RADIO Engineering

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

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IN ENGLAND 1/-

Edited by
M.B.SLEEPER

MARCH 1925

VOL. V NO. 3

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RADIO ENGINEERING

Edited by M. B. SLEEPER

Associate Editor, Alfred A. Ghirardi

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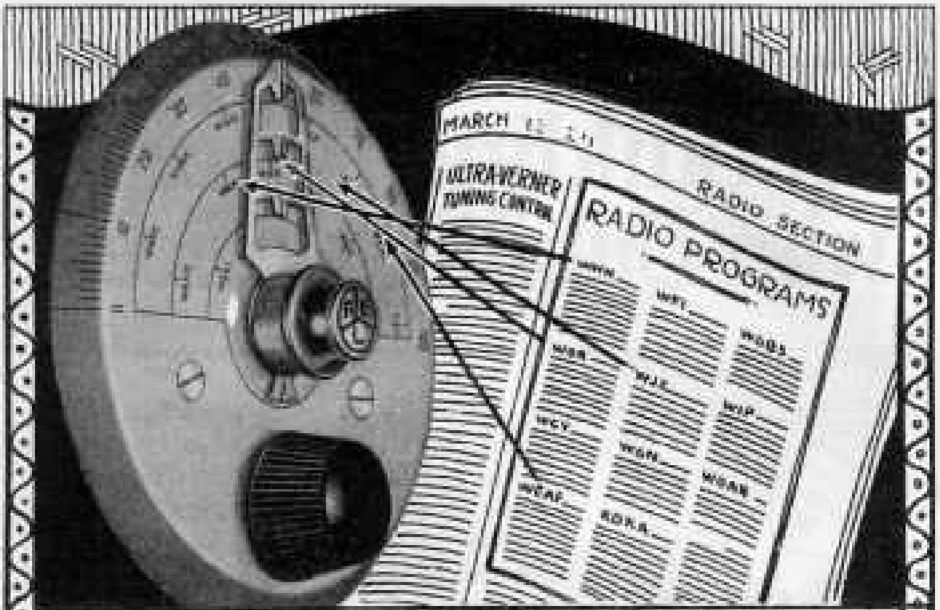

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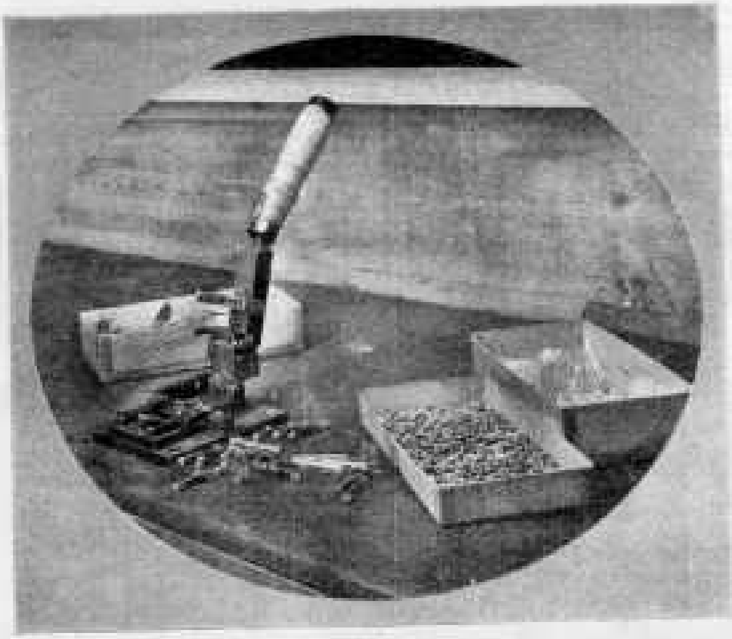


Fig. 2. This device keeps the elements from buckling as the corks are pressed into the glass tubes.

The Engineering Side of Manufacturing Gridleaks

Some valuable notes in the methods employed at the Daven factory, where thousands of tubular resistors are manufactured daily

WE HAVE become so familiar with the various parts for sets, that most of us think of them merely in terms of actual performance and dollar and cents cost. We fail to appreciate the painstaking care and scientific investigation that is going on every day in the larger manufacturing plants in an effort to turn out products of the highest uniform quality possible, regardless of varying conditions which tend to alter their characteristics. It is gratifying to see that competition is forcing the manufacturers to keep on their toes constantly, experimenting with new and better ways of doing things, at the same time reducing overhead costs. All of this is ultimately passed on to the consumer in the form of better apparatus at lower prices.

A striking example of manufacturing under conditions in which every little step of the process must be carried out with the most exacting care and patience is furnished in the making of tubular resistance units for use as gridleaks and various other purposes. A trip through the plant of the Daven Radio Corporation, where more than 2,000 resistance units are manufactured every day, reveals the inside story on the little gridleaks and resistors we usually snap into clip holders and proceed to forget all about, because experience has taught us that they can be depended upon without further attention.

