives good volume with some distortion. Resistance coupling results in practically perfect reproduction but lacks volume. By combining the two methods, using transformer coupling in the first stage followed by two stages of resistance coupling, very good volume is obtained with practically no distortion. If a good transformer is employed, it will hardly introduce any distortion when used in the first step.

The amplifier described here makes a very neat, compact unit, suitable for use with any set. The input terminals are located on the left to provide easy connection to the receiver. The battery connections are on the right. The instruments are all mounted on the front panel. This feature makes assembling easy and results in a very compact unit.

Design of the Amplifier. A Formica panel 7 by 10 ins., 3/16-in. thick, carries all of the instruments. On the front is a rheostat for the first stage tube and another for the remaining stages. Two jacks are used for plugging in at the first or last steps. Peep holes are provided for observing the brilliancy of the tubes. Behind the panel are the three panel-mounted sockets, A.F. transformer, and resistance coupling units. These units are so constructed that both resistors and fixed condensers can be removed easily to permit trying different values.

The parts used in the amplifier are: Two Haynes-Griffin rheostats, two Haynes-Griffin panel-mounted sockets, double circuit and open circuit jacks, one Haynes-Griffin A.F. transformer type 91, six binding posts, two Daven resisto-coupler units, two .006 mfd. Micadons, one .0025 mfd. N. Y. Coil fixed condenser, two 0.1 megohm, one 0.5 megohm, and one .25 megohm Daven resistors.

Assembly And Wiring The picture wiring diagram in Fig. 1 shows the exact wiring and connections. These are numbered to correspond with the following step-by-step assembly instructions. These instructions have been prepared to aid you in this work. You will save time by going thru the work in the order indicated.

1. Mount the binding posts on the front panel, keeping the holes in them horizontal. Put lugs on the screws as the parts are mounted. Have them point in the directions indicated by the short heavy lines in the picture wiring diagram. It is well to tin the lugs before putting them on the instruments as it is usually hard to do so afterward. Mount the rheostats in place, keeping the terminals at the top. Have the pointers on the knobs fastened so that they point to the tails of the arrows on the panel when the rheostats are turned all the way to the left. Fasten the two resisto-couplers on the panel with ½-in. 6-32 F.H. screws and nuts. Now mount the three sockets with ½-in. 6-32 F.H. screws.

2. Connect 1, the A—binding post, to 2 and to 3. Lugs 2 and 3 are the left hand terminals of the rheostat looking at the panel form the rear. Connect 4 to 5 and 6 to 7. These are the adjacent terminals on the resisto-couplers.

3. Mount the open circuit jack on the left, looking at the set from the rear, with the frame at the top.

4. Connect 8, the frame terminal of the jack, to 9. 9 is a point on wire

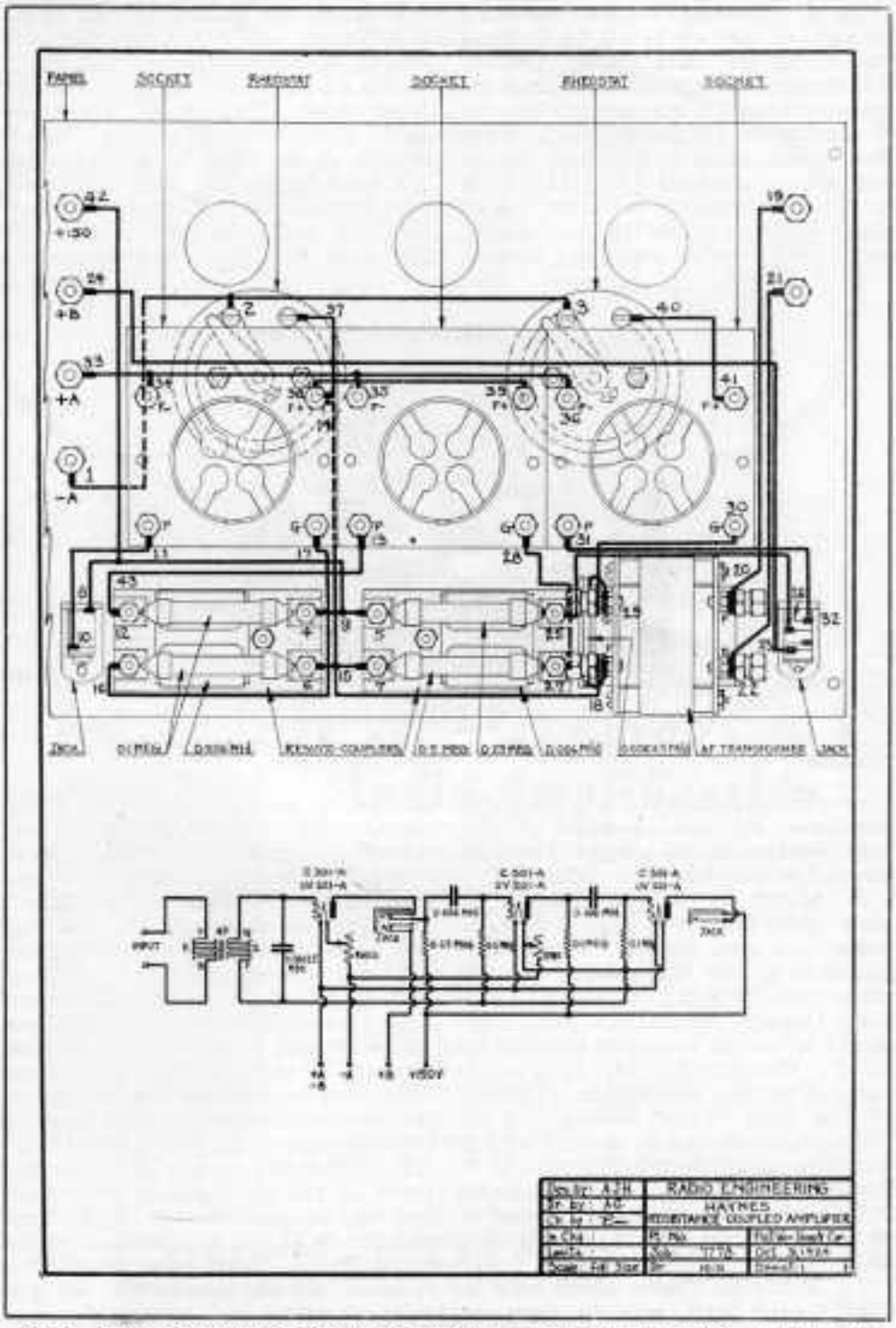


Fig. 1. In the picture wiring diagram the sockets are shown turned upward. Below is the schematic hook-up.

4 to 5. Connect 10, the remaining terminal of the jack to 11, the P terminal of the left hand socket. Connect 12, the upper left hand terminal of the resisto-coupler on the left, to 13, the P terminal of the center socket. Keep this wire up close to the under side of the sockets. Connect 14 to 15. 14 is a connection made to the under side of the F+ spring of the left hand socket, and 15 is a point on wire 6 to 7 between the two resisto-couplers. Connect 16, the lower left hand terminal of the resisto-coupler on the left, to 17, the G terminal of the left hand socket.

5. Mount the A.F. transformer in place on the panel with ½-in. 6-32 F.H. screws and nuts, keeping the secondary terminals at the left, looking at the panel from the rear.

6. Connect the 0.00025 mfd. condenser across the secondary terminals G and F. Connect 15 to 18. 18 is the F terminal of the transformer. Connect 19, the upper "input" binding post on the right, to 20, the P terminal of the transformer. Cover this wire with M-R varnished tubing. Connect 21, the lower input binding post, to 22, the B terminal of the transformer. Cover this wire with M-R varnished tubing.

7. Mount the double circuit jack in place on the panel, with the frame at the top.

8. Connect its bottom lug, 23, to the B+ binding post 24. Cover this wire with M-R varnished tubing and run it on top of the socket bases close to the front panel. Connect 25, the upper right hand terminal of the resisto-coupler on the right, to 26, the upper left hand lug on the jack. This wire runs between the A.F. transformer and the right hand socket base. Connect 27, the lower right hand terminal of this coupler, to 28, the G terminal of the middle socket. Connect 29, the G terminal of the transformer, to 30, the G terminal of the right hand socket. Connect 31, the P terminal of this socket, to 32, the upper right hand lug of the jack. The remaining lug of the jack is not used. Connect 33, the A+ binding post, to 34 and 35, and 36. These are the F— terminals of the sockets. Cover this wire with M-R varnished tubing between 34 and 36. Connect 37, the right hand terminal of the rheostat on the left, to 38 and 39. These are the F+ terminals of the two sockets on the left. Cover this wire with tubing between 38 and 39. Connect 40, the remaining terminal on the right hand rheostat, to 41, the F+ terminal of the socket on the right. Connect 42, the +150 V. binding post to 43. 43 is a point on wire 8 to 9 between the open circuit jack and the resisto-coupler on

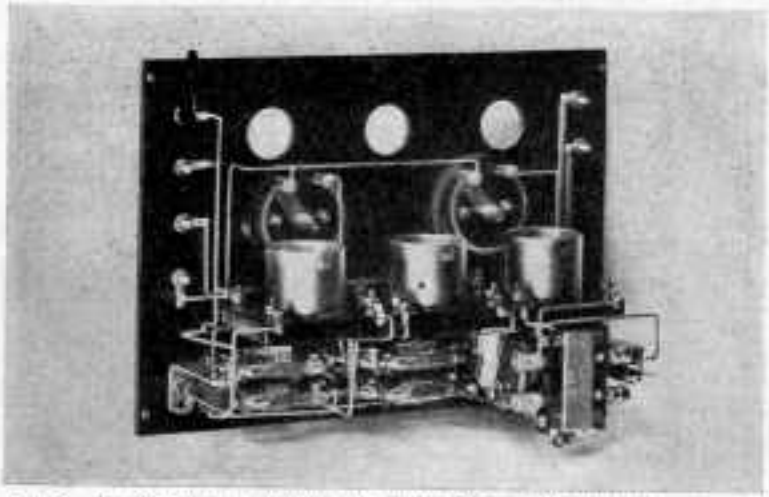


Fig. 2. A rear view showing the mounting of the transformer and resistance units beneath the sockets.

the left. This completes the wiring and assembly of the amplifier.

Testing And Operating

First check up all connections against both the picture wiring diagram and the schematic. If everything seems all right, place the condensers and resistors in the clips of the resisto-couplers. To test the B battery circuit, place the tubes in the sockets and connect the negative terminal of the A battery to the A+ binding post and the positive terminal of the battery to both the B+ and 150+ binding posts. Turn the rheostats half way to the right and plug the phones in each jack. The tubes should not light up when this is done. If they do, there is a short circuit somewhere between the plate and filament leads. Now, leaving the rheostats half on, disconnect the A battery and connect the positive terminal of the A battery to the A+ binding post and the A— terminal to the A— binding post. The tubes should now light up. If they do not, there is an open circuit in the filament connections. Connect the negative terminal of the B battery to the A+ binding post, the +150-volt terminal to the +150 binding post, and the +90-volt tap to the B+ binding post. Connect the input terminals of the amplifier to the output terminals of the tuner. Plug the phones in on the first stage. This should give an increase in volume over that obtained on the tuner alone. Now plug in on the last stage. This should give more volume increase.

Run the tubes as low as you possibly can, consistent with the volume required. This increases the life of the A and B batteries and the tubes and will prevent distortion. This amplifier will improve both the appearance and the volume produced by any existing tuner and the quality is perfect enough to satisfy the cal experimenter or broadcast listener.

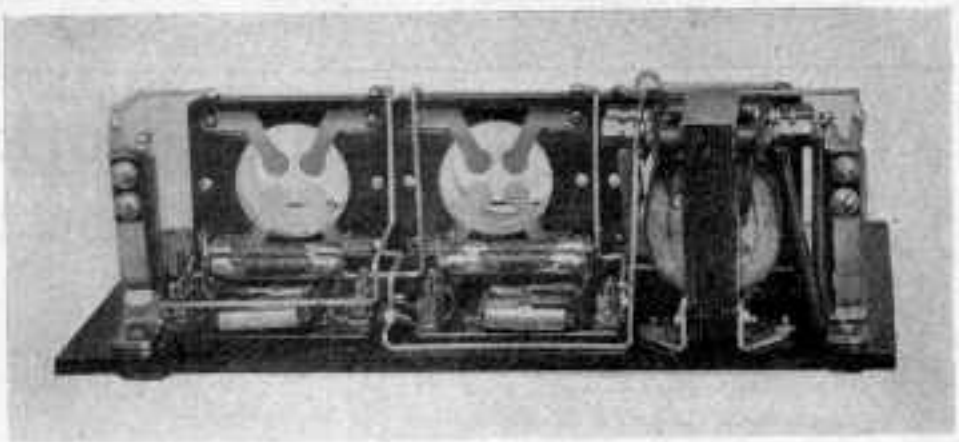
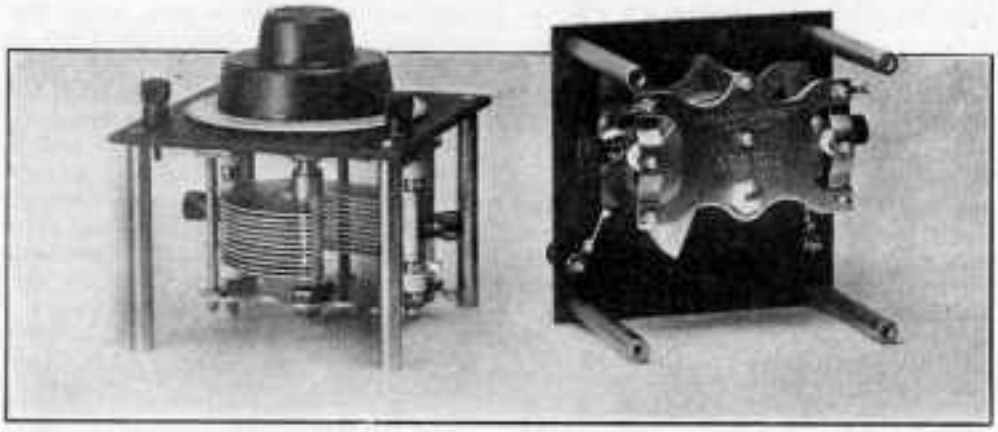


Fig. 3. Here are the works of the amplifier, all fastened to the rear of the front panel.

If you have a set already constructed with a one step transformer coupled amplifier already built into it, you can add the two stage resistance coupled amplifier by connecting it on where the first jack is shown in the schematic wiring diagram, Fig. 1. The two stage resistance unit can be added to a two step transformer coupled unit if you want still greater power. The amplification is approximately the same as with a two tube push-pull amplifier for, contrary to the ideas of some experimenters, the push-pull amplifier does not give very much more amplification than a single tube, but is simply arranged to handle a large amount of current without distortion. As a matter of fact, there is liable to be less distortion through the use of a two stage resistance unit added to a two-step transformer coupled amplifier than with the push-pull circuit.



Condensers for Testing Work

FOR making measurements and tests, as well as setting up experimental circuits, variable condensers are always necessary. Nowadays practically all the condensers are furnished for panel mounting only, and it is not convenient to set them up on the laboratory table without some special arrangement for supporting them. Moreover, it is advisable to have the plates in a horizontal position and shielded as much as possible from the accumulation of dust. The accompanying illustration shows the method we have used at the Darien laboratory. These particular condensers are of the General Instrument make, of the type insulated with Isolantite. Mydar dials are used so as to get very accurate settings.

You will see that two binding posts are mounted on the panel. Both of these, however, are connected to the rotary plates. Connections are made to the fixed plates with binding posts put into holes drilled and threaded into the supporting strips which hold the plates. This is done because mounting the terminals for the fixed plates on the panel would defeat the purpose of the low-loss design. For the benefit of those who want to know the capacity at various settings, the following data is given. You will see that the settings were taken for particular capacities rather than measuring capacities at particular adjustments. This is done so that the curves can be drawn more carefully.

CONDENSER CALIBRATIONS

Capacity Mfds.	11-plate Type	21-plate Type
0.000020	9.5°	.....
30	14.0	.....
40	18.0	.....
50	22.0	14.5°
60	26.0	.....
70	30.5	.....
80	34.5	.....
90	38.0	.....
100	42.5	25.0
110	46.5	.....
120	50.5	.....
130	55.0	.....
140	58.5	.....
150	62.5	35.0
160	66.5	.....
170	71.0	.....
180	75.0	.....
190	79.0	.....
200	83.0	45.0
210	87.0	.....
220	91.5	.....
230	95.5	.....
240	.....	.....
250	.....	55
300	.....	65
350	.....	74.5
400	.....	83.5
.000450	.....	91.5

RADIO ENGINEERING

M. B. SLEEPER, Editor
F. A. SKELTON, Managing Editor

Published monthly by
M. B. SLEEPER, Inc.
Publication Office, Lyon Block, Albany, N. Y.
Editorial and General Offices
A-52 Vanderbilt Ave., New York, N. Y.
Chicago Advertising Office
Morley Company, 157 E. Ontario Street.

Twenty cents per copy in the United States and Canada; in foreign countries one shilling. Two dollars per year, twelve numbers in the United States and Canada; ten shillings in foreign countries.

Vol. V JANUARY, 1925 No. 1

EDITORIAL

ONE of the most extraordinary things about radio is that almost every unimportant development has originated in a wild idea which the public has accepted as sound and invested in it so quickly and freely that its perfection was forced upon its sponsor. And, strangely enough, it has been possible in almost every case to complete the development before the public lost interest.

Do you remember the old United Wireless Company, the first big-scale commercial application of the radio telegraph? It failed, but the interest it created lasted long enough to bring about established ship-to-shore communication. The microphonic-contact detector was only the germ of an idea, yet the experimenters who found it worthless kept it alive until good crystal detectors were produced.

Compared to present-day tubes, the old, round DeForest audion was a little bulbfull of tricks. Still, we bought them. If we hadn't, the chances are that the Doctor would have stopped trying to make them work. Tubes called for high-voltage batteries. Those flashlight cells made a dreadful lot of trouble, but we bought them, and forced the battery companies into developing something good.