The units have a resistance element of ink-coated paper, which is held in place and centered in a glass tube by two corks. Connection is made to it by two tinned copper leads passing through the corks, and soldered to the metal end caps. This gives a compact unit which is air tight, so that no atmospheric changes affect the paper element after the tube is sealed with the end caps. The high quality of the finished product, which to all outward appearances is very simple, is only obtained by carefully planning each assembly operation so that the work follows right through the line, careful attention being paid to all the little kinks and tricks peculiar to the work.

The chemical composition and manufacturing process through which the raw paper has passed before reaching the factory, is a very important factor. To insure uniformity, paper of one stock is bought in large enough quantities to make millions of elements. When received at the factory it goes through a special aging process and is then coated with a resistance material held in a binder. The composition of this material and the conditions under which it is applied to the paper are a trade secret of the manufacturer. Experience with various forms of power and hand operated paper cutters has shown that the ordinary photographer's paper trimmer is the most satisfactory device for cutting up the paper into the little 5/32 by 15/16-in. strips required.

The glass tubes, corks, and nickeled brass end caps are bought from outside manufacturers. It is interesting to note here that a tolerance of only 0.004 to 0.005 in. is allowed on the outside diameter of the glass, and a tolerance of 0.030 in. on the length. Also the glass is of special chemical composition since it is essential that it have practically infinite resistance. The stock of tubes, corks, caps, and elements is at all times kept in an electrically heated oven at a temperature of 115° Fahrenheit. This prevents any absorption of moisture. The subsequent assembling operations are so timed that not more than five minutes elapses between the time the stock is taken from the oven and the time the tubes are sealed airtight.

Fig. 3. A grid leak capping machine, the only device of the sort to be found in this country, for it was developed by the Daven Company.

In the first operation, the connecting leads or clips are attached to the paper elements in hand presses. This takes place in two stages. In the first, the punch die bends the shoulders of the clips into a "U" shape to receive the paper. In the second stage the sides are bent down flat on the paper and nine little sharp points press into the clips and paper at the point of contact, insuring a good connection. A photograph of this press is shown in Fig. 1. The two steps are necessary to prevent the paper from being bent and curled up. These elements with the clips are then placed in the heated stock oven.

In the next operation the resistance of the elements is measured and brought to the correct value. This is done in an ingenious way. Two supports are arranged on the table in the form of blocks which receive the clips of the elements. The two terminals of the measuring instrument are arranged on a bar so that by means of a foot operated lever they may be brought down tight on the clips and the meter read. If the resistance value is not correct, ink is either added or removed from the strip by means of a brush.

Fig. 1. The press which fastens the lead clips to the resistance elements.
Fig. 4. Testing the grid leaks on a direct-reading meter.

As the work progresses along the table one operator threads one clip through a hole in the cork, the next person puts this unit in a glass tube and puts the other cork on loosely.

In the next step, the corks are passed tightly into the glass tube, and the ends of the clips are crimped slightly. A special machine was devised, for this work, to prevent the element from buckling up inside the tube when the corks are pushed in tight. When the lever is pushed down part way, two jaws come down and pinch the clips, holding them fast. A further movement of the lever pushes two plungers horizontally against the corks, driving them home into the tube. This machine is shown in Fig. 2. The elements are then centered in the tube, and proceed to the soldering table.

The old method used to solder the caps to the clips was to have a jig which held nine units in an upright inverted position. The operator would hold a metal cap over a gas flame with a pincher and fill it with molten solder. Then he would put the cap under a unit and rest it in a hole in the bottom plate. By pushing the unit down into the cap and giving it a slight twist the clip and end cap were fastened and connected together by the solder.

While this method produced very good results, the problem of increasing production led the engineers of the Daven Corporation to devise a new capping process. The result of their work is the automatic capping machine shown in Fig. 3. This requires four operators, two for inserting caps and two for inserting glass, cork, and element units. This machine caps many thousand units per day.

The capper has thirty-two tube-holding arms arranged radially on a turn-table driven by an electric motor. One operator puts a cap in the lower holder of each arm as the table turns. The cap runs over a gas flame for a distance of about 12 ins. as the arm travels around. This heat is so the solder will stick more readily. When it reaches a certain predetermined point a drop of molten solder is dropped into it from a spout leading from a solder pot. By means of a valve gear operated by the turntable a slide valve in the bottom of the pot is opened and closed at the proper time to deliver the drops of solder. The cap continues on its way, still over the gas flame, until it gets to a place where it is carried over a flat supporting ring. At this point the next operator inserts the glass tube and presses it on firmly, the pressure being taken up by the ring underneath. This unit continues over to an automatic counting device and is then released from the arm by a tripper and falls into a box, the solder having hardened by this time. It then goes over to the other side of the machine where the process is repeated and the other cap put on. The glass tubes and caps are of such size that a clearance space exists between them to allow the excess solder to run out during the capping operation. This thin wall of solder between the glass tube and metal cap also serves as a cement so that it is impossible to pull the metal caps off from the tubes. The difference in the coefficient of expansion of the glass tube and brass cap also serves to aid this action.

The resistors are then inspected and any excess solder is trimmed off around the glass. An inspection is also made to insure that the paper element is properly centered in the glass tube and that the caps are on straight. A final resistance measurement is made and the resistors sorted according to their values. It has been found more practical to give an operator a tray full of resistors of various values and require that she test each one and sort them out, rather than keep the various sizes separate and have an operator test all resistors of one value. The latter method would be a temptation for her to slip through a batch of resistors without testing them since the readings would all be practically the same and the work monotonous.