So it has gone. Every new stunt has gone thru this cycle. A new idea, capitalized by an imaginative opportunist, snapped up by public—particularly experimenters—found useless, meanwhile perfected, finally marked successfully. We can say in all seriousness—Isn't radio wonderful?

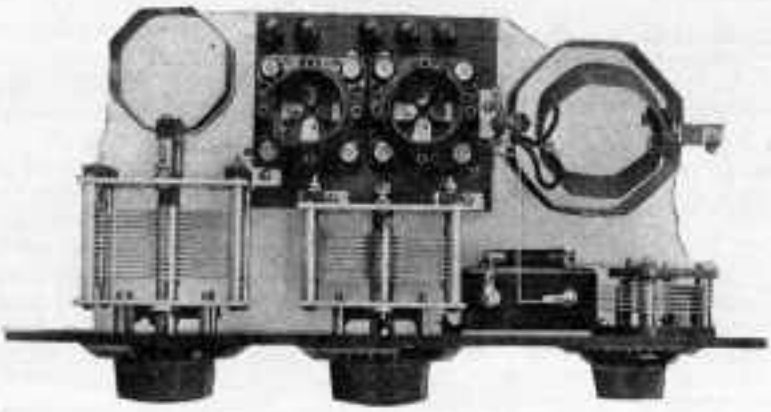
Right now battery substitutes are halfway thru their cycle. Unquestionably from all of it there will emerge successful devices. That's why we feel that competitors shouldn't go to extremes in knocking them. They must be supported a little longer for, by next fall, we shall know who's who among the manufacturers of these devices.

Out at Darien, we have been working on the plate voltage supply problem from a different angle. Accepting the B battery as a satisfactory source of plate potential when operated at a very small current drain, we are trying to find out how we can get the same kick in the loud speaker with a lower current from the B batteries.

There is the greatest upkeep expense for a radio set. An outfit which operates on one-half the usual current drain can be sold with sales arguments that mean far more to the B.C.L. than the familiar "more sensitive, more selective, purer tone" story that everyone tells. In addition to working for more distance per tube, let us try for more volume per milliampere. This is a thought for the man who wants a radio problem that is worthy of some real thinking.

Here is something else for experimenters to think about. Regeneration, used to one form or another, is becoming of increasing importance in highly efficient receiving circuits. The actual effect of regeneration is to wipe out the resistance in the grid circuit. If someone can design a circuit of practically zero resistance, the effect of regeneration will be obtained without the use of the feedback circuit. Of course, we are steadily decreasing the losses in the coils and condensers but the difference between ordinary operation and the regenerative effect is the small amount of a resistance that we have not yet been able to cut out. How do you suppose we can design a circuit or add an auxiliary circuit so as to bring the effective resistance almost to zero?

M. B. SLEEPER,
Editor.



R-F-C Type Receiver

This set is equipped with one stage of non-radiating tuned R.F., and a stage of regenerative tuned R.F. coupled through a transformer to a crystal detector. Reverse feed-back is employed in an entirely new method

IN spite of the efforts of radio engineers to develop circuits which do not employ regeneration, there is no denying the fact that we are still without a satisfactory system for accomplishing results which can be obtained with regenerative circuits. This is shown convincingly by the results during the last Transatlantic receiving tests. Altho many neutrodyne and tuned R.F. receivers, employing five tubes, were able to bring in the foreign stations, the really outstanding result of the tests is the reception accomplished by single tube regenerative receivers.

Efficiency has been greatly increased by reducing the resistance of tuning circuits through the use of low-loss condensers and coils but the difference between the minimum resistance obtained without regeneration and the resistance with regeneration is an important and controlling factor.

The R-F-C Circuit System The receiver illustrated in the accompanying photographs is the result of many tests and experiments carried on at the Darien laboratory to develop a circuit system which would allow the use of regenerative radio frequency amplification without radiation and to use this method in connection with a crystal detector.

The tendency toward substituting a crystal for a tube detector is not merely a passing fad but a practice which is approved by results obtained in careful tests. Not only does the crystal give true rectification, which a poorly adjusted tube does not, but it accomplishes its work as successfully as the audion.

In the type 6900 receiver the elimination of one tube may not seem to justify the means employed but more than the elimination of a tube is accomplished in this set. First of all, there is one less control than in the usual outfit with two stages of tuned R. F., for the right-hand condenser, as will be explained later, is not a tuning control but merely prevents oscillation. This set is more sensitive than the tuned R. F. receiver because it takes full advantage of regeneration. In ordinary outfits regeneration would require still another adjustment in addition to the three tuning condensers.

On the other hand, this outfit is not proposed as the best that can be built for one outfit or another is the best only as it meets most fully the particular requirements of the owner.

However, it can be said that, particularly if one or two stages of A. F. amplification are added, the results are bound to please the most exacting radio operator or B. C. L.

How the R-F-C Set Operates Referring to the schematic diagram in Fig. 2, you will see that the first condenser and coupler provide one stage of non-oscillating tuned R. F. amplification. The second condenser and coupler form the tuning circuit for the second stage. In the plate circuit of the second tube is a Rauland R-199 radio frequency transformer. Normally the circuit oscillates. Consequently, it is necessary to put a coupling coil in the plate circuit arranged for reverse feedback so as to stop the circuit from oscillating. The secondary of the R. F. transformer goes to a Rasla fixed crystal detector and the telephones or the primary of an A. F. transformer. It was found after careful experimenting that an 0.00025 mfd. variable condenser across the phones or transformer primary permitted the second R. F. stage to be adjusted right under the oscillating point. This furnished the best control over the entire wavelength range and was much more satisfactory than making the feedback coupling variable because a capacity across the output was necessary. Once the coupling coil is set, regulation over the broadcast range can be accomplished with the small variable condenser.

We believe that very interesting developments will come from the experiments with this type of circuit for it offers a wide range of tests for those who want to work out further improvements on the circuit. For lack of a better name, we have called it the R-F-C system indicating radio frequency-crystal.

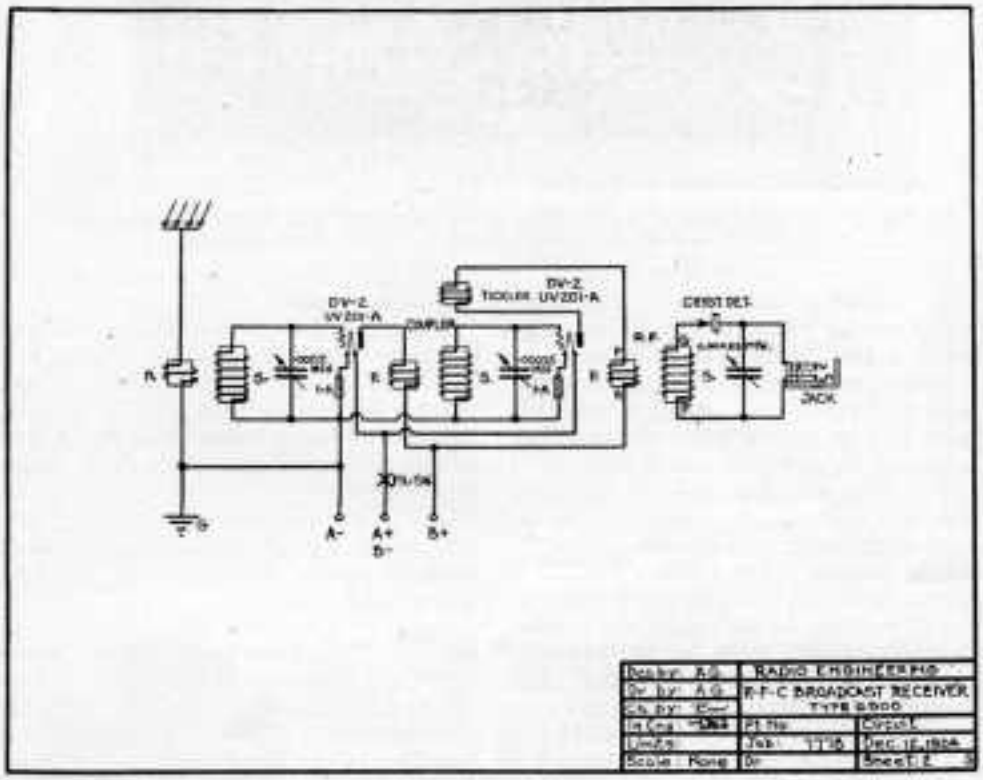


Fig. 2. Examine this schematic diagram carefully and you will see how the R-F-C circuit is put together.

Standard Parts Required There has been some criticism from our readers because standard equipment has been specified without giving the details for experimenters who want to make up their own parts. It has seemed advis-

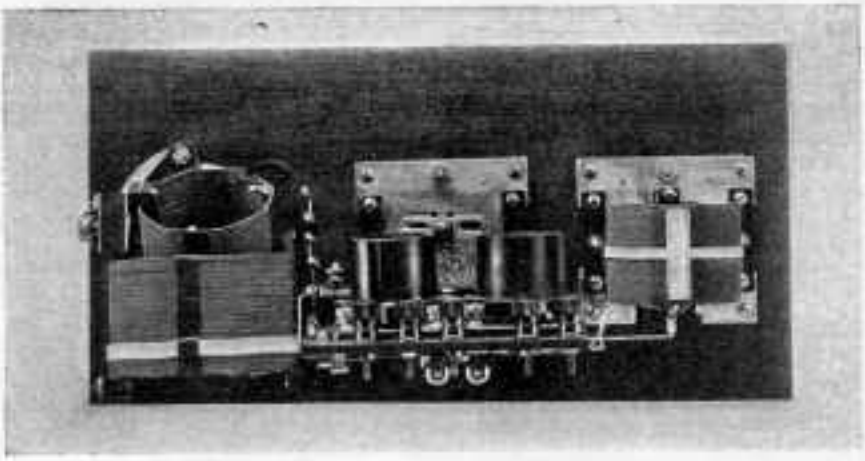


Fig. 1. No adjustment of the coupling coil is necessary once it has been set. The coupler is fastened to the tube panel with an angle bracket.

able, however, to specify equipment which can be obtained readily in radio supply stores, partly because so many set builders prefer to do only the assembly work and partly because it is generally safer to buy special items already made according to standard specifications.

For those who want to build their own coils, the following specifications for the antenna coupler and the feedback coupler will be helpful. The antenna coupler is wound with approximately 55 turns of No. 22 wire on the secondary and 6 turns of the same size wire on the primary. This coil is 2⅜ ins. across the flats. The coupler has approximately 50 turns of No. 18 D. S. C. wire, measuring 3⅜ ins. across the flats, for the secondary, 6 turns of the same wire for the primary, and 20 turns of the same wire, wound 2⅛ ins. across the flats, for the plate coil.

The antenna coupler is the standard Eastern pickle bottle coupler and the variocoupler the regular Eastern 3-circuit tuner. In addition, two National condensers fitted with 3½-in. vernier dials are employed, one of 0.00035 and one of 0.0005 mfd., a Rauland R-199 R. F. transformer, Rasla fixed crystal detector, an Elgin 0.00025 mfd. variable condenser, with a 3-in. Kurz-Kasch knob and dial, Walbert filament lock switch, Harco telephone jack, two 1-A Amperites, five Eby or Marshall-Gerken binding posts, and two standard base Benjamin sockets.

These parts are mounted on a front panel measuring 14 by 7 by 3/16-in. and a tube panel 5 by 4 by 3/16-in. If you want a very high finish on the panels, black Formica is recommend or, if you prefer mahogany or walnut grain, Celoron is good.

For hardware two coil mounting pillars and four angle brackets are needed, with the usual assortment of machine screws and nuts.

Drilling the Panels Altho the actual location of the holes are not shown in the illustrations, full size blueprints can be obtained for use as panel patterns. If you want to scale off the locations of the parts, you can determine these details approximately from the picture wiring diagram, as it is shown at exactly one-half size.

There are no special difficulties to be encountered in laying out the panels. All holes are of standard sizes, either No. 18 or 15/32-in. The latter size is employed for the jack, filament lock switch, and the holes through which the condenser shafts pass.

Suggestions for Wiring The best mechanical design is unavailing if the connections are not properly made. With the picture wiring diagram and the illustrations it is an easy matter to copy the original set. A little care in shaping the wire will not only prevent trouble when

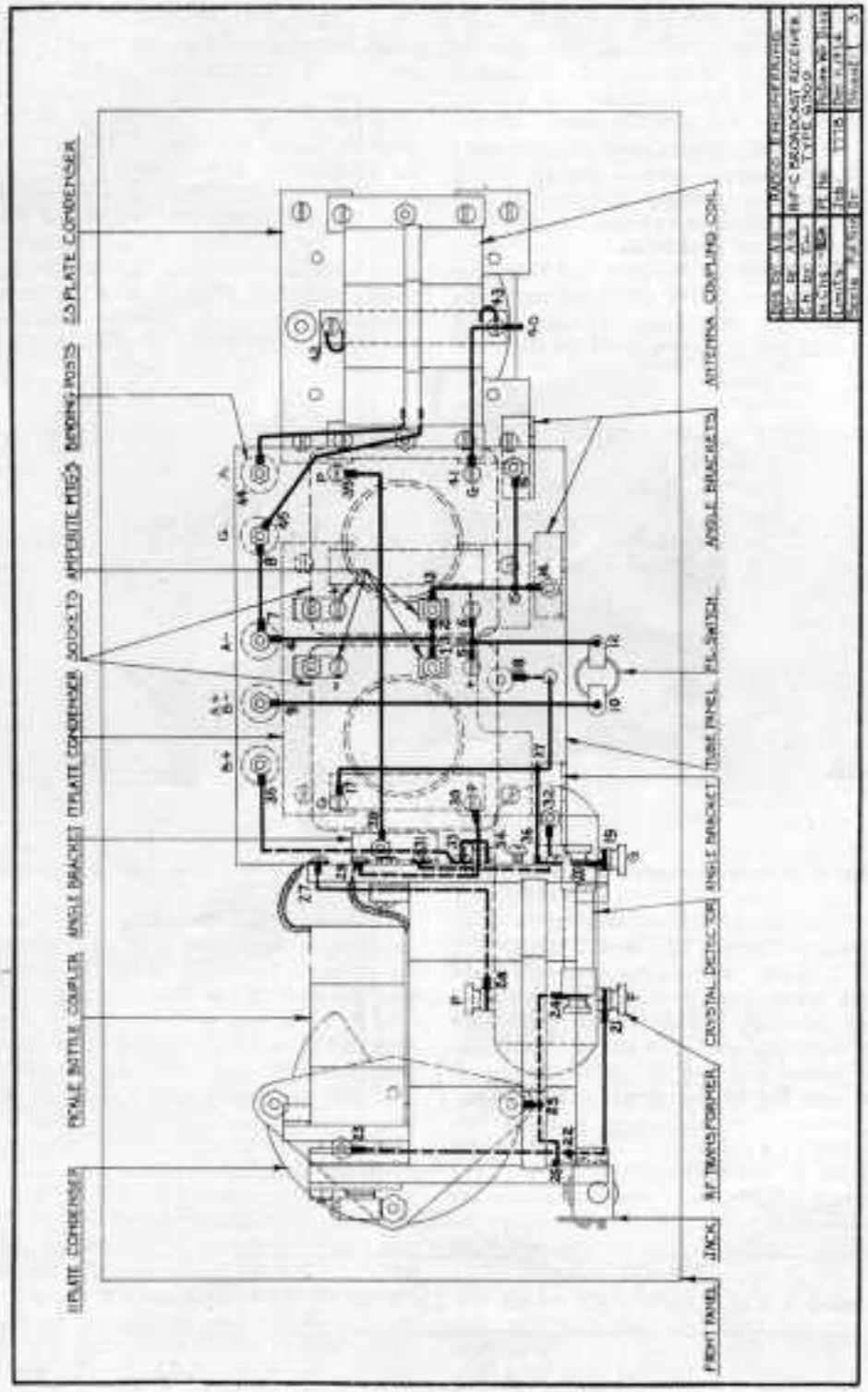


Fig. 4. The tube panel is tipped up to show the connections.

the set is in operation but will greatly improve the appearance of the outfit as well. There is a tendency to encourage set builders to make connections without soldering but this practice should be discouraged for screws and thumb nuts have the most mysterious way of letting wires slip out from under them and they give no warning except that the set stops functioning as it should.

Altho many set builders feel that they must have an electric soldering iron, this is really not necessary. If you do not feel that you can get a good electric iron, such as the American Beauty, a Nokorode soldering kit, which costs only half a dollar, will do astonishingly good work when used in accordance with the very thorough instructions supplied with the soldering kit. The secret of successful joints does not lie in the design of the iron but in its correct manipulation. Moreover, non-acid paste, such as Nokorode, or rosin core solder, such as the Kester or Belden brands, made with the correct proportion of rosin necessary for radio work. If you use the paste, be sure to get soft solder or you will have trouble in making it melt properly.

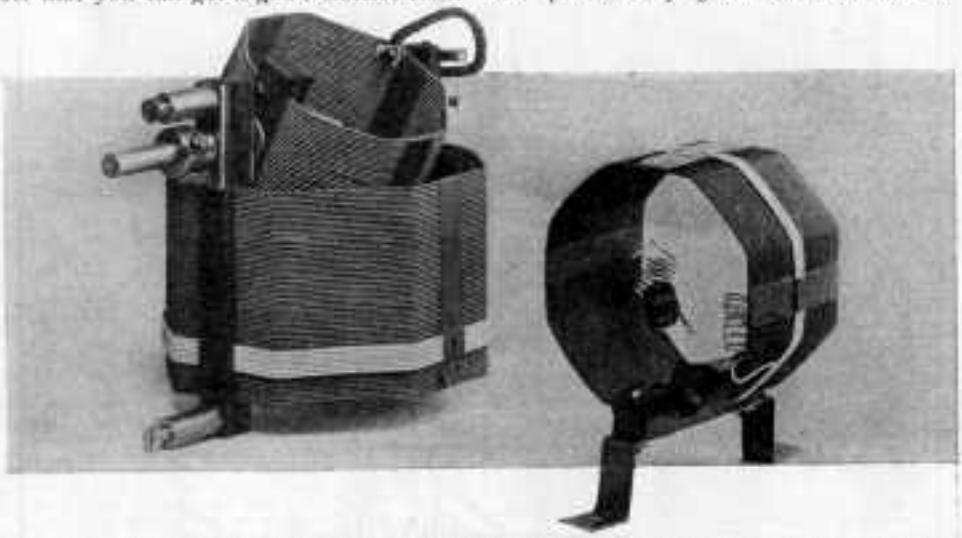


Fig. 5. A close-up of the pickle-bottle type tuner and coupler. The coupler shaft is cut off as it is not needed.