When the final test has been completed, the paper labels having the resistance values marked on them, are pasted on the glass tubes and the finished products packed for shipment.

In measuring the resistances, a definite and constant voltage, provided by a bank of No. 6 Eveready dry cells, is applied to the resistor and the current flowing through it is measured by a sensitive microammeter calibrated to read directly in megohms. These meters are calibrated daily by comparison with a standard. The meter used for the first measurement when the brushing operation is performed is checked every ten minutes by making up twenty complete resistors of different sizes and measuring their values with the final test meter. In this way a check is obtained on the meter, and the factory superintendent also knows exactly what is being turned out so that any troubles become apparent at once.

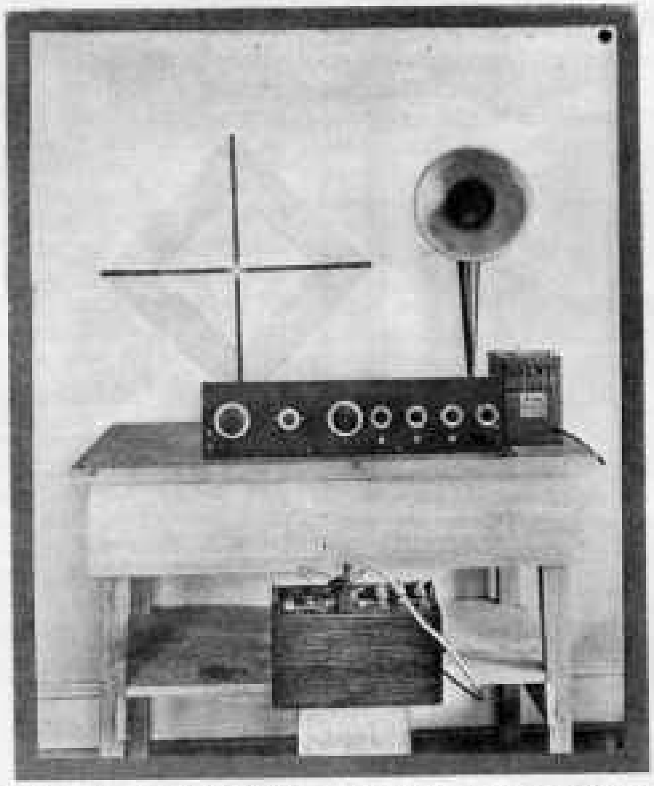


Fig. 1. The Cotton super, ready to operate. The tubes are operating on a Balkite B, and a Gould Unipower A, run from 110 V. A. C.

Our Interpretation of the

Cotton Super-Heterodyne

Part 1. Here is a Super-Heterodyne that actually performs as you have always expected, an expensively designed Super to work

CONSIDERING the possibilities of the super-heterodyne type circuit, it is surprising to hear so many reports concerning the failure of sets using this system of reception. For the very extreme in long distance work, the super-heterodyne should be superior to all other circuits. Moreover, with the new reduction in the price of both R. C. A. and De Forest tubes, the super has been brought within the resources of many who felt that fifty dollars' worth of tubes put the super-heterodyne out of the question.

The real trouble with this system is not in the system or the circuit itself but in the application of it. Of course, the Ultradyne has been highly successful, but that does not employ the straight super circuit. The Silver-Marshall type has been very popular because of its simplicity and, as previously reported, exceptionally fine work has been done with it. The more elaborate super sets, however, have not generally met the expectations of those who built them. Practically all this can be traced to the design of the super-heterodyne transformers. In other words, the trouble has not been with the circuit but with the manner in which it has been employed.

Dick Cotton, probably the best known practical radio man in New England, who gave us the type 5300 DX receiver a year ago, is responsible for the general design of what is now called the Cotton super-heterodyne, an eight-tube outfit, built around the transformers manufactured by the Samson Electric Company. The long wave transformers themselves, for which Professor Bowles is chiefly responsible, are made with helical-wound coils. The design of the transformers, together with the advantages of the helical winding method, provide exceptionally high amplification in the intermediate stages, a point where most long wave transformers fall down badly.

There are three special design problems involved in this type of equipment, the first tube should be sufficiently regenerative to provide a maximum response without being critical in operation and should be sufficiently simple in design to reduce the tendency to operate on harmonics; the oscillator must be as free from harmonics as possible, with a correct method of coupling to the receiving circuit so as to take full advantage of the heterodyne effect; the filter and long wave transformers must be designed with a correct balance of tuning sharpness and amplification factor. Perhaps more important than all these points, however, is the accurate matching of the filter and long wave transformers. The Samson types are matched to 1/12 kilo-cycle.

In addition, the mechanical design of the complete set must be right or the best parts and circuit will be unavailing. You will notice that in this set, for example, the grid leads between the transformers are only ¼-in. long. In fact, there is probably not more than half the number of feet of wire used for connections in this outfit as in most receiving sets.