Assembly and Wiring

Fig. 4 is a picture wiring diagram of this receiving set. Because of the arrangement of the parts, the drawing may be a little bit difficult to understand, but if you make comparisons with the illustrations, particularly the rear view in Fig. 3 and the bottom view in Fig. 5, you should have no trouble. The picture wiring diagram shows the rear of the set with the tube panel turned up. The parts drawn with dotted lines are either behind the variocoupler or above the tube panel. Before putting an instrument in place have the soldering lugs on the terminals and the thumb buts tightened down securely. The Spintite wrenches are particularly good for this work.

1. Remove the mounting clips from the base of each Amperite, and cut off the ends of two clips where they bend over the end of the base. Using ½-in. 6-32 F. H. screws and nuts, mount these clips on the under side of the tube panel. Note carefully how they are arranged. The two clips toward the front of the base panel are those which have been cut off, while the rear pair have the ends bent down flat and filed out with a rat-tail file so that the screws which will be put in later through the base panel and sockets will make connection with the clips. Remove the screws which hold the contact springs on the sockets, put the sockets on the top of the base panel, and in place of the screws which were used for terminals, use ¾-in. 6-32 R. H. screws

passing through the base panel and up to the four corners of the sockets. These screws must have lugs under them. You will see that this arrangement serves two purposes. The longer screws hold the sockets to the base panel and at the same time allow connections to the terminals to be made at the under side of the tube panel. Be very sure that the sockets are put on correctly and the slots in the socket tubes are located as shown in Fig. 1, the top view.

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.

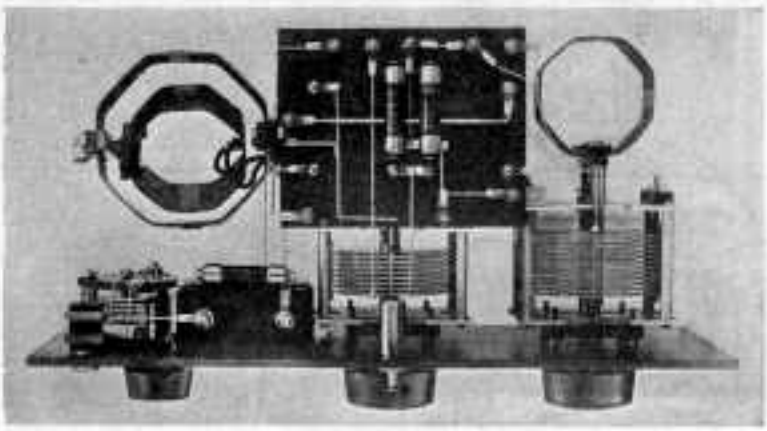


Fig. 6. A bottom view showing the Amperites, R.F. transformer, and fixed crystal detector.

2. Mount the five binding posts on the tube panel using two lugs under the nuts where they are shown in Fig. 4.

3. Connect 1 to 2, 3 to 4, 5 to 6, and 7 to 8. Connections 1 to 3, and 5 to 6 are made between the lugs themselves without the use of connecting wires.

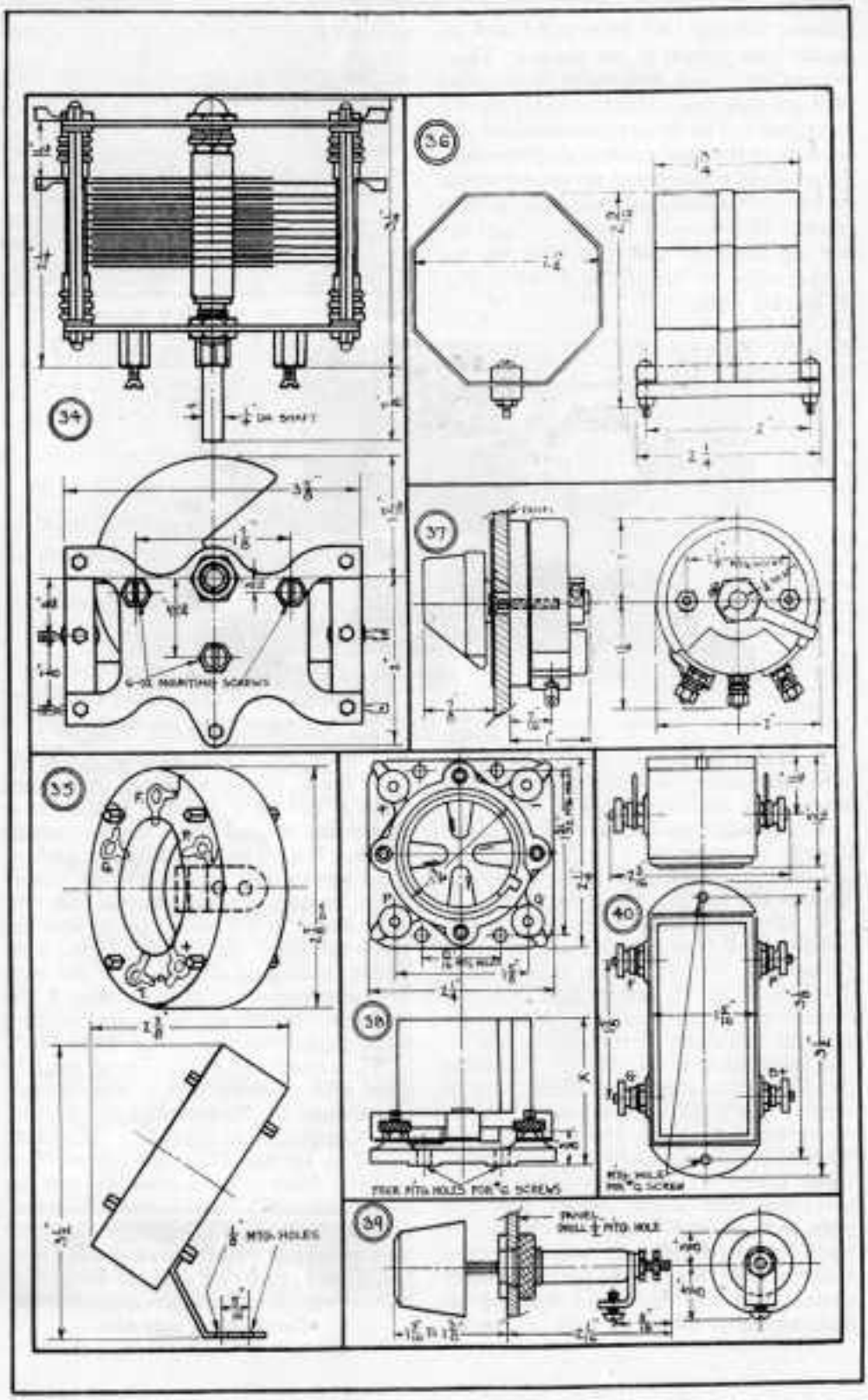
4. Mount the variable condensers, lock switch, R. F. transformer, and the telephone jack on the front panel. Use ½-in. 6-32 F. H. screws and nuts for mounting the transformer. Make sure that the secondary terminals are toward the lower part of the panel. To mount the National condensers it is necessary to remove the dials. 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

5. With the condensers in place, remove the R. H. screws which go through the rear end plate of the smaller condenser and thread into the supporting pillars. Put an angle bracket on each of these screws and tighten up the screws again in their proper places. Do the same thing to the screw going into the lower left-hand post of the larger condenser, looking at the set from the rear. This arrangement is shown in Fig. 1, the top view. Fasten the tube panel to these three angle brackets, using ½-in. 6-32 R. H. screws and nuts. These must be fitted with soldering lugs as they provide connections 14, 16 and 32.

6. Connect 9 to 10, 11 to 12, 13 to 14, 15 to 16, and 17 to 18. Wire 17 to 18 runs from the G terminal on the socket through a hole in the tube panel and up to the binding post on the fixed plates of the variable condenser.

7. Put a soldering lug on 19, the G post of the R. F. transformer, and an-

(Continued on page 40)


34
36
37
35
38
40
39
6-32 MOUNTING SCREWS
⅛ MTG. HOLES
FOUR MTG. HOLES FOR 6 SCREWS

Data Sheet No. 5

34. GENERAL INSTRUMENT TYPE 56D NOLOSS CONDENSER: This item represents a new departure in low-loss condensers in that four insulators, each one only 7/16-in. diameter by ½-in. long, comprise all of the dielectric material used. These are made of Isolantite which ranks with quartz, air, and pyrex, as a minimum dielectric loss material. The condenser is of the grounded rotor type and has metal end plates which are outside of the dense electrostatic field. It has good, long bearings and a friction-wipe contact on the rotor. Connections can be made directly to the stator and rotor by means of the soldering lugs provided. Three 6-32 F.H. machine screws are used for mounting. The dimensions shown are for the 21-plate 0.0005 mfd. size.

35. KELLOGG R.F. TRANSFORMER: The primary of this aperiodic, air-core transformer has 11 turns wound in a single layer on a thin rubber tube. The secondary is wound in honeycomb fashion and is supported by small rubber pegs. A separation of about ¼-in. is allowed between the two windings. Taps are provided on the secondary. The unit is supported at an angle on a nickeled brass foot for one hole mounting. Green silk covered wire is used without dope or varnish of any kind.

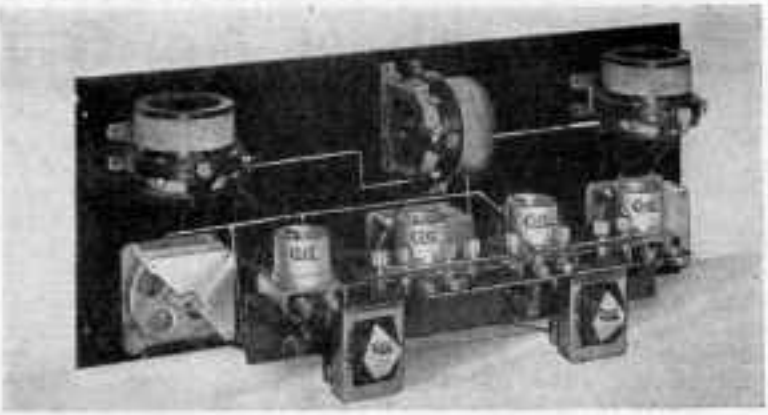
36. EASTERN PICKLE BOTTLE COUPLER: In this low-loss aperiodic antenna coupler, dielectric material has been reduced to a minimum. No tubing or dope of any kind is used, the windings being of pickle bottle form, self supported and reinforced with narrow strips of gummed paper. The primary has six turns of white silk covered wire and the secondary has 55 turns of green silk covered wire. Each is wound in a single layer to reduce the distributed capacity. Two clamping strips of Formica are used for mounting the coil. This coupler will tune from 200 to 600 meters when used with a .0005 mfd. condenser.

37. PACENT RHEOSTAT AND POTENTIOMETER: The dimensions given apply both to the rheostat and potentiometer. The winding is supported on a composition form, and the contact arm is permanently set at the factory. The shaft and knob are removable and the construction is such that either panel or baseboard mounting can be employed. The middle binding post goes to the contact arm. The knob is unique in appearance and a silvered dial is also furnished. Two-hole mounting is used. The rheostats are supplied with resistances of 6, 10, 20, 30, and 50 ohms, and the potentiometer of 375 ohms.

38. BENJAMIN SOCKETS: The electrical and mechanical design of these sockets is very good. They are made of Bakelite. The shell floats on four light springs which act as shock absorbers and prevent microphone noises caused by vibration of the tubes. This feature has long been sought for in connection with the use of UV-199 tubes. Each contact, spring, and soldering tab, forms a continuous unit and is fastened to the shell with an eyelet. Both binding posts and soldering tabs are provided for connection. The dimension X in the drawing is 1¾ in. for the standard socket and 1-1/16 in. for the UV-199 socket. All other dimensions are common to both.

39. MARSHALL-STAT: This is a vernier rheostat suitable for either standard or dry cell tubes, and is very compact. The entire unit is made of heavily nickeled brass. One hole mounting is used with a knurled collar which screws up in back of the panel. One connection is made to the screw at the extreme back and the other to the screw on the angle piece.

40. ALL-AMERICAN R.F. TRANSFORMER, TYPE R-199: This transformer is very neat and compact and is enclosed in a bakelite case. It was specially designed for use with UV-199, C-299, and similar tubes, and the wavelength range is from 225 to 550 meters. Both binding posts and soldering tabs are provided for connection.



Four-Tube Coto Symphonic Broadcast Receiver

Extreme selectivity is obtained in this set by the use of a built-in wavetrap circuit. One stage of tuned R. F. is followed by a detector and two stages of A. F. amplification.

ALTHO the parts employed in the Coto Symphonic Receiver are familiar, since the couplers, variable condensers, sockets, and transformers have already become popular among set builders, the complete outfit is new and presents ideas which are most interesting.

The important feature of this receiver is that it is constructed with one step of tuned radio frequency amplification used in connection with a wave trap and that variable coupling is provided between the wave trap and the antenna coupling coil, the secondary and its corresponding antenna coil, and between the primary and secondary of the tuned R.F. transformer. While three adjustments are added in this way, they are not at all critical, making it possible to leave them unchanged over a wide range of wave lengths and operating conditions. However, when it is necessary, these elements can be adjusted and the sharpness of tuning or the amplification increased accordingly. The wave trap for example, is very loosely coupled under normal circumstances and, as a result, does not have a tendency to absorb energy on the wavelengths being received. However, it can be brought into operation very quickly to cut out interference. The same thing is true with the primary-secondary coupling. For ordinary use, the coupling is made as tight as possible, being reduced only when interference calls for still sharper tuning.

The use of adjustable coupling between the primary and secondary of the tuned R.F. transformer is always a good idea, making it possible to obtain maximum amplification without causing the first tube to break into oscillation.

Many experimenters and set builders do not realize that, in a tuned R.F. receiver, tuning the secondary has the effect of tuning the primary. Therefore, if the coupling between the primary and secondary is too tight, the tuning action of the secondary condenser upon the primary or plate circuit is the same as if tuning were employed in the primary. That would, of course, cause the tube to oscillate. At the longer wavelengths, this effect is hardly noticeable, but at about 300 meters or below, even when neutralization is employed, the adjustment becomes critical and the tendency to oscillate quite pronounced.

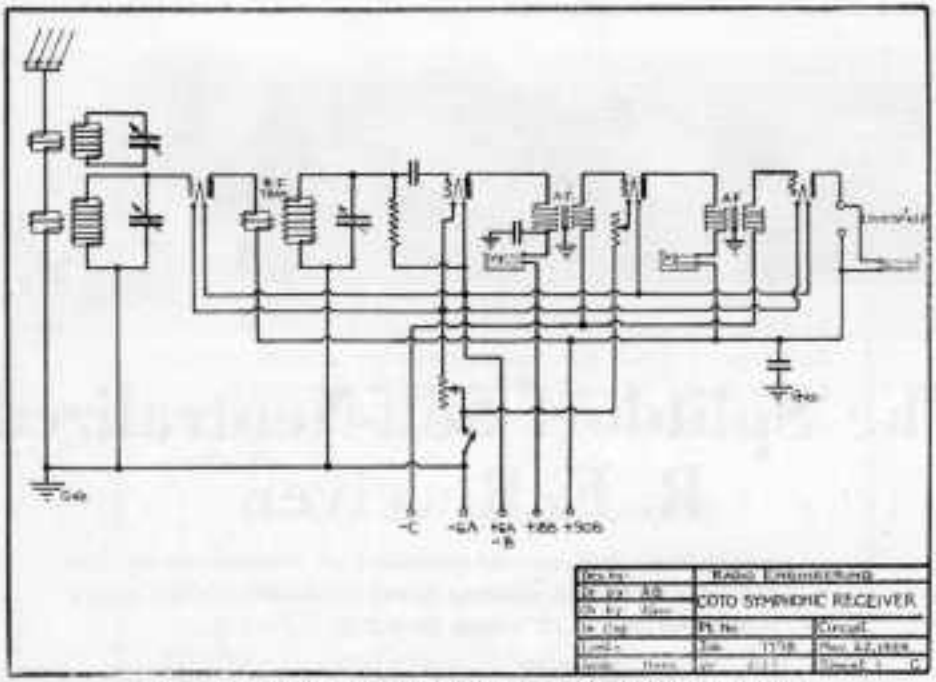
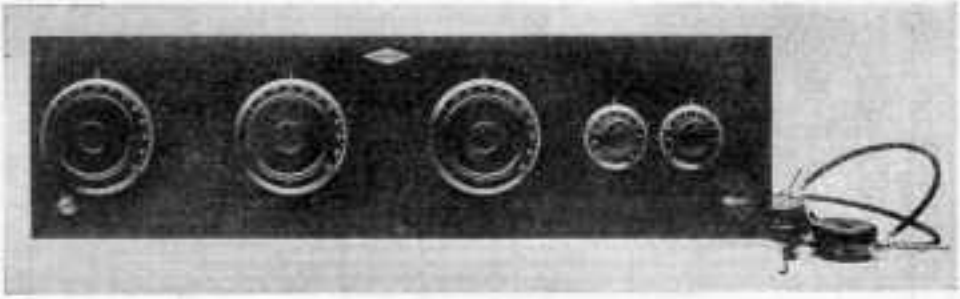


Fig. 2. Schematic wiring diagram of the Coto Symphonic receiver.

The sockets on this set are of very good design, for the terminals are insulated from the metal frame with hard rubber strips. Instead of the ordinary type of spring contacts, a special arrangement is employed by which the springs grip each pin on both sides. Thus a large contact surface is obtained with a side-wiping action which keeps the pins clean and bright.

The variable condensers are one of the first to be designed successfully with a single bearing for the shaft which carries the rotary plates. You can see the vernier by which fine adjustments of the capacity are obtained. These condensers, by the way, were also one of the first to be made with a metal end plate. Both stator and rotor plates are insulated from the frame.

Fig. 3. Showing the arrangement of controls for tuning the set.



The Splitdorf Self-Neutralized R. F. Receiver

In this five-tube set, the problem of neutralization has been attached in a unique manner incorporating many interesting mechanical features. Part 1

THE Splitdorf R. F. receiver, shown in the accompanying illustrations, represents a happy combination of high efficiency, simplicity of construction, ease of operation, as well as freedom from disturbances due to oscillation. It provides two stages of tuned radio frequency, detector, and two stages of audio frequency amplification. A single circuit coil, tuned by a .43-plate variable condenser, is employed for the secondary circuit. This delivers the maximum amount of energy from the aerial to the first R. F. tube, and does not reduce the selectivity of the set since the following stage of tuned R. F. amplification provides all that is necessary. The two interstage R. F. coupling coils are of the air core type, each tuned by a 17-plate variable condenser. Since no potentiometer is necessary for controlling the tendency to oscillate, the three condensers are the only controls used. Stations may be logged since the settings for any station remain constant for a given aerial and ground. The two 0.00025 mfd. fixed condensers, the number of turns in the primary and secondary of the two interstage couplers, the size of wire and method of winding are all vitally important factors in securing the inherent balance and non-oscillating features which hold good at all broadcast wavelengths.

How the Circuit Is Arranged. Examination of the schematic wiring diagram shows that one rheostat controls filament current of the two R. F. tubes and the other controls the detector and the two A. F. tubes. A negative grid return is employed on the two R. F. stages. The two A. F. stages have provision for using a C battery for biasing the grid. A jack is provided for plugging in on the first A. F. stage when locating a new station with the phones. A 1 mfd. fixed condenser by-passes the radio frequency currents around the B battery employed in the R. F. steps. A .006 mfd. fixed condenser is used for by-passing any R. F. currents in the A. F. amplifier around the loud speaker, A, C, and A. F. amplifier B batteries.

The set is designed primarily for use with an aerial. During a test at the Darien laboratory it was found to be extremely selective, a movement of the center dial one or two divisions either way completely tuning out any station. Fair results were secured using an aerial alone on a ground alone. In apartment houses in a city like New York, where

many high powered broadcasting stations are located, all local stations should be brought in on a loud speaker using only a ground connection.

Design Details of the Set. There are several new construction features in this outfit. The detector and two stage A. F. amplifier comes already assembled and wired in a deck form. It is only necessary to fasten this to the baseboard with four screws and make the outside connections to it. The three inductance coils are wound on Bakelite tubing and each one has its .00025 mfd. condenser already connected across the top. The primaries of the two R. F. transformers are wound with large wire to cut down resistance losses. These coils are spaced 6½ ins. on centers and the antenna coil is located 3½ ins. above the other two coils so as to avoid magnetic coupling. Grounded rotor condensers and bakelite sockets are used.

A front view of the set is shown in Fig. 1. Looking from left to right we have the antenna tuning and the two R. F. controls. Next comes the rheostat No. 1 which controls the two R. F. tubes, and rheostat No. 2 which controls the detector and two A. F. tubes. The small knob in the lower left hand corner is for the filament switch; in the lower right hand corner is the phone jack.

A Formica panel 7 by 26 ins., 3/16-ins., thick, supports the condensers, rheostats, jack, and filament switch. A wooden baseboard 8 by 25 ins., 5/8-in. thick, fastened to the front panel, carries the detector and A. F. amplifier unit, sockets, 1 mfd. fixed condenser, and coils. In addition, there is a Formica binding post panel 2-5/8 by 25½ ins., 3/16-in thick, for the battery, aerial, ground, and loud speaker connections.

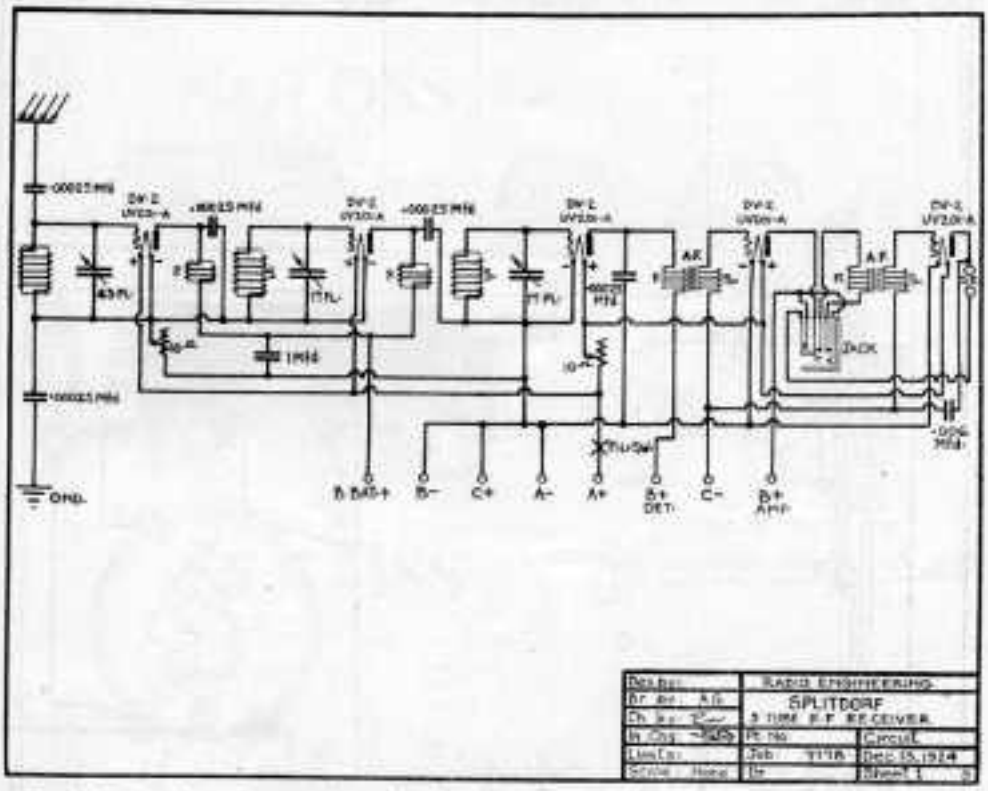


Fig. 2. This wiring diagram shows the circuit system employed for the Splitdorf receiver.

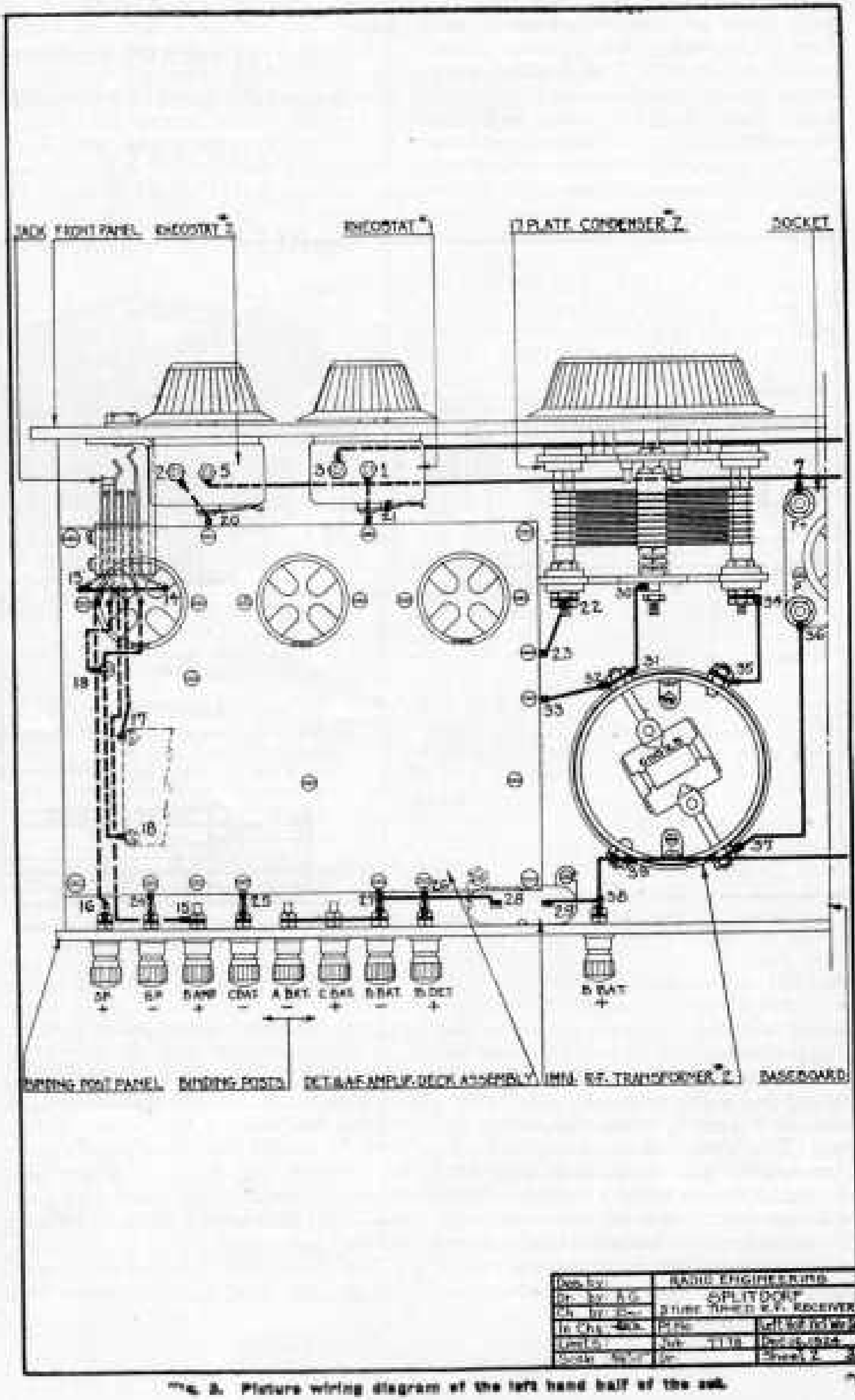


Fig. 3. Picture wiring diagram of the left hand half of the set.

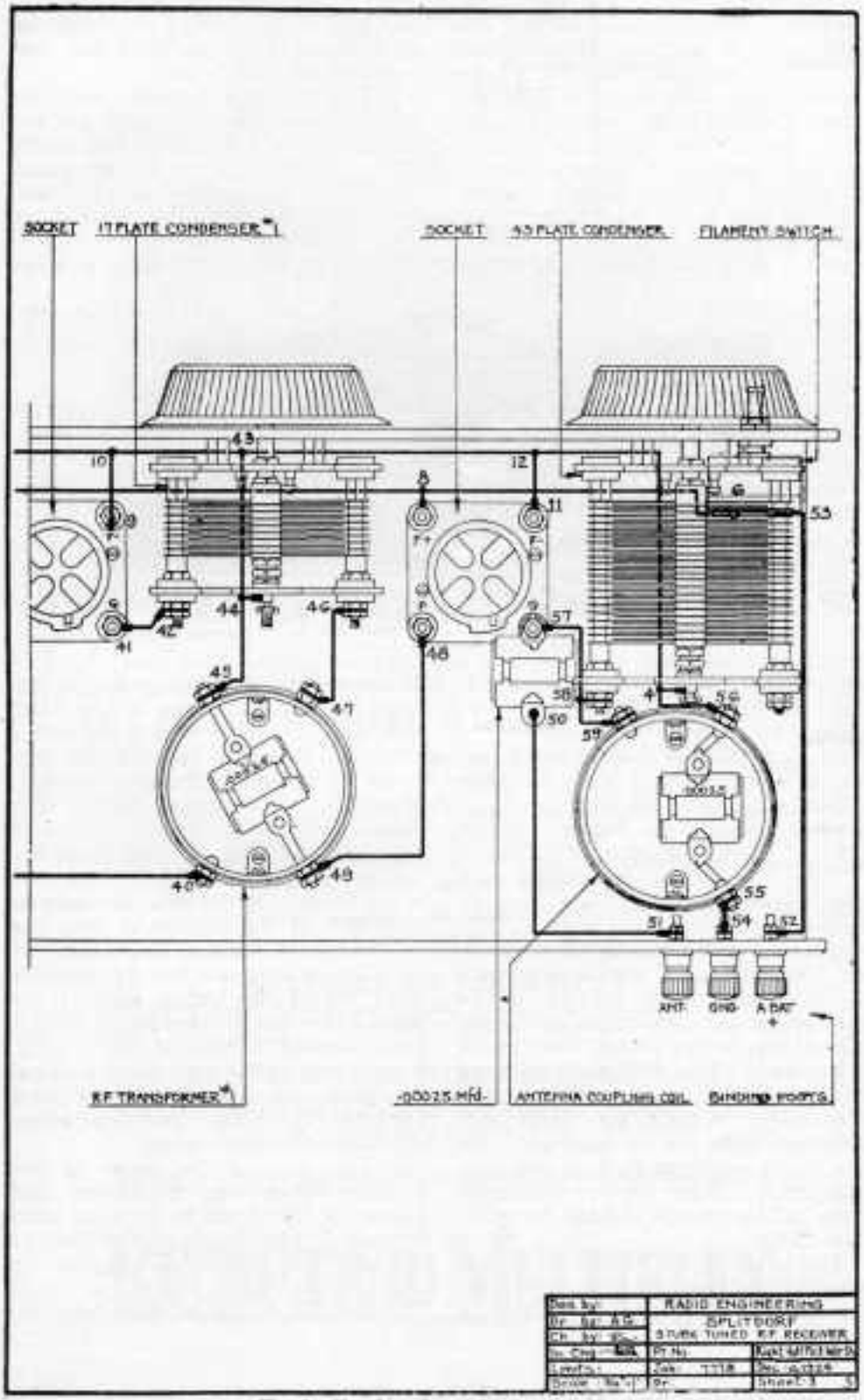


Fig. 4. Showing the right hand half of the Splitdorf outfit.

Standard Parts Required. Parts required for this outfit are: One 43-plate Heath condenser, two 17-plate condensers, three 4-in. Splitdorf dials, one Cutler-Hammer battery switch, 2 Pacent jack, two 10-ohm Splitdorf rheostats and dials, one Splitdorf detector and A. F. amplifier unit, one antenna coupling coil and two R. F. transformers with .00025 mfd. condensers, two table mount sockets, one .00025 mfd. fixed condenser, one 1 mfd. fixed condenser, 12 engraved Eby binding posts, Formica panel 7 by 26 by 3/16-in., and another 2-5/8 by 25½ by 3/16-in., a wood baseboard, 8 by 25 by 5/8-in., bus, bar, screws, nuts, lugs, and solder.

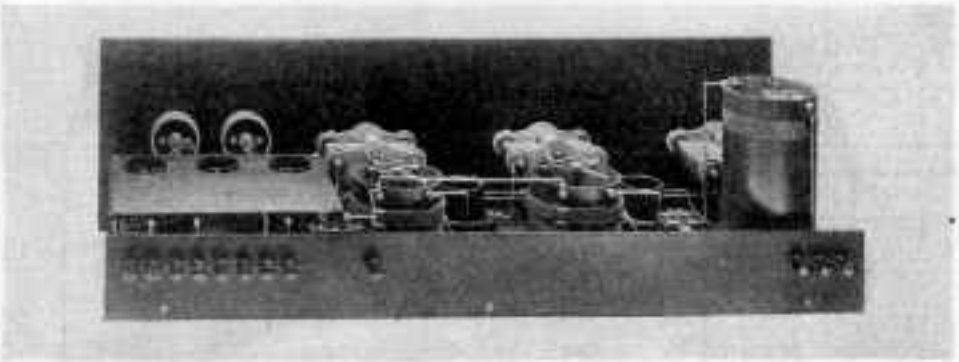


Fig. 5. This view shows the rear of the set. The A. F. transformers are under the tube panel.

Assembly and Wiring Figs. 3 and 4 show a picture wiring diagram of the set, in which the connections have been drawn exactly as they were arranged in the original receiver. The diagram is drawn looking down on the set. All soldering is done to lugs, some of which are already mounted on the instruments as they come in the kit. Tin all lugs before putting them on the instruments. This will make soldering much easier. Use either Kester rosin core solder or plain soft solder with Nokorode paste put on sparingly. The new Firth soldering fluid is also very satisfactory. 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 assembly and wiring as simple as possible. Read through each step before starting the work as it may save time and extra work later on.

1. Unscrew the outside nut and washer on the filament switch and put the stem through the large hole in the lower left hand corner of the panel, looking at the panel from the front. Put the nut and washer on again at the front of the panel, keeping the body of the switch in a horizontal position. Mount the jack in the large hole at the lower right hand corner in the same way, with the frame vertical and to the left side. Mount the large 43-plate condenser in the set of holes at the left. Mount the two remaining 17-plate condensers in the respective sets of holes to the right. Remove the dials from the two rheostats by loosening the set screws in the knobs. Mount these rheostats on the right of the condensers with the 1-1/8-in. F. H. machine screws and nuts provided, making sure that the terminals point toward the bottom edge of the panel. Now put a tinned lug on the left hand terminal of rheostat No. 1, (Fig. 3,) and one on the right hand terminal of rheostat No. 2, looking at the panel from the rear. Have these lugs pointing in the directions shown.

2. Take two of the pieces of the braided copper wire connections and fasten the lug of one to the right hand terminal 1, and the lug of the other to the left hand terminal 2. Tighten up all the nuts on these rheostats as it will be impossible to get at them later on.