It is interesting to note that one of the most important factors which makes possible the compactness and neatness of the receiving set is the use of Wirit for connections. With heavy bus bar it would be almost impossible to carry out the wiring as it is done on this set. Wirit, however, is small and light enough so that it can be bent easily into the exact forms necessary, yet it is sufficiently rigid to hold its shape. Moreover, bus bar is rather dangerous to use on equipment of this sort because considerable flexibility is required in order to relieve strains which bus bar would put upon the soldered connections. Those who have had experience with super-heterodynes already know what it means to shoot trouble on an open circuit.

Notes On the Operation Special data on the results obtained with this set will be given in the second part. It is sufficient to say at this point that this outfit really does do the things that we all expect of a super-heterodyne. During the Transatlantic tests many super-heterodyne owners were greatly disappointed to find that they were not able to do as well as others who were using the old three-circuit regenerative receiver with a two-stage audio amplifier. The Cotton super-heterodyne, however, in a number of instances, was able to bring in Transatlantic stations in localities where all other receiving sets failed.

In the matter of operation, this outfit is as easy or easier to handle than a one-tube regenerative set. Of the seven controls on the front panel, five are permanently adjusted when the outfit is first put in operation. After that, all the tuning is done with the two Univernier controls on the variable condensers. With any particular loop, the set can be calibrated or logged, making it possible to tune instantly to the wavelength of any transmitter after the settings have been once taken down.

It may seem, at first thought, as if this is a very complicated set to assemble and operate but the design has been worked out so carefully that, if the step-by-step assembly instructions are followed through, there is not a chance of making a single error in the assembly work. Half an hour's operation will show you all you need to know about the operation and, at the same time, that half hour will sell you thoroughly on the advantages of a well designed super set.

In addition to the parts required for the receiver itself, eight UV201-A or DV-2 tubes are required, 90 volts of B battery, a 6-volt A battery, and a 4½-volt C battery, as well as a loud speaker. A collapsible loop, such as the Marion type, is recommended or, for a more attractive appearance, the new self-supporting Carter loop. Both these types have a center tap, as required for this type of circuit. No cabinet is shown in the accompanying illustrations as that depends upon the individual tastes of the owner.

The storage battery should provide six volts, with a capacity of about 120 ampere-hours. The Everyready type is suitable for this purpose. If you do not want to use a separate charger, the 6-volt Gould Unipower A is very good as it has a built-in Balkite charger and can be left floating on the line so that it will always be fully charged. The B battery can be made up of two No. 770 Eveready batteries, the large size built for multi-tube sets of this sort. As alternatives, the Balkite B, operating directly from 110 volts A. C. is suggested or the Gould Unipower B of 90 volts. This also has a built-in Balkite charger, making a complete unit.

Standard Parts Required The front panel for this super-heterodyne is 28 ins. long, 7 ins. wide, and 3/16 in. thick, with a base panel 27 ins. long, 7 ins. wide, and 3/16 in. thick. This should be of black or mahogany Formica or Celoron. There are two terminal strips, which can be cut from scrap material, about 3¼ ins. long, ¾ in. wide, and 3/16 in. thick. The key items on this outfit are the Samson filter and long wave transformers and the coupler, the Benjamin sockets, Chelten Midget condenser, Cardwell condensers, Dubilier by-pass condensers, and Benjamin panel support brackets. Altho it is advisable to use the same parts that are shown throughout, the other items can be substituted without seriously upsetting the mechanical design and the operation.

In addition to the items mentioned above, we used one open and two double circuit Carter jacks, two 5-megohm and one 0.05-megohm Daven gridleaks with mountings, two 0.001 mfd., one 0.005 mfd., and two 0.0005 mfd. Dubilier Micadons, eight Eby or Marshall-Gerken binding posts, three lengths of No. 7 Mitchell-Rand varnished tubing, one 2-in. Accuratune rheostat dial, one 400-ohm Pacent potentiometer, three 20-ohm Pacent rheostats, Samson 1 to 6 and 1 to 3 audio transformers, a Walbert filament lock switch and two Walbert Univernier controls for the variable condensers. In addition to the screws and soldering lugs, two ⅜ in. nickeled angle brackets, four coil mounting pillars, and two panel support pillars were required.

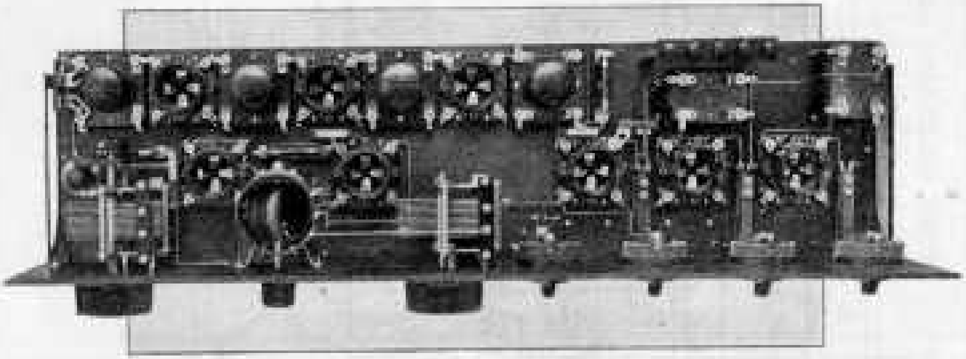


Fig. 2. Partly due to the mechanical design which reduces the length of the leads, and partly because of their arrangement, very little wiring can be seen.