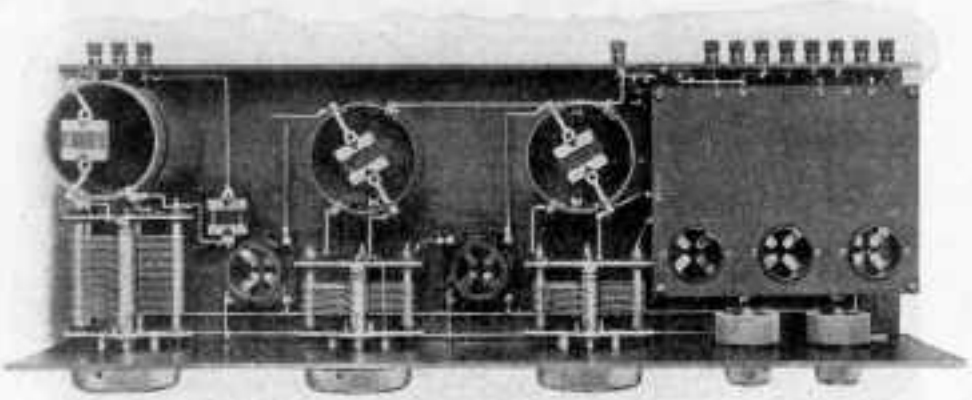


Fig. 6. The arrangement of the receiver has been carefully worked out, as you can see from this top view.

Leave the other ends of these two wires free for connection to the deck assembly later on.

3. Mount the two sockets on the baseboard with the 7/8-in. R. H. wood screws provided, using the picture wiring diagram and the holes drilled in the baseboard to locate their positions. Keep the F + and F — terminals facing the front edge of the baseboard. Now fasten the front panel to the baseboard with the three 1-in. F. H. wood screws. See that the lower edge of the panel is flush with the under face of the baseboard, and that there is a 3/8-in. space between each end of the baseboard and the corresponding end of the panel.

4. All of the following instructions are given looking at the set from the rear, as this is the natural way in which the work will be done. Using a full-length piece of bus wire, connect the left hand terminal 3, of rheostat No. 1 to 4, the rotor connection of the 43-plate condenser. Keep this wire 1/4-in. from the front panel, and 3/4-in. from the baseboard, and leave a 6-in. length of wire beyond 4 for a connection to be made later. Connect 5, the right hand terminal of rheostat No. 2, to 6, the left hand terminal of the filament switch. Run this wire 3/4-in. from the front panel and 3/4-in. from the baseboard, and solder it at 7 and 8, the F + terminals of the sockets. Connect 9, the F — terminal of the left hand socket, to 10, a point on the wire nearest the panel. Run this wire up, over, and down, keeping the horizontal part 1 1/2-in. from the baseboard. In making the connection at 10, put a small loop in the end of wire 9 to 10 so that it can be hooked around wire 3 to 4 and then soldered. Make all connections of that type in this manner. Connect 11, the F — terminal of the right hand socket, to 12 in the same way.

5. Using the picture wiring diagram as a guide, assemble all the binding posts on the binding post panel, with the engraved heads protruding from the dull side of the panel. Have the hole in each binding post pointing up and down and fasten each post to the panel with one of the hexagon nuts provided. Place a tinned soldering lug on each binding post except the A Bat — and C Bat + posts, and fasten each in place. Insert the small copper jumper bar over the A Bat —, C Bat +, and B Bat — posts. All of the lugs should point straight up, excepting the Ant, A Bat +, Speaker +, and B Amp +.

6. Solder pieces of bus wire about 2 ins. long to the lugs on the Speaker —, C Bat —, and B Det + binding posts, leaving the wires projecting up. Solder a wire about 4 ins. long to the lug on the B Bat — post, and leave it projecting up. All of these wires will be used later for connecting up the detector and A. F. amplifier assembly.

(The concluding data on this set will appear in the February issue.)

A Simple Method for Making A. F. Transformer Amplification Curves

The method of making A. F. transformer curves described here takes the mystery out of characteristic tests

MANUFACTURERS who want to find out for themselves the real story about the amplification curves on various transformers, or the experimenter who wants to make some interesting tests, can very easily set up a circuit for making A. F. transformer curves, using the circuit shown in Fig. 2.

On some transformers, surprising variations will be found between the curves published by manufacturers and those obtained with this circuit. Sometimes curves shown in descriptive pamphlets are not made from actual measurements, while others are decidedly inaccurate owing to the use of make-shift testing circuits. The data on the system to be described was given to us by Mr. Samuel Cohen, Chief Engineer of the General Instrument Company. This system of testing is very accurate and can be depended upon to show the true amplification obtained in the transformer under test at various audio frequencies.

The accompanying photograph shows the laboratory of the General Instrument Company in which this circuit is used for research work. We have also made up this equipment for use in our laboratory at Darien, Connecticut.

Audio frequency alternating current is supplied to the circuit from a vacuum tube oscillator. Data is not given on the oscillator, although it will be described in detail a little later. The output of the oscillator is connected to a coupling transformer made from an ordinary A. F. transformer. The iron core, however, is removed and the windings placed in a small tin box which serves as a shield. The shield is connected to the ground.

In addition, one 200-ohm and two 400-ohm potentiometers are needed, a fixed resistance of 20,000 ohms, another resistance, R_2 of 200 ohms, and one 2 microfarad condenser. Ward-Leonard resistance units are well suited for this purpose. A Federal 8-contact cam switch is needed to connect or disconnect the transformer under test, with a vacuum tube for the transformer coupled amplifier followed by a stage of resistance

coupled A. F. amplification. In addition, a 0 to 10 thermo-couple milliammeter and a 0 to 125 thermo-milliammeter are needed. The former may be a calibrated thermo-couple connected to a low-reading milliammeter while for the milliammeter a Weston type 301 instrument will be satisfactory. This meter should be connected in the plate circuit of the last resistance coupled amplifier.

reading of the thermo-ammeter T. A. by resistance R_2. The ratio of the drop last determined to the drop first determined gives the voltage amplification of the transformer at the particular audio frequency employed.

For example, if the first reading of the thermo-ammeter is 4 milliamperes the drop across resistance R_2, of 200 ohms, is 0.80. If, after the switch is thrown

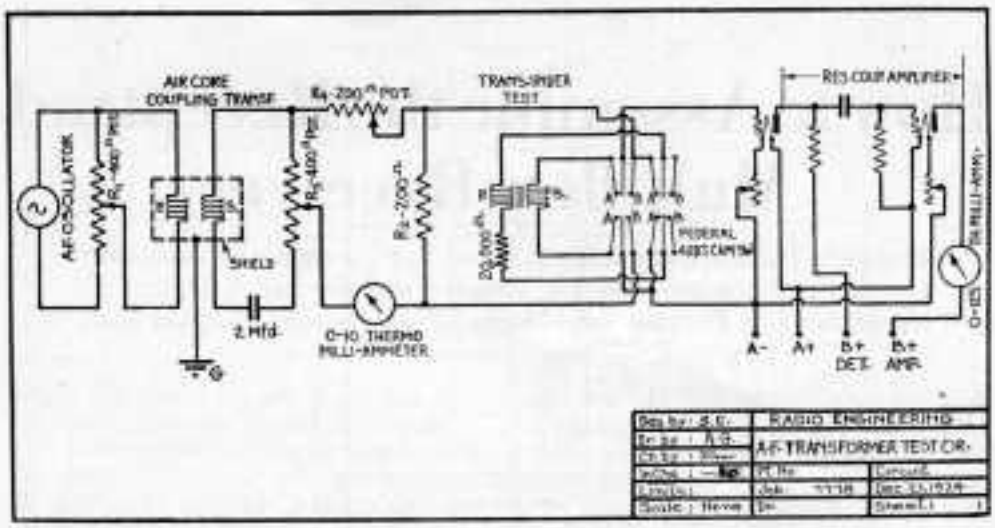


Fig. 2. This wiring diagram shows the connections for the audio frequency transformer characteristic testing set-up. The 0—10 thermo milliameter is the meter referred to as T.A. A resistance coupled amplifier is used in this circuit because its operation is independent of the audio frequency and does not introduce any distortion in addition to that which may be found in the A.F. transformer under test.

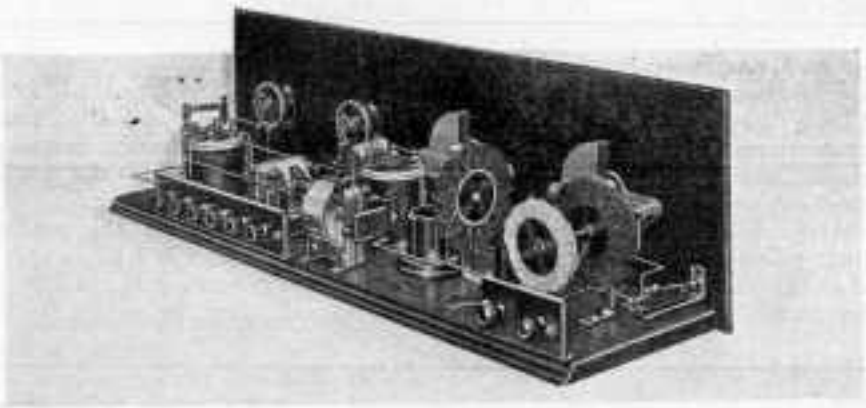
The testing process is very simple. The transformer to be tested is connected as shown. Then the switch is thrown to position AA. By adjusting the rheostats R_3, and R_4, the reading of thermo-couple ammeter T. A. is brought to about the center of the scale. Then the reading of the milliammeter in the amplifier plate circuit is recorded. Also the drop across resistance R_2 is determined by multiplying the reading of the thermo-ammeter T. A. by the resistance in ohms of R_2.

Next, the switch is thrown to position BB and resistances R_3 and R_4 again adjusted until the same reading is obtained in the milliammeter in the amplifier circuit. Again the drop across R_2 is determined by multiplying the new

to BB, the thermo-ammeter shows 8 milliamperes, the drop across R_2 is then 1.60. The ratio 1.6/0.8 is 2, which is the amplification obtained by the transformer at the A. F. frequency employed.

If it is not possible to bring the ammeter to its first reading without running the thermo-ammeter off the scale start the measurements all over with a lower first reading on the thermo-ammeter by adjusting R_1.

Tests are made at various audio frequencies to ascertain the characteristics of the transformer. The frequency of the oscillator is measured at this laboratory is measured by means of a Seibt audio frequency meter. This meter is a Campbell bridge having a calibrated variable inductor with fixed condensers.



How to Assemble the Receptrad Multiflex Receiver

In this set there are one stage of tuned R. F., a stage of transformer coupled R.F., crystal detector, reflexed transformer A.F., straight transformer A.F., and two stages of impedance coupled A.F. amplification

MANUFACTURERS of construction kits, in common with those who build complete sets, find it necessary, as soon as a kit of one type is put on the market, to start work immediately on a new design or circuit, not only to continually improve results but to have something new to offer as soon as the current design has lost its originality.

The multiflex employs one stage of kit follows their very popular superheterodyne outfit which they previously manufactured. All through the summer and the fall the laboratory development has been carried out until now the new design is ready for the set builders.

The Multiflex employs one stage of tuned radio frequency amplification, and one stage of transformer coupled R.F., followed by a fixed crystal detector and two stages of transformer coupled A.F. with an additional stage of distortionless impedance coupled A.F. This is an unusual combination but the results certainly justify the arrangement employed. Although the effect of six tubes is obtained, only four are required since one is eliminated by the use of the crystal detector, and another by reflexing one of the audio stages.

A feature of this set which will appeal to many radio men is the arrangement for using either an antenna and ground or a loop antenna. No special switching circuit is required for the loop can be plugged into a jack at the front, or the antenna and ground connected to binding posts at the rear.

The kit is made up in two parts, the type M4-8 which contains the essential instruments, and the M4-12 which provides all the additional parts to make up the complete receiver. In the first kit there are the following Receptrad parts: 5 to 1 Silvertone reflex A.F. transformer, 3 to 1 Silverton A.F. transformer, Choke coil transformer and 50,000 ohm by-pass resistance, antenna coupler, radio frequency coupler, fixed crystal detector, and 200 ohm rheostat. The accessory kit contains a Formia panel 7 by 24 ins., drilled and engraved, four Na-Ald sockets, a 6-ohm rheostat, one single and two double circuit Pacent jacks, Cutler-Hammer filament switch, two 13-plate DR Duplex variable condensers, two 4-in. knobs and dials, a 0.001 mfd. Freshman fixed condenser, eight binding posts, and the two binding post strips, together with the necessary hardware.

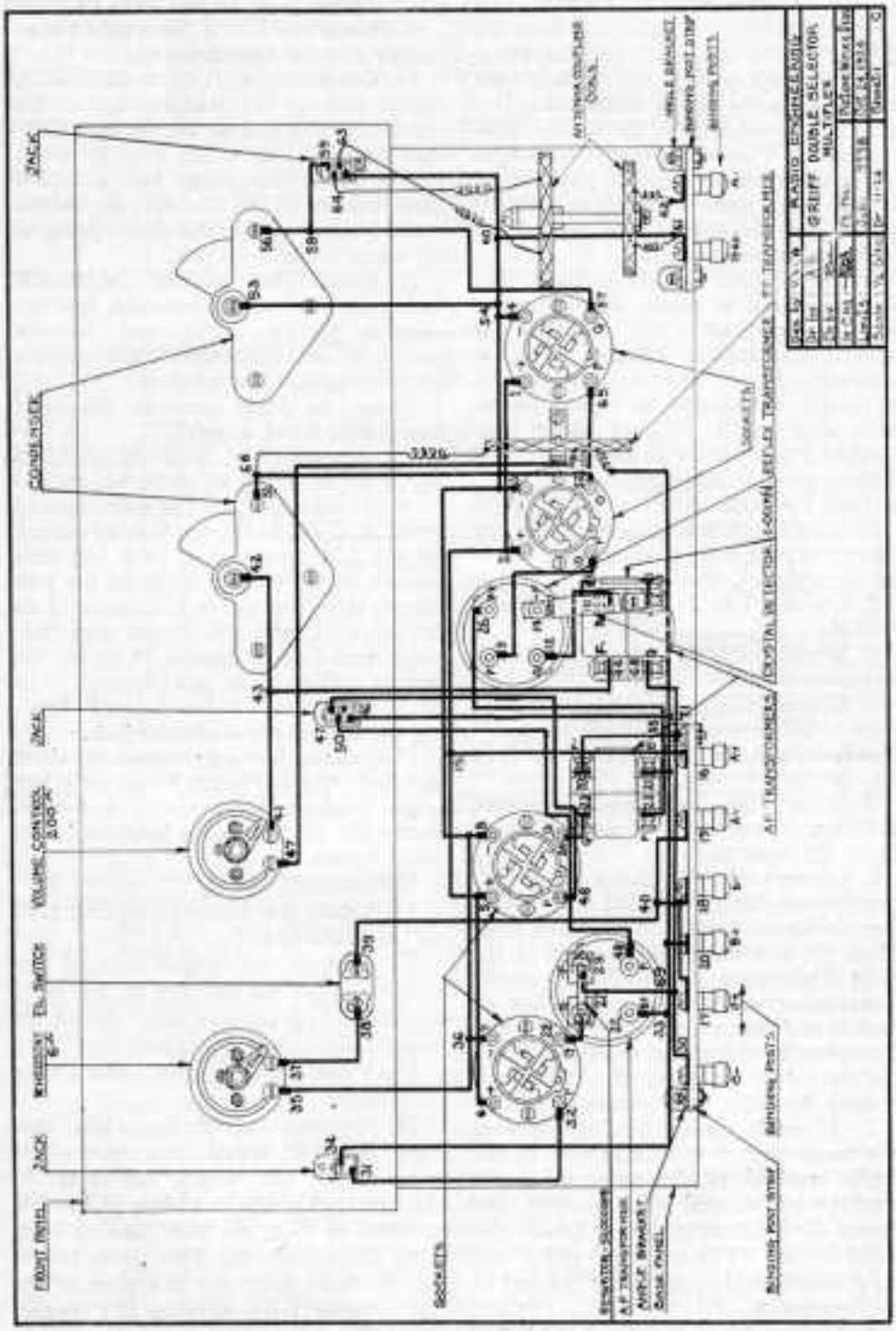


Fig. 3. Picture wiring diagram showing the connections as they were made on the original set.

Assembly and Wiring

This outfit is also sold completely assembled and mounted in a cabinet. The following step-by-step instructions are for the assembly of the combination Receptrad kits which include every item necessary. You are strongly advised to follow the assembly steps as given below as they have been prepared in such sequence that the work can be carried out in the easiest manner.

In the original model soldering lugs were not used at points where binding posts are supplied. This simplifies the work considerably. Where wires are fastened together, however, soldering is necessary. Be sure to use either Kester rosin core solder or soft solder with Nokorode paste. Use as little solder and flux as possible, applying sufficient heat to make the solder flow freely.

1. First mount the four sockets on the baseboard with their binding posts in the positions shown.

2. Connect 1 to 2, 3 to 4, 5 to 6, and 7 to 8.

3. Mount the large reflex transformer on the baseboard.

4. Connect 2 to 5, running the wire close to the base so that it will not interfere later with the center jack. Connect 9 to 10.

5. Mount the right-hand Silvertone A.F. transformer, 1 to 5 ratio, looking at the set from the rear.

6. Connect 11, the B + post, to 12; connect one side of the 0.001 mfd. Freshman condenser to the wire running from 11 to 12, and the other terminal of the fixed condenser to 13, the P post on the transformer. Put an angle bracket on post 13 and fasten it to one of the springs for mounting the crystal detector. Fasten the other detector spring at 14, the — F post on the reflex transformer.

7. Assemble the six binding posts on the supporting strip, fasten two of the angle brackets to the strip, using the machine screws and nuts supplied, and fasten the brackets to the baseboard with wood screws. The left-hand end of the strip should be 1⅛ ins. from the end of the baseboard.

8. Connect 15 to 16, the A + binding post; connect 17 to 18 and 18 to 19.

9. Mount the 1 to 3 Silvertone transformer and the impedance coil.

10. Connect 20 to 21, 20 to 22, and 23, the G post on the transformer, to 24, which is the G post on the socket. Connect 25 to 26, 27 to 28, and 29 to 30. Fasten one of the springs for the 50,000 ohm resistor to 27, the G post on the transformer. Fasten the other spring to 29, which is the — F post.

11. Mount the variable condensers, high resistance volume rheostat, low resistance rheostat, jacks, and filament switch on the front panel, checking their positions against the drawing.

Fasten the front panel to the baseboard with wood screws.

12. Connect 31 to 32, 33 to 34, 35 to 36, 37 to 38, 39 to 40, 41 to 42, and 43 to 44. Connect 45, on the wire running from 20 to 21, to 46, the bottom contact on the jack; connect 47, the top jack contact, to 48; connect 49 to 50, the first contact down on the jack, connect 51 to 52, 53 to 54, which is on the wire running from 3 to 4, connect 54 to 55, the bottom spring on the jack; connect 56 to 57, and 58 to 59. Connect 3 to 8, keeping the wire above the center jack.

13. Put two binding posts on the short terminal strip and fasten to the strip two angle brackets, using screws and nuts. Secure the brackets to the baseboard with wood screws.

14. Connect 60 to 61.

15. Mount the antenna coupling coils on the baseboard.

16. Connect the outside tap of the smaller coil to 62 and one of the inner taps to 61; connect the inner tap on the larger coil to 63, and an outer tap to 64.

17. Mount the R.F. transformer on the baseboard.

18. Connect one of the white taps from the R.F. transformer to a short piece of bus bar running out from 65; the other white tap to a piece of bus bar soldered at 45 to the wire running from 20 to 21; connect the outer green tap on 66; the inner green tap to a piece of bus bar running from terminal 67; connect 68 to 69, on the wire running from 29 to

Why engineers favor De Forest Tubes

The DV-2 has a filament potential of 2½ volts and a filament consumption of 25/100 of an ampere.

Uniformity gives accuracy in laboratory work. One set of De Forest Tubes brings in signals as clearly and as deeply as another.

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.

THE mechanical characteristics that recommend De Forest Tubes to the rough usage of the laboratory add months to their lives in the less turbulent sockets of the fan.

The electrical characteristics—the high Mu—that the engineers find so desirable provide a higher amplification constant.

De Forest Tubes will do all they are required to do—and more. One specialist, an expert on resistance coupled amplification, uses them because of their high mutual conductance with which the amplification varies directly. Another finds that only De Forest Tubes will stand momentary overloading and work perfectly after the load is removed.

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

Sold by authorized dealers only. Made by the makers of De Forest Radiophone, Loud Speaker and all radio parts. De Forest Radio Company, Jersey City, N. J.

DE FOREST RADIO COMPANY
Jersey City, N. J.

DE FOREST TUBES

Reg. U. S. Pat. Off.

The "Magic Lamp" of Radio

30; and 70 to 71, on the wire running from 68 to 69.

This completes the wiring of the set. This outfit is designed for UV-201-A, C-301-A, or DV-2 tubes. All these tubes require six volts. If you wish, you can use the low current tubes, although the volume will be sacrificed. The B battery should be of 65 to 90 volts, and the C battery an adjustable Eveready 3, so that the biasing voltage can be regulated when the set is in operation. With a higher B battery voltage, the C battery voltage must be increased.

Fig. 4. The left and center dials are for tuning, while the right hand dial regulates a potentiometer which controls the volume.

The tuning of this set is exceedingly simple. The condenser dials are kept at about the same settings over the entire range. The volume control regulates the signal strength and prevents distortion. When the set is ready to operate you will see very quickly how this dial should be adjusted.

Notes on Impedance Coupling Some notes on impedance coupling may be interesting to those who are not familiar with audio frequency amplifiers of this sort. The circuit arrangement is somewhat similar to that employed on resistance coupled amplifiers. However, the D. C. resistance of the impedance coil is kept as low as possible in order to make the current consumption of the plate circuit low. The A. C. impedance, on the other hand, is very high, limited by the expense of the coil and the mechanical dimensions. Theoretically, a perfect impedance coupled amplifier would employ a coil of almost infinite impedance to alternating currents.

In operation, the steady flow of current passes through the impedance coil but, when a charge is placed on the grid, the impedance opposes any change of current through it. Then the charge is passed on to the grid of the following tube. The efficiency of this type is about the same as that of a resistance coupled amplifier. As a matter of fact, those who use one or the other generally believe that the type they use is superior. It is true that the impedance coupled amplifier does not require an extra high plate potential. On the other hand, an impedance coil is slightly more expensive than a resistance coupled amplifier unit.

One of the first commercial applications of impedance coupling was in the S. C. R. 75 airplane receiver, manufactured during the war by the Western Electric Company for the United States Army. This outfit was a three tube non-regenerative receiver designed for VT-1 tubes. The impedance coils were encased in soft iron shells, mechanically connected with the core so as to give a closed magnetic field. This was done to make the impedance as high as possible and to protect the wire. The windings were impregnated with rosin.

What is QUALITY in a Radio Set?

Lieut. Greiff, working in conjunction with Receptrad engineers, sets new standards in quality and craftsmanship with the new

DOUBLE SELECTOR MULTIFLEX

It is the aristocrat of radio receivers. See it—tune it—hear it. You will be convinced the Receptrad Multiplex is supreme in

Tone Quality, Simplicity of Operation and Performance.

Six Tubes Reflexed into Four—Two Dial Controls—No Outdoor Aerial Required—The Multiplex is at once the favorite of the broadcast listener and the distance fan.

In Handsome De Luxe Cabinet, $100. Complete Batteryless Lamp Socket Type for Direct Current, $125

MULTIFLEX KIT FOR BUILDERS

The Greiff Double Selector can be easily assembled in a few hours. All you need is the Multiflex Kit, including all parts, Price $80. Contains principal parts. Price, $29.50.

RECEPTRAD "SUPER-HET" KIT

The Greiff Double Selector can be easily assembled in a few hours. All you need is the Multiflex Kit, including all parts, Price $50. Containing principal Super-Het Kit with all essential parts sells for $83.50. The smaller Kit containing most essential parts, $33.

FREE: Write for blue prints of the Multiflex and the Super-Het—also interesting literature.

RECEPTRAD MULTIFLEX

IS THERE anyone who does not know Oscar Roos? At the top of this page you will see him doing something with a slide rule. He is always doing something, altho many of us are apt to doubt that because few of us can understand most of the things he does. However, he's satisfied, because he believes he knows what it's all about. Oscar Roos is one of the few men who can tell truthfully about what he was doing in radio years and years ago. Right now, he is the latest addition to the consulting staff of F. A. D. Andrea.

It is interesting to note that several important features of apparatus design have become standardized thru a general agreement among radio manufacturers. These points, by the way, have been advocated for several years by Radio Engineering. Machine screws, unless special construction makes it impossible, are to be threaded 6-32. Instrument control shafts are to be ¼-in. in diameter. Scale markings for rheostat dials are to be divided from 0 to 10, with the word OFF shown separately. Regular control knobs are to be divided from 0 to 100, with the numerals arranged to increase as the dials are rotated in a clockwise direction. Vernier controls must turn in the same direction as the main dials. These few points will help more than might appear at first thought to make parts interchangeable.

The Weston Electrical Instrument Company has just published an important pamphlet covering measuring instruments of their manufacture which are essential to the accurate testing of radio sets and parts. Much can be learned from the data presented, for the manufacturer who thinks it is only necessary to test a condenser for short circuits or a transformer for opens is not keeping up with the steadily increasing standards of their competitors.

That manufacturers too often design their equipment with their eyes on the things others are making, instead of finding out by actual measurements what they are doing is indicated by the increasing number of couplers and R.F. transformers wound in the lattice or spider web fashion. No one would have the courage to call a coil "low-loss," when wound by those methods, if he ever actually compared them with the closely wound single-layer solenoid.

Keen competition in the matter of "super-transformers" is developing between the Rauland Manufacturing Company and Samson Electric, with the new type just introduced by General Radio as a third competitor. Whether these types will prove superior to the familiar designs must be decided in actual use by manufacturers and set builders.

Contrary to the general impression, the Connecticut Telephone and Electric Company has not stopped production on the S-13 Sodion, the smaller tube which requires a potentiometer control. In fact, the Acme Apparatus Company has designed their new Cabot circuit construction kit around the S-13 Sodion.

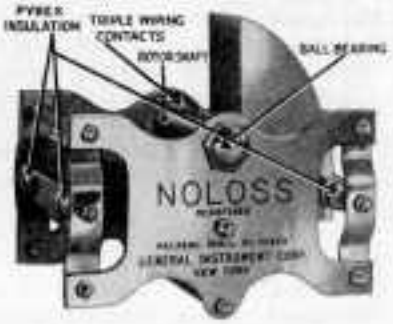
Rugged and Efficient

NOLOSS

TRADE MARK

TYPE 51

PYREX INSULATION



A variable condenser made so rugged that it withstands the hardest jar, sturdily keeping the capacity constant for a given setting.

A variable condenser whose high frequency readings measured at 1500 kilo-cycles show negligible measurable losses. The equivalent series resistance is .0037 ohms, the phase angle difference is 3.6 seconds, and the power factor is .00175 percent.

Pyrex and Isolantite insulation make General Instrument NOLOSS condensers possible.

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

NOLOSS

TRADE MARK

TYPE 56

ISOLANTITE INSULATION

General Instrument Corporation

Manufacturers of Laboratory Equipment

423 BROOME STREET

NEW YORK, U.S.A.

R-F-C Type Receiver

(Continued from page 19)

other on 20, a terminal on the fixed crystal detector. Bend these around as shown in Fig. 6 so as to make connection 19 to 20. Connect 21 to 22, the outer terminal on the jack and connect 22 to 23. 23 is the terminal for the variable plates on the small variable condenser. Connect 24, on the crystal detector, to 25, the terminal on the fixed condenser plates, and connect 25 to 26, the inner contact on the jack.

8. Cut off the shaft of the vario-coupler flush with the bushing. Remove the screw which serves as the terminal for the lower end of the primary winding on the vario-coupler. This is the third screw from the bottom. Take off the lower primary lead. Put the screw through one hole of an angle bracket and tighten the screw in place again. Then fasten this angle bracket to the tube panel with a ½-in. 6-32 R. H. screw and nut. Put a lug under the nut as it serves as connection. Solder the primary lead which you took off to the angle bracket.

9. Connect 27 to 28. 27 is the top terminal on the coupler contact strip. Connect 29 to 30. 29 is the second contact down on the terminal strip. It is well to insulate this wire with MR varnished tubing. Connect 31 to 32. 31 is the third terminal down on the strip and 32 is a lug on the screw which holds the angle bracket. Connect 33 to 34. 33 is the fourth terminal down on the strip and 34 the B binding post on the R. F. transformer. Another lug on 33 must be connected to 35. Connect 36 to 37. 36 is the bottom terminal on the terminal strip and 37 a connection made to the wire running from 17 to 18. Connect 38 to 39. 38 is soldered to the lug under the nut of the screw which holds the angle bracket to the tube panel.

10. Remove the thumb screw and nut from the connection to the fixed plates of the 25 plate condenser and screw on to this a coil support piller. Put a soldering lug on the screw under the pillar. Cut off the head from the ½ in. 6-32 screw, thread it part way into the end of the coil support pillar, put the nut on the projecting part of the screw and tighten up the nut against the end of the pillar so that

(Concluded on page 60)

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
	Benjamin Elec. Co., Chicago, Ill.	
	2-Standard base sockets	$2.00
	Davidson Radio Corp., 222 Fulton St., New York.	
FX	1-Rasla fixed crystal detector	1.25
	Diamond State Fibre Co., A-423 Broome St., New York.	
155	1-Black celoron panel 7 by 18 by 3/16 in.	2.95
	Eastern Coil Corp., 22 Warren St., New York City.	
P5	1-Pickle bottle coupler 5-turn primary	2.00
3C	1-3-circuit pickle bottle tuner	6.00
	H. H. Eby Mfg. Co., X-40 So. 7th St., Philadelphia, Pa.	
Ensign	5-Ensign binding posts	1.00
	Elgin Radio Corp., No. State St., Elgin, Ill.	
	1-.00025 mfd. variable condenser	2.40
	James Goldmark Co., E-83 Warren St., New York.	
W	1-100-ft. coil of Wirit	.90
	Harco Products Co. 25 Church St., New York City.	
SCC	1-Harco double circuit anti-capacity jack	.80
	Kurz-Kasch Company, So. B'way, Dayton, Ohio.	
	1-3-in. tapered knob and dial	.75
	Mitchell-Rand Mfg. Co., 18-F Vesey St., New York City.	
7	1-length special No. 7 tubing	.15
	National Company, Inc., Brookline St., Cambridge, Mass.	
	1-.00035 mfd. condenser with 3½-in. vernier dial	5.75
	1-.0005 mfd. condenser with 3½-in. vernier dial	6.00
	Radiall Company, RE-320 W. 42nd St., New York City.	
1A	2-Amperites for UV-201-A tubes	2.20
	Rauland Mfg. Co., F-2650 Coyne St., Chicago, Ill.	
R-199	1-R.F. transformer	5.00
	Walbert Mfg. Co., A-931 Wrightwood Ave., Chicago, Ill.	
	1-Filament lock switch	.50
	MISCELLANEOUS PARTS	
	2-Pkgs. of 25 soldering lugs	.40
185	4-Left hand nickeled angle brackets	.40
14	2-Nickeled coil mounting pillars	.16
62	1-Pkg. of 10½-in. 6-32 F.H. nickeled screws	.12
63	1-Pkg. of 10½-in. 6-32 R.H. nickeled screws	.12
64	1-Pkg. of 10¾-in. 6-32 R.H. nickeled screws	.14
49	2-Pkgs. of 10 6-32 nickeled nuts	.16
	Complete set of parts	$41.15
	BLUE PRINTS	
	Set of three full-size blue prints for the R-F-C Receiver	$.75

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 Sodion receiver.

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

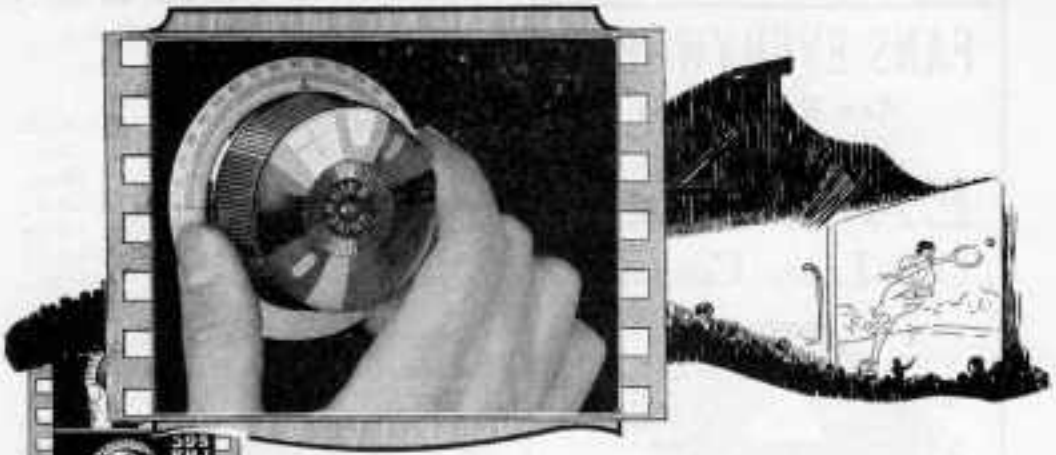
July—Resistance coupled amplifier, Tools for the radio model shop, Crystals that oscillate.

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.

MICRO-SELECTIVE TUNING CONTROL



Want more stations?
"SLOW-MOTION" Tuning
will get them for you!

REMEMBER how the "*slow motion*" picture helped you see details that were unnoticed in the usual running? In a similar way the "*slow motion*" (12-to-1 ratio) of the UNIVERNIER helps you find *dozens more* stations that are missed if "searching" is done with the usual coarse adjustment (as you are compelled to do with many so-called vernier dials which merely duplicate the action of the obsolete vernier condenser). With its continuous "*slow motion*", the UNIVERNIER *first* finds the station you want—*then* clears it up. That's why it's such a record-breaker for locating those hard-to-get distant stations and bringing them in so easily, quickly, clear and loud. Promise yourself a real surprise—replace your dials with UNIVERNIERS tonight!

A RECORD! Denver, Colorado hears 5N.O. Newcastle, England

Read this interesting letter from Mr. Walter E. Kessler, of Denver, Colorado:

Gentlemen: Using a three tube Superdyne set, I tuned in station 5N.O. Newcastle, England in the most Trans-Atlantic Radio Tests.

Believe me they were hard to find and do not believe that I could have done it but for the "UNIVERNIERS" with which the set was equipped.

I thought that you might be interested to know that your UNIVERNIERS were used on a set that reached out this distance.

7 UNIVERNIER Features

1—12-to-1 ratio—proven the right ratio.
2—Entire range of set under continuous vernier control.
3—Positive smooth action—no slipping or jerking.
4—Sturdier mechanism.
5—New attractive "dished" dial.
6—Cannot destroy the accuracy of low-loss condenser bearings.
7—Costs no more than a good dial.

Mahogany Knob and Gold-plated dial . . $1.50

Black Knob and Silver-plated dial $1.25

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

Jobbers and Dealers: Write for Discounts

MEMBER RMA

THE WALBERT MANUFACTURING COMPANY
931 Wrightwood Avenue
Chicago, Illinois

WALBERT UNIVERNIER

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

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

Notes on the Manufacture of Variable Condensers

(Continued from Page 7)

ning at 4500 r.p.m. The tapping is done in lathes in a unique manner. Ordinarily, holes are tapped in a drill press, the direction of rotation being reversed to remove the tap from the work. This is a slow operation since it takes nearly as much time to remove the tap as it does to do the actual tapping. In this plant, the taps have shanks of smaller diameter than the tapped hole, and are about 8 ins. long. The shank is held in the lathe chuck. A stator post is held up against the tap by the operator. When it has been tapped it is allowed to slide right along the shank and the next one is started. In this way the tap shank acts as an accumulator, holding about 15 posts. It is removed then from the lathe chuck and the posts dropped off. The end plate bearing holes are tapped in the same way only here an auxiliary fixture is employed to hold the plate perpendicular to the tap so that the thread will not be cut at an angle due to the thinness of the plate. If this hole were out of line the whole rotor shaft would be out.