Drilling The Panels Because of the space required, drawings are not given here for the layout of the front and tube panels, altho they are shown at full scale in the type 7200 blue prints. Because of the large number of holes required on the base panel, it is advisable to fasten the blue prints firmly to the panel and mark through the centers of the holes with an automatic center punch. This is safer than to take the dimensions for the drawings and then lay them out on the panels. Moreover, it is easy to check up to make sure that each hole has been indicated because the punch marks show on the prints.

Mahogany panels are usually left with

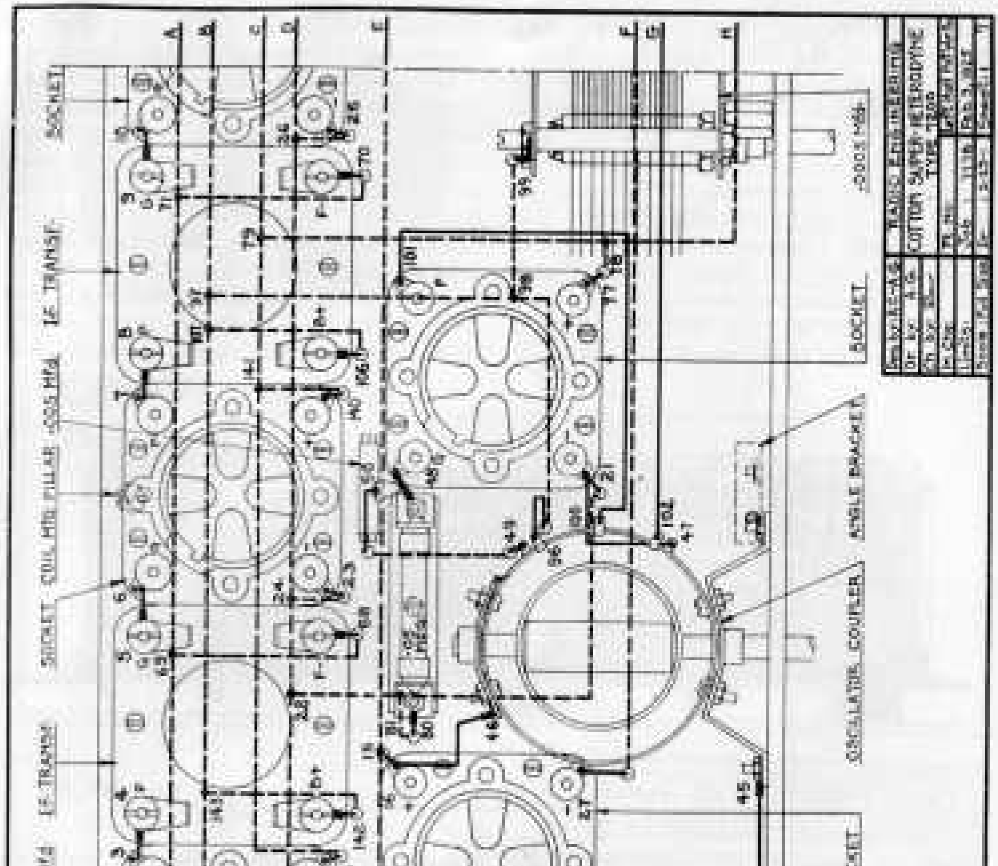


Fig. 3. Left hand half of the set, looking down on the tube panel. The wires are shown as they were in the original set.