The spacing posts between the end plates are machined, drilled, and countersunk, in the usual way. The slots in the small hard rubber insulating blocks are accurately milled, and then the holes are drilled. The drilling jig holds eight blocks and the drill press has two different sized drills so that one operation drills all the holes. The jig is constructed so that these holes are not located from the ends of the blocks, but directly from the slots, to insure a perfect fit with the stator posts. The blocks are fastened to the end plate spacers with eyelets inserted two at a time. These blocks are fastened to the stator assemblies which have undergone the same soldering and cleaning operations as were described for the rotors.

The complete stator unit is assembled, the pigtail fastened to the rear end plate, and the lower bearing lubricated with vaseline. The ball bearing is then inserted in the rear cone bearing and the

(Concluded on Page 46)

Notes on the Manufacture of Variable Condensers

(Continued from page 44)

rotor put in place. Push-pull screw drivers are used to speed up the work.

After the condenser has been assembled the rotor and stator plates are examined for clearance while the rotor plates are being revolved. Any twisted plates are straightened out and the bearings are adjusted. A special indirect lighting system is used to lessen the strain on the eyes of the testers.

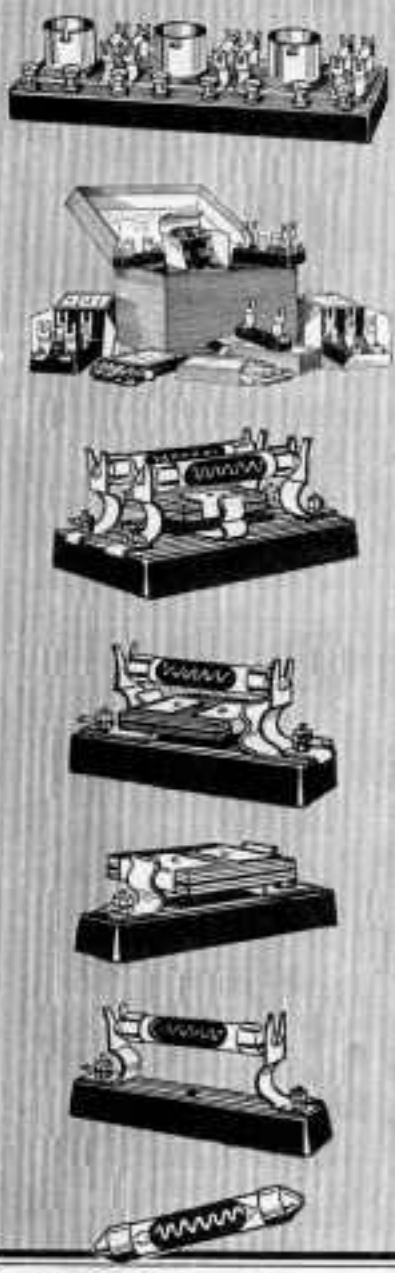
The condenser now goes through a final inspection to see that no parts are missing, all screws are tightened, the bearings examined, and the verniers are put in place. All condensers are given a final insulation test on 1000 volts A. C. This shows up faulty insulation, improper plate spacing, and also serves to burn out any dust existing between the plates.

The condensers are then wrapped in tissue paper and packed in heavy corrugated cardboard boxes with a drilling template instruction sheet, and mounting screws in each box. Every step in the machining, assembling, and testing is carried out with absolute precision. Time saving devices are employed wherever possible and everything is planned so that parts pass on from table to table without excessive handling.

A New Molding Machine

Among the special exhibits at the Boston Radio Show was the Terkelsen press for molding Bakelite parts. This press promises to popularize Bakelite molding among radio manufacturers, for it is so much simpler to install than the presses now in common use. It does away entirely with the use of hydraulic pressure and the elaborate piping and equipment that goes with it. Each machine is operated by an individual motor which runs free except for the moment that pressure is applied. A gauge automatically regulates the pressure, making it uniform throughout the duration of a run. Some of the concerns using Terkelsen presses are the Northern Industrial Chemical Company, General Electric, and C. D. Tuska.

DAVEN RADIO PRODUCTS



THE history of the Daven Radio Corporation dates back before the days of Radio Broadcasting. Its engineers have concentrated their efforts in the perfection of amplifying devices, which have been copied and duplicated by others, but their quality never equalled.

In perfecting the Daven Resistance Coupled Amplifiers, many careful laboratory experiments were made at great expense. The SUPER AMPLIFIERS and the knock-down kits are the results, and have convinced the most skeptical that Resistance Coupling is the ultimate method of amplification.

The SUPER-AMPLIFIER comes to you in complete form, ready to install. All the connections are underneath the molded Bakelite base. It gives wonderful volume, and is absolutely distortionless.

THE KITS are for those who prefer to build their own. They are easy to assemble and may be used in any standard tuning circuit. Sockets and mica-fixed condensers are not included, but instructions are furnished giving complete information and diagrams. Supplied for either three or four stages.

Ask your dealer for our 25c booklet "The RESISTOR MANUAL" which tells all about the many possibilities of Resistance Coupled Amplification and how to use it.

TRADE MARK

DAVEN RADIO

"The Sine of Merit"

CORPORATION

Resistor Specialists

Newark New Jersey

The Aristocrat of Amplifiers

FRESHMAN MASTERPIECE

It's Easy To Build

A five tube radio frequency receiver when you use the Freshman Masterpiece Kit

No Neutralizing or Balancing Condensers Required

With this kit you can build a radio frequency receiver that will bring in even the most distant stations with the volume and clarity of locals. So selective that stations can be brought in day after day at the same dial settings. A set that will be the equal, if not the superior, to any 5 tube receiver on the market, and what's more, it's the easiest set in the world to operate.

KIT CONSISTS OF

3 Masterpiece Tuned Radio Frequency Units carefully matched and balanced. Complete with wiring diagram and instructions for building any 5 tube tuned radio frequency receiver and also drilling template for proper mounting.... **$17.50**

Each and every Freshman Masterpiece Coil bears a serial number and Trade-mark—our guarantee of electrical and mechanical perfection. Every genuine Freshman Coil is made of specially insulated wire to prevent short-circuiting, so often caused by inferior coils. For your protection demand only the genuine.

At your dealers, otherwise send purchase price and you will be supplied without further charge.

Chas. Freshman Co. Inc.
Radio Condenser Products

Freshman Building
240-248 W. 40th St., New York

! NEW !

RUSONITE
SUPER REFLEX KIT

THE

RUSONOLA

A Two Tube Reflex Set

WRITE FOR INFORMATION

Orders taken for January Delivery

RUSONITE PRODUCTS CORP.
15 Park Row New York, N. Y.

Tops Don't Come Off
25 Different Markings

H. H. EBY Mfg. Co.
Phila., Pa.

Silver-Marshall, inc.
RADIO

You Can Build the Same Set that Experts Use

A Silver Super-Heterodyne

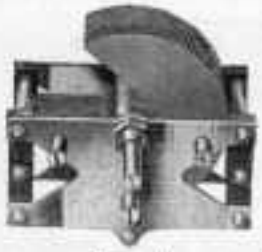
You can obtain the same results as other radio engineers, technical editors, and amateurs all over the country. They have built the SILVER SUPER and reported it to outclass any other seven-tube set on all points—to surpass practically all eight-tube supers.

SILVER SUPERS topped in the Trans-Atlantic tests. One New Yorker worked KGO with an eighteen-inch loop every night for two weeks. Sets in Chicago are working through the locals regularly to the west coast, on small loops. These facts have been brought out repeatedly in leading Radio publications. Read what radio editors and Mr. Silver himself has had to say in the Chicago Herald and Examiner, the Evening Post, Christian Science Monitor, Radio Broadcast, American Radio Journal, Citizens' Radio Call Book, Radio Ages and M. B. Sleeper in Radio Engineering.

Fifty per cent of the Silver Supers sold are giving satisfaction beyond the expectations of their builders. Forty-nine and nine-tenths per cent are doing all we claimed—coast to coast reception on a small loop. Twenty per cent of the builders asked for additional information. Ten per cent had their sets inspected, and just ONE-TENTH OF ONE PER CENT declared themselves unsatisfied.

PARTS USED IN LABORATORY MODEL

2 Silver .0005 Low Loss Condensers No. 501	$ 4.50
2 6" Metallic Dials—Pointer Knobs	1.00
1 Howard 6½ Ohm Rheostat	1.10
1 Howard 200 Ohm Potentiometer	1.50
6 Insulated Top Binding Posts	.05
1 Carter 183A Jack	.40
1 Carter 181 Jack	.70
1 Silver R. F. Transformer Unit No. 401	12.00
1 Silver Oscillator Coupler No. 402	2.50
7 Benjamin Sprung Sockets (UX or UCLA?)	1.50
2 Thordarson 2½:1 Audio Transformer	6.00
1 On-Off Switch	.60
5 .5 MFD By-pass Condensers	.90
2 .00025 Mica Condensers with Leak Clips	.45
2 .002 Mica Condensers	.70
2 .0001 Mica Condensers	.75
1 .000025 Balancing Condenser	1.10
1 5 Meg Ohm Grid Leak	.50
1 1 Meg Ohm Grid Leak	.50
1 7x21x2/16" Bakelite Panel, Drilled, Grained and Engraved (Specify with or without meter hole.)	7.00
1 7x21x⅛" Oak Base Board, Bus Bar, Brackets, Screws, Nuts, Solder, Tape	1.50
Total	$60.00



Type 501
Silver Low Loss Condenser

Cap. .000009 to .0005. Loss so low as to be immeasurable. Ideal for any circuit. Price...$4.50

These are the same parts described by M. B. Sleeper in the December Radio Engineering. They are the parts specially recommended by McMurdo Silver, Asso. I. R. E., designer of the easily-built seven tube Wonder Sets. Send for his book "The Portable Super-Heterodyne." Price, 50c.

Type 401
Silver Transformer Unit
50 Kilocycle

Employs two interstage and one filter transformer. 1½ to 2½ times more efficient than anything on the market. It is the Original. Price...$14.00

SILVER-MARSHALL, Inc.

Dept. J.
105 S. Wabash Ave.
Chicago, Ills.

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

The Lowest Price for a Good Speaker

CONSCO

REGISTERED TRADE MARK

Because of increased production, we are able to reduce our price. Formerly $12.50—now $10.00. The lowest price Goose Neck Type Speaker on the market.

It is made of Indestructible Fibre, has a 12" bell and stands 25" high.

The CONSCO Speaker is unconditionally guaranteed. If for any reason you are not satisfied, your dealer will refund the full purchase price if the Speaker has not been tampered with.

If your dealer does not carry the CONSCO Speaker in stock, we will ship to you direct express prepaid upon receipt of purchase price.

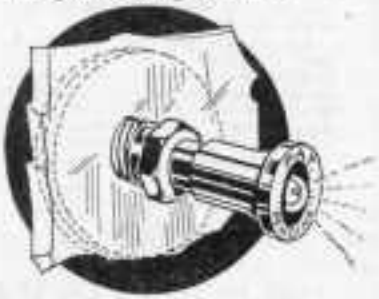
CONSCO ELECTRIC CO., INC.
147 W. 23rd St. New York City, N. Y.

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 $30 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., 903 Fifth Ave.
New York

At last--

A practical solution to the "B" Battery Problem

Now you can get "B" Battery current direct from your electric light socket—without interference—and at the trifling cost of less than one-fifth of a cent per hour.

Throw away your "B" Batteries—install a Kellogg Trans-B-former and your set will operate at maximum efficiency all of the time. You will also get these definite results:

1. Improved reception.
2. Reduced operating expenses.
3. Increased DX possibilities.
4. Improved appearance.

Developed, perfected and guaranteed by the Kellogg Switchboard and Supply Company, 1066 West Adams Street, Chicago, Ill.

Dealers—write for unusual trade proposition.

KELLOGG

Trans-B-former

CERTIFIED GRID LEAKS. Absolutely accurately calibrated, permanent fixed resistance units from ¼ to 10 megohms. Price 50c.

USE THE AUDIOHM for clarity and volume control. Put one across the secondary of your transformer. Price $1.50 with adjustable bracket.

LAMP SOCKET ANTENNA. Just what is an electric light line, no need of outdoor or indoor aerials. Efficient, neutral, most efficient on market. Price 50c.

INDOORIAL. Hang or lay anywhere, roll up when not in use. Wonderful directional effects, cuts out local stations. Use on ground. Price $1.50.

ELECTRAD

GET Clear, Distortionless Reception. Distortion, weak signals, lost signals are almost always caused by inferior small parts. Protect yourself from disappointment, insure getting

Distance, Clarity and Volume

By using Electrad radio parts. Money back guarantee they will improve your set. Electrad Parts are on sale at most all reliable radio stores. Sold direct if dealer cannot supply you. Money back guarantee.

YAHOOOL, a variable grid leak will give you exactly the correct grid resistance. Any resistance from ¼ to 20 megohms. Once set is permanent. Price $1.50, mounted $1.50.

ELECTRAD Inc.

438 Broadway, New York

KURZ-KASCH

ARISTOCRAT

DIALS AND KNOBS

LEADERS IN THEIR LINE

Manufacturers use them for their beauty and efficiency. Moulded of Bakelite — the quality is guaranteed. No set screws to tighten — the Patented Split Bushing eliminates the need.

Set builders use them for easy handling and recognized superiority. Assembly is simple. The Bushing is placed on the shaft, the dial goes over the bushing, and the knob is screwed on. All dials are finished in a smooth black, without set-screw holes to mar the surface. They must be good.

Genuine Kurz-Kasch products bear the trademark on the back of each part. Accept no substitutes.

The cost — 4" - $1.00, 3" - 75c, 2" - 50c

THE KURZ-KASCH CO.

DAYTON, OHIO

"What a Difference The Hammarlund Makes!"

Stations you never heard before—wonderful volume—pleasing clarity—freedom from interference—are the advantages the new model "C" Hammarlund Condenser brings to you.
No watch was ever built with more precision—no design more carefully thought out.
All capacities; plain and vernier. Sold by the better radio dealers.

Write for Descriptive Folder.

HAMMARLUND MANUFACTUFING CO.
424-438 West 33rd Street New York

For Better Radio
Hammarlund
PRECISION
CONDENSER

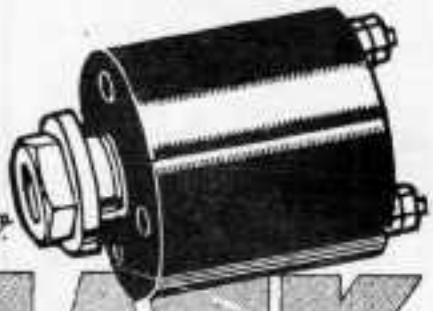
9 Points of Superiority

1—Soldered brass plates, chemically treated against corrosion; perfect alignment.
2—Stator plates specially shaped for any law—linear or low wave.
3—Adjustable ball-bearing rotor shaft, grounded through metal end-plates.
4—Soldered clock spring pig-tail, with automatic stop.
5—Minimum dielectric losses (so exact to be measured.
6—Rugged, compact construction; covered wire.
7—Micrometer survive moves all plates; no backlash.
8—Takes any size dial.
9—The product of 14 years experience, making precision instruments.

three jacks in one

WHATEVER the circuit, TRI-JACK does the trick! Single open, single closed, double closed—TRI-JACK is the best bet for any of these jack duties. TRI-JACK is three jacks in one. Other TRI-JACK features are super-compactness, practically zero capacity, bakelite body, and solderless connections. Fits any standard plug.

90c at all good dealers, who also sell and recommend B. M. S. Fantail Jacks (6 types), TRI-COIL ($2) and TRI-PLUG (75c)



BROOKLYN METAL STAMPING Corp.
719 Atlantic Avenue Brooklyn, N.Y.

TRI-JACK

You Can't Buy It—

but if you are the least bit handy with tools, you can build an amazing Telos set yourself in a single afternoon.

The basic goodness of Telos design is the same as it has been for three years. But now, Telos excellence has been extended to include *three* stages of tuned R. F. and super-imposed (reflexed) resistance-coupled A. F. as well.

The new Telos KIT opens up a world of fascinating possibilities in radio. You can build a 5, 6 or 7 tube set, and run it all on dry cells! It will cost you less to run than any other set of like power!

You can introduce a crystal detector if desired! You can use transformer A. F. if you prefer. But no matter what combination you select, you will find clear, unmistakable instructions in the book that comes with every Telos KIT, and you will accomplish results you never thought possible before!

Fill out the coupon now. Get your copy of the new, generously illustrated booklet, "The KIT of a Thousand Possibilities." It's free, but the edition is limited to those who are genuinely interested in superlative radio reception!

Telos Radio

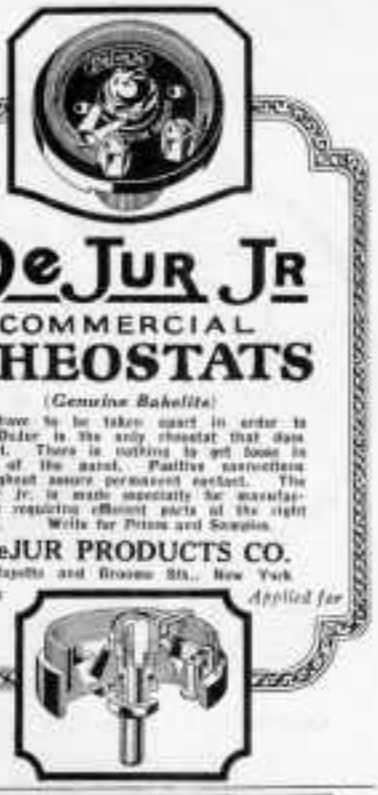
Danziger-Jones, Inc.,
Dept. R., 23 Waverly Place,
New York, N. Y.

Send me at once your booklet "The KIT of a Thousand Possibilities."

Name .....

Address .....

.....



DeJUR JR
COMMERCIAL
RHEOSTATS

(*Genuine Bakelite*)

not have to be taken apart in order to. The DeJur is the only rheostat that does. There is nothing to get loose in back of the panel. Positive connections throughout assure permanent contact. The DeJur Jr. is made especially for manufacturers requiring efficient parts at the right price. Write for Prices and Samples.