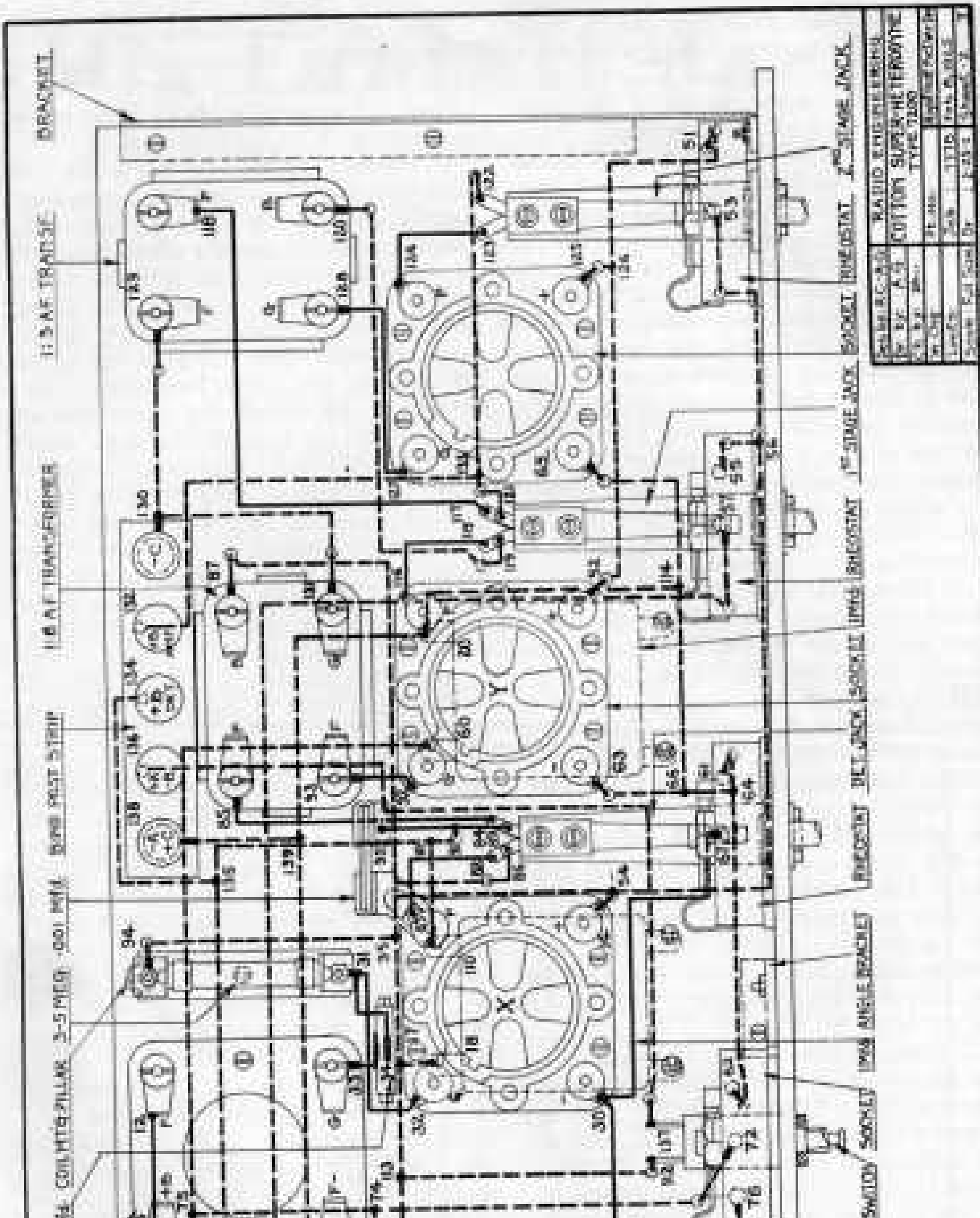


Fig. 4. Picture wiring diagram of the right hand half. The numbers refer to the connections as they are described in the assembly instructions.

the polish finish altho they can be made dull by rubbing them lightly with No. 0 sandpaper and oil. Care must be taken in this work or the design of the grain will be sanded off. Black panels, however, are still the most popular, either grained or polished.

Assembly And Wiring The importance of following the assembly instructions in the order given and the necessity for careful and neat workmanship cannot be stressed too strongly. Altho somewhat complicated in appearance, this set has been designed in such a way that it can be put together without any difficulty but it is imperative, particularly for the novice, to be guided by the step-by-step instructions. Figs. 3 and 4 show the wiring as it was done on the original set. Wherever a number is shown a connection must be made.

1. Mount the eight Benjamin sockets on the base panel. Be sure that the terminals are in the positions shown in the picture wiring diagram. Use ½-in. 6-32 R.H. screws and nuts. Sockets X and Y come over the 1.0 mfd. by-pass condensers. Therefore, it is necessary to countersink the holes for the front mounting screws on these two sockets at the under side of the panel, sufficiently so that the nuts are flush with the surface. The screws must be cut off also in order that they will not interfere with the condensers. Mount the filter and intermediate transformers. The filter is the left hand transformer, looking at the set from the front.

2. Connect 1 to 2. 1 is the G post on the filter and 2 the G post on the adjacent socket. Connect 3 to 4. 3 is the P post on the socket and 4 the P post on the adjacent I. F. transformer. Connect 5, the G post on the I. F. transformer, to 6, the G post on the adjacent socket. Connect 7, the P post on the socket, to 8, the P post on the adjacent I. F. transformer. Connect 9, the G post on the I. F. transformer, to 10, the G post on the adjacent socket. Connect 11, the P post on the socket, to 12, the P post on the adjacent transformer.

3. Mount the two 1.0 mfd. Dubilier by-pass condensers on the under side of the tube panel, using ½-in. 6-32 R.H. screws and nuts. Fasten one of the Daven gridleak mountings on the tube panel just in front of the filter transformer. Use a ½-in. 6-32 R.H. screw and nut.

4. Connect 13 to 14. 13 is the left hand terminal of the gridleak mounting, and 14 the plus terminal on socket X. This wire should be run through a hole in the tube panel and straight down, parallel to the rear edge of the panel, until it comes opposite the hole in the panel through which it goes up to be soldered on the socket terminal. Connect 15 to 16. 15 is the connection on wire 13 to 14, and 16 the plus terminal on the socket. Connect 17 to 18. 17 is a connection made to wire 13 to 14 and 18 a lug on the 1.0 mfd. condenser under socket X. Connect 19, the minus post of the left hand rear socket, to 20, the right hand lug of the right hand 1.0 mfd. condenser. Connect 21, the minus post on the second front socket, from the left to 22, on wire 19 to 20. This must be insulated with MR tubing where it passes over wire 13 to 14. Connect 23, the minus post of the next socket at the rear, to 24, a connection on wire 19 to 20. Connect 25, the minus post on the next socket, to 26, on wire 19 to 20. Connect 27, the minus post of the front socket, on the left to 28, a lug on a ½-in. 6-32 R.H. screw put through the tube panel and held by a nut. Lug 28 is on the under side of the panel. Connect 29, a lug on the upper side of the panel, to 30, the minus terminal of the X socket.