DeJUR PRODUCTS CO.
Lafayette and Broome Sts., New York

Patents Applied for

DEMONSTRATORS WANTED

FOR THE

"DE LUXE" COAST TO COAST 5 TUBE

RETAIL $39.49 PRICE

NEUTRODYNE

SEND NO MONEY
RUSH NAME AND ADDRESS TODAY FOR PROPOSITION

GENUINE LICENSED RCA PARTS

Live young men wanted in every town to own, operate and take orders for this big 5 tube De Luxe Coast To Coast Neutrodyne kit. Genuine licensed Hazeltine parts, synchronized and matched. Loud, clear, powerful. Delicate tuning. Complete assembly retails for only $39.49. Special discounts to those who want to act as demonstrators. Liberal financial arrangements. Send no money to get this kit. Just send name and address and pay postman on arrival. Written money back guarantee with each kit and plan. Can be assembled in two hours with exact size plan and wiring chart. Write today for proposition or kit. Be first in your town.

THE RADIO SHACK
America's Largest Radio Dealers
Dept. A34, 55 Vesey St., New York, N. Y.

READ THIS CAREFULLY

It may save you both time and money in your radio work

Sooner or later, the products of practically every radio manufacturer, as well as those of concerns who supply radio manufacturers, find their way to the laboratory maintained by RADIO ENGINEERING. We do not feel, as some other publications do, that we are called upon to issue certificates of merit to products of which we approve, but we do feel that it is part of our job, in order to provide our readers with the most accurate design data, to know most everything about all kinds of radio supplies, instruments, sets, devices, and tools. In fact, we do a great deal to help the manufacturers of these things to improve them, find wider uses for them, or to locate their faults and weaknesses.

Much of this information is of such a special nature that it is not of interest to general readers, altho it may be of tremendous help in individual cases. Consequently, if you want special data you do not find in the pages of RADIO ENGINEERING, write a letter to the Manufacturers and Experimenters Service Division.

State specifically the nature of your problem—you may require data concerning a particular testing circuit, perhaps you are undecided about a choice of parts or materials, you may need some advice about complete sets, or perhaps the problem concerns raw materials, molded parts, screw machine products, or tools and machinery.

A vast store of information, gathered by men of long experience in the various phases of the radio industry, is at your command. Ask the M. and E. Service Division, M. B. Sleeper, Inc., A-52 Vanderbilt Avenue, New York City.

Most Practical Ratio

An ideal operating ratio—not too low nor too high—for infinitely close tuning with perfect ease. A ratio approved by leading radio engineers and proven by the silent endorsement of thousands of users.

New Accuratune Micrometer Controls mark an unusual advance in tuning devices! Designed upon a new principle which eliminates all lost motion and back lash. Increasing tuning efficiency over that of any known vernier or tuning device. A truly wonderful instrument—indispensable in DX work.

Accuratune Micrometer Controls fit all standard condenser shafts. Mount flush with panel. Easily replace ordinary dials with no set alterations.

NEW ACCURATUNE FEATURES

No back lash.
No cutting of condenser shafts.
No wobble of dial.

At your dealers, otherwise send purchase price and you will be supplied postpaid. Price $1.50.

MYDAR RADIO COMPANY

8-E. Campbell St. Newark, N. J.

Canadian Representatives: Radio, Ltd., Montreal

ACCURATUNE
MICROMETER CONTROLS

BETTER RHEOSTATS
LOWER PRICES

The Spring does it!

? ? ?

Guarantees Permanent Contact

MAKE US PROVE IT!!

Send for descriptive catalogue

SHEFFIELD TRIMMING & STAMPING CORP.

211 Centre St. NEW YORK CITY

WIRIT

JAMES GOLDMARK COMPANY

1921 The first concern to manufacture the familiar square tinned copper bus bar was James Goldmark Company. This bus bar was drawn to the specifications furnished by M. B. Sleeper.

1925 Again James Goldmark leads the wire manufacturers as the first to produce WIRIT, the newer, better conductor for wiring radio sets, also drawn to M. B. Sleeper's specifications.

WIRIT is No. 18 tinned wire of electrolytic copper, specially tempered to be flexible and at the same time hold its shape.

Both manufacturers and set builders will find that, with WIRIT, sets can be wired more neatly and in less time than with any other conductor.

WIRIT, per 100 ft. spool.....90c

Special Prices in Quantity to Manufacturers

JAMES GOLDMAN COMPANY
83-A Warren St., New York City

MORE MONEY?

A Dollar and a Half an Hour for You

CAN you do radio installation and maintenance work? If so, have yourself officially registered in the I and M Registry in Radio Engineering, so that set owners in your town will know that you are doing this work.

¶ It costs only two dollars to have your name, address, and telephone number listed in the Registry for a whole year—less than what you are paid for a single job. Send in this data at once, so you will be all set for the big Christmas business.

SET BUILDER'S BOOK

Success Insurance for Radio Men

EVERY design in the Radio Set Builder's Book has been thoroly tried and tested, for the designs in this book have been chosen from the best sets described in Radio Engineering Magazine.

¶ Outfits with one, two, and four tubes are shown, including reflex, straight radio frequency, and regenerative models. Photographs, scale drawings, and picture wiring diagrams. The price of this book is fifty cents, or you can get it free with a year's subscription to RADIO ENGINEERING.

ALL-AMERICAN

Reliable!

ALL-AMERICAN Standard Audio Frequency Transformers in any radio receiving set mean but one thing—assured efficiency in amplification. Since 1919 ALL-AMERICAN Audios have answered the demand for an instrument that could be relied upon for maximum amplification and faithful tone reproduction. Set builders who know radio do not experiment—they specify ALL-AMERICANS, with full assurance that they will consistently perform with highest efficiency.

Precision-Made

ALL-AMERICAN reliability is a natural result of ALL-AMERICAN *precision manufacture*. Each part is scientifically designed and accurately built to exact standards. Special machinery and testing equipment assist in achieving perfection. 3 to 1 Ratio, $4.50. 5 to 1 Ratio, $4.75. 10 to 1 Ratio, $4.75.

ALL-AMERICAN Reflex Receivers

Complete receiving sets with range, volume and selectivity unequaled in receivers of this type. All instruments are mounted on panel and baseboard ready to be wired. Clear photographs, blueprints and a 48-page instruction book make wiring the easy work of only one delightful evening.

All-Amax Junior (one-tube, semi-finished) $22.00
All-Amax Senior (three-tube, semi-finished) $42.00

The Radio Key Book is the most valuable book of radio facts ever published. Sent for 10 cents, coin or stamps.

RAULAND MFG. CO.
Pioneers in the Industry
2682 Coyne Street Chicago

There's an ALL-AMERICAN Transformer for every circuit

The Largest-Selling Transformers in the World

R-F-C Type Receiver

(Continued from page 40)

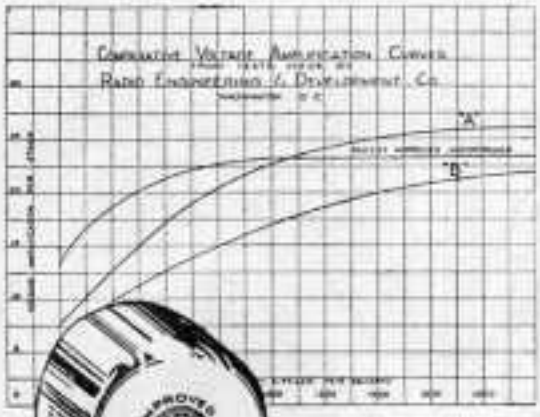
only ⅛ in. of the screw projects beyond the nut. Thread the projecting end of the screw into the threaded hole just below the binding post thumb nut over the fixed plates of the condenser. Then remove the mounting legs on the pickle bottle coupler and put the screws which clamp the Formica strips into the outer ends of the two coil support pillars which have been fastened to the variable condenser. It just happens that the distance between the threaded hole in the condenser end plate and the fixed plate binding post screw is exactly right for mounting the pickle bottle coil.

11. Connect 40 to 41. Run the upper lead from the secondary of the pickle bottle coil to the screw going through the clamping strips into the coil support pillar, making connection 42. Run the lower end of the secondary winding to the screw going into the lower pillar, making connection 43. Run one end of the primary winding to the antenna post, 44, and the other end to the second lug on the ground binding post, connection 45.

This completes the wiring of the receiver.

How to Adjust the Coupler With the assembly work completed, connect the batteries to their proper binding posts, using six volts for the A battery and forty-five volt batteries for the B. Although individual experimenters have their own ideas, we have found at the Darien laboratory, that the vertical type Eveready are handier to use than the flat type as they take up so much less table space. Plug in the telephones and pull the lock switch out to the center position. This should light the filament.

With the coupling coil in the vario-coupler in a vertical position, tune in a station by means of the two large variable condensers. It is best to try first with a long wavelength station. Regulate the position of the coupling coil and the capacity of the 0.00025 variable condenser until the circuit oscillates slightly. Then go to a short wavelength station and see if, without changing the coupling coil, you can make the circuit oscillate by merely changing the 0.00025 condenser.



Comparative voltage amplification curves from tests made by the Radio Engineering and Development Company of Washington D C

The Chart tells the story

High amplification over entire band of sound frequencies Undistorted reproduction at all frequencies, with no one high peak of amplification at any point of the band. Brass grounded case, with satin nickle finish Ratio 1½ to 1 Location of binding posts permit short leads

The better class dealers carry Pacent Radio Essentials
Send for complete catalog

PACENT ELECTRIC COMPANY, Inc.
91 Seventh Avenue, New York City

Washington Minneapolis Boston San Francisco
Chicago Birmingham Philadelphia St. Louis
Buffalo Jacksonville Detroit

Pacent
RADIO ESSENTIALS

"DON'T IMPROVISE — PACENTIZE"

Perfect Control With FAMOUS

Dials and Rheostats

GENUINE OAKELITE

FAMOUS Dials and Rheostats make it easy to obtain that perfect control so necessary for distance reception.

FAMOUS RHEOSTATS

Scientifically designed and made by skilled radio workmen, FAMOUS Rheostats enable you to control perfectly the current flow to the filament and maintain perfect contact under all conditions. Assure best results with any type tube.

FRP

FAMOUS SUPER GRIP DIALS

The super grip allows the FAMOUS dial to be rotated slowly and easily, assuring sharp tuning and perfect control. Just the dial for finding distant stations. Made in two, three and four inch sizes.

Good Territory Open—Write for Proposition.
DISTRIBUTORS WANTED

Famous Radio Products, 33 Grand St., New York

I and 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.

Conn., South Norwalk—A. GHIRARDI*
White Bridge. Tel. Nor. 2724

D. C., Washington—A. C. BURG
U. S. Soldiers' Home. Tel. Col. 750 Br. 41

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
6545 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. SCOBEY
478 Stuyvesant Ave. Tel. Web. 7254

N. Y., New York—APEX RADIO CO.
123 Liberty St. Tel. Rector 3176

N. Y., New York—PAUL FRANCK
317 West 119th St. Tel. Morningside 9140

N. Y.,—Brooklyn—J. McPARTLAND
932 Flatbush Ave. Tel. Fla. 1758R

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—RADIO CONST. LABS.
71 W. B'way. Tel. Walker 2143

N. Y., New York—J. ROEMISCH
841 Lexington Ave. Tel. Lex. 4420

O., Kent—KLADAG RADIO LABS.*
Kline Bldg. Tel. 127

Pa., Scranton—J. J. MAHON
730 Capouse Ave. Tel. Bry. 2944

Pa., Lewistown—S. T. ROBINSON
123 S. Main St. Tel. Lew. 723

Pa., Pittsburgh—L. E. SIEGFRIED
1513 Tyndall St. Tel. Can. 8913

Tex., Fort Worth—C. L. FARRIS
500 Taylor St. Tel. Wor. 3927

Samson Super-Kit

Another Radio Achievement

KIT INCLUDES

3 Samson Long Wave Transformers
5000 meter wave length

1 Samson Filter Transformer
for this wave length

1 Samson Oscillator Coupler

Also full information on how to Build This Set

All Samson Transformers are made with the
FAMOUS HELICAL WINDINGS

Remember that "Samson" stands for 42 years of leadership in the manufacturing of electrical specialties. Other Radio Samson Products:

SAMSON
AUDIO TRANSFORMERS

SAMSON
PUSH-PULL TRANSFORMERS

Write for Proof of Samson Superiority

SAMSON ELECTRIC CO., Canton, Mass.

Manufacturers since 1882

WILLIAMS PRESS, INC.
ALBANY — NEW YORK

The men who know say "Use Formica"

ONE hundred and twenty-five of the leading radio manufacturers of America by their example tell you to use Formica as the panel and tube material in the set you are building. They use it themselves—because they know it to be the most uniform, best looking, most satisfactory form of Bakelite.

The bigger the panel you use and the more apparatus you mount on it the more important it is to use Formica. For Formica will not sag, warp or get out of shape — it has the strength to give you years of perfect service.

This year, scores of manufacturers will use Formica base panels, and Formica terminal strips. They stop electrical losses and greatly increase the efficiency of a set.

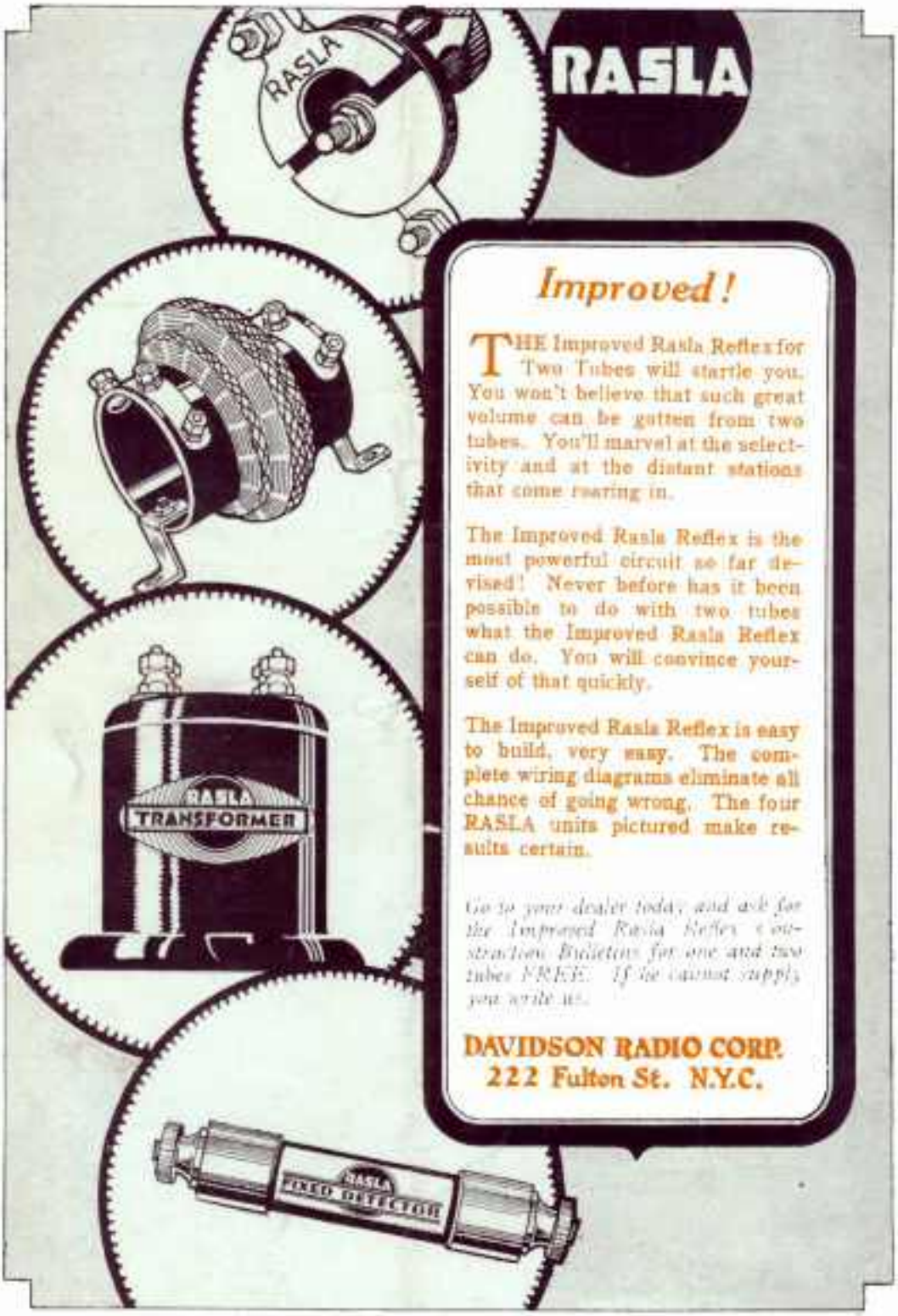
There is no question as to which is the best radio insulating material — and you want the best. Four beautiful finishes: Gloss black, flat black, mahogany and walnut.

Dealers: For the big Neutrodyne and super-heterodyne panels, Formica is practically a necessity. Formica will sell stronger than ever this year.

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

FORMICA
Made from Anhydrous Bakelite Resins
SHEETS TUBES RODS

Hear the Formica band every Wednesday evening from 9 to 10 Central Standard time over WLW.



RASLA

Improved!

THE Improved Rasla Reflex for Two Tubes will startle you. You won't believe that such great volume can be gotten from two tubes. You'll marvel at the selectivity and at the distant stations that come roaring in.

The Improved Rasla Reflex is the most powerful circuit so far devised! Never before has it been possible to do with two tubes what the Improved Rasla Reflex can do. You will convince yourself of that quickly.

The Improved Rasla Reflex is easy to build, very easy. The complete wiring diagrams eliminate all chance of going wrong. The four RASLA units pictured make results certain.

Go to your dealer today, and ask for the Improved Rasla Reflex Construction Bulletins for one and two tubes FREE. If he cannot supply you write us.

DAVIDSON RADIO CORP.
222 Fulton St. N.Y.C.