5. Fasten a Daven gridleak mounting, using a ¾-in. 6-32 R.H. screw and nut, beside the right hand I. F. transformer.

6. Connect 31, a lug on the gridleak mounting, to 32, the G post on the X socket. Solder one lug of a 0.0005 mfd. Micadon to a lug on the G post of the right hand I. F. transformer, making connection 33 and connect the top lug of the condenser, 34, to 31. Connect 35, on the left hand gridleak mounting, to 36, the G post on the lower left hand socket.

7. Tighten the contacts from the Chelten Midget condenser in the position shown in the picture wiring diagram

and, with the condenser resting on the tube panel, in the position shown, connect 37, the stator terminal, to 38, the P post on the filter. Connect 37 also to 39, the P post on the socket. This wire must be run close to the upper surface of the tube panel.

8. The loop binding posts are mounted on a Formica strip 3¼ ins. long, ¾-in. wide, and 3/16-in. thick. At the extremeties are holes for the mounting screws 2½ ins. apart. On the Cardwell condensers you will find two holes, the same distance apart, on the rear end plate. Put ½-in. 6-32 R.H. screws through these holes, from the inside out, and turn on to them two coil support pillars. These support the binding post strip. Put three Eby binding posts on the strip, the lower two with lugs pointing to the right, and the upper post with a lug pointing upward. Mount the strip on the coil support pillars with ½-in. 6-32 R.H. screws. Put a lug on the upper screw between the strip and the post, and the solder this lug to the lug on the upper binding post so that the connection is made from the post to the end plate of the condenser. This connection is not numbered. Mount this condenser on the left end of the front panel in the position shown. Put the Univenier knob and dial in place temporarily to make sure that it fits snugly. Mount the other variable condenser at the center of the panel and test the knob and dial on it also but do not leave these knobs in place as they may become scratched during the assembly work. Mount the oscillator coupler on the front panel using ½-in. 6-32 F.H. screws and nuts. Be sure that the three adjacent terminals at the end of the tube are upward, and put a soldering lug on the left hand screw holding the coupler to the front panel. Put a lug, pointing to the left, under the head of the rear lower bolt holding the rear end plate of the left hand Cardwell Condenser to the connecting rod. This is terminal 105.

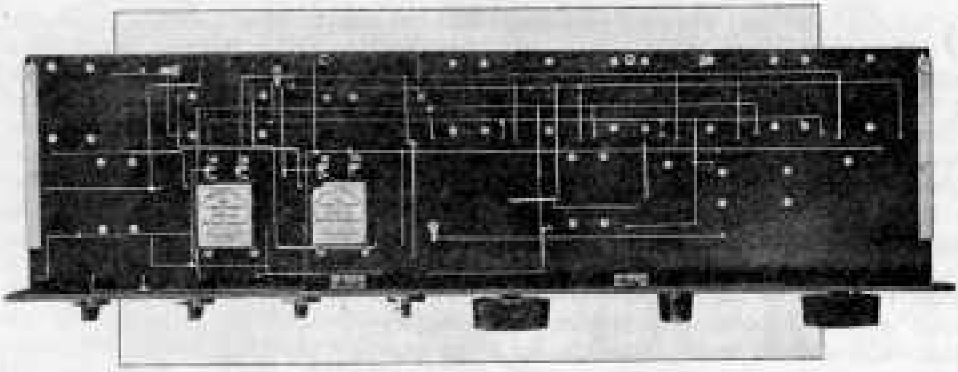


Fig. 5. By following the step-by-step instructions the wiring can be done as neatly as in this set.

Put a lug pointing to the right on the screw holding the fixed plates to the lower insulating strip. This looks like the upper strip in the picture wiring diagram but it is actually on the lower strip. Put a lug on the right hand condenser in a position corresponding to that of terminal 105. This lug should point down, and put a lug on the screw holding the fixed plates to the upper insulating strip to make terminal 103.

9. Fasten the Benjamin support brackets to the front panel using ½-in. 6-32 F.H. screws and nuts and to the base panel with ½-in. R.H. screws and nuts. In addition, put on the two small angle brackets which hold the two panels together at the center. Use ½-in. 6-32 F.H. screws through the front panel and ½-in. 6-32 R.H. screws through the tube panel.

(To be concluded in the April issue)

Fig. 1 The X-Laboratories use a center shaft to operate the vernier

Some Details of the Popular Vernier Controls

Showing the methods worked out by various manufacturers for meeting the demand for more accurate adjustments on the tuning controls. Here is a range of choice from high and low ratio knobs to the vernier mounted on the condenser itself.

ONE OF the best answers to those who speak disparaging about our efforts to make tuning sharper by reducing losses in tuning circuits is the increased demand for vernier controls. It seems as if our circuits must be more efficient because, unquestionably, they do require more accurate adjustment than was the case two or three years ago.

Fig. 1 illustrates the mechanism employed on the X-Laboratory condenser. This is an excellent mechanical job, not only because the arrangement is very compact and neatly worked out, but because the gears are mounted on adjustable bearings with spring tension to take up all the back-lash between the gears. The plates are controlled by the large knob and dial, with a friction arrangement permitting them to turn independently of the vernier gears, or by a small knob at the front working on a shaft passing through the main shaft to the gears at the rear. You will see that a cover is provided to keep out the dust.

In Fig. 2 the same idea is employed in a different way. The Accuratune dial has a large knob fastened to the dial and held to the condenser shaft by a bushing and set screw. On the bushing there is mounted also a gear and spring washer which has a cork rim. When the small knob is turned, it operates a train of gears causing the large knob and dial to turn slowly while the spring washer and gear remains stationary, held in place by the friction contact with the instrument panel. When the large knob is turned, however, the spring washer revolves against the panel.

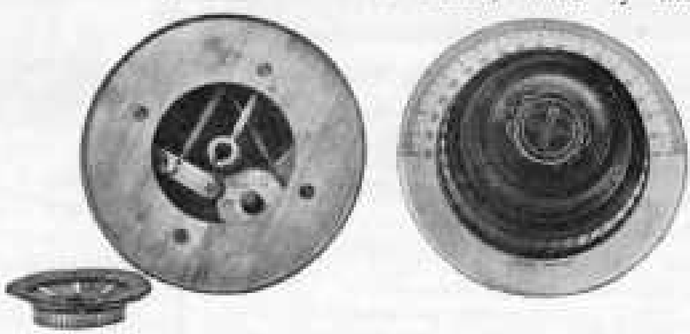


Fig. 2. The Accuratune has two knobs, one on which the dial is mounted, for rough settings, and a smaller one which, working through gears and a friction disc, provides an 80 to 1 reduction

The Velvet vernier, made by the National Company, is an interesting mechanical job. The details are given in Fig. 3. There is a gear box of stamped brass fastened by screws to the front of the panel. At the center are two concentric shafts, to one of which the knob is fastened by a set screw, and to the other, a bushing and set screw which goes over the end of a condenser shaft behind the panel. On the front shaft is fastened a small brass disc held firmly against three discs of the same size which run against the inner rim of the gear box. The three discs run on bearings which are fastened to a larger ring. When the shaft is turned, it causes the three discs to rotate and they, operating against the rim of the gear box, make the center ring and bushing revolve.

The stamping shown just below the gear box fits over the mechanism to keep the dust out. When the device is assembled, the dial is fastened in place by screws threaded into the bearings of the three brass discs. Finally, the knob is secured to the center shaft. Therefore, when the knob is turned the dial is rotated slowly, the reduction in this device being approximately 5 to 1.

At the left of Fig. 4 the Phenix Ultravernier is shown, with a view of the rear just below. This is a simple and very attractive dial. The dial is fixed to the front panel by means of two screws. The center of the dial serves as a bearing for the bushing which is secured to the condenser shaft by a set screw and also for the ring which has gear teeth on the inside. At the bottom of the dial is a small knob carrying a gear which works against the teeth in the ring. This gives a reduction of 20 to 1. A special feature of this dial is the arrangement for recording settings for various stations. Because of the silver finish, settings can be noted in pencil and later rubbed off if necessary.

Fig. 5 shows the Univernier, made by the Walbert Manufacturing Company. Above is a front view of the assembled dial. The dial has a center hole to fit over the condenser shaft and another hole through which the pin on the lower side of the gear disc passes into a hole in the panel. Thus the dial is held in place and the bakelite gear disc is prevented from revolving. When the gear disc is put in place, the bushing at the center is put over the condenser shaft and the pin slipped through the hole in the dial and into the hole in the panel. Then the set screw in the bushing is tightened. The knob is fastened to the shaft, of which the bushing is a part, by a screw at the center, but the knob is not held to the shaft. However, there is a gear at the center of the knob operating the large off-set gear which carries a small gear operating, in turn, another large gear fastened to the shaft, in this way providing a reduction of 12 to 1.

Fig. 3. Friction discs are used for the Velvet Vernier in place of gears. This prevents any looseness. The knob turns independently of the dial. The reduction ratio is approximately 5 to 1

Fig. 4. The front of the Phenix calibrating dial, with a view of the inside below. Fig. 5. Knob, dial, and gear of the Univernier, made by the Walbert Manufacturing Company. This was the first concern to produce a geared vernier knob

A New Method Molding Bakelite

The Terkelsen press overcomes the limitations of mechanical types by using live pressure applied thru powerful springs

AMONG the many machines and devices which have been developed along with the growth of the radio business is the Terkelsen spring press for molding articles from Bakelite and composition. This machine is of particular interest to radio concerns who are preparing to manufacture their equipment entirely in their own plants for, while the familiar hydraulic presses require an elaborate installation of pumps and accumulators arranged with a complicated system of piping and valves, the spring press is a self-contained unit which can be set up anywhere in the factory.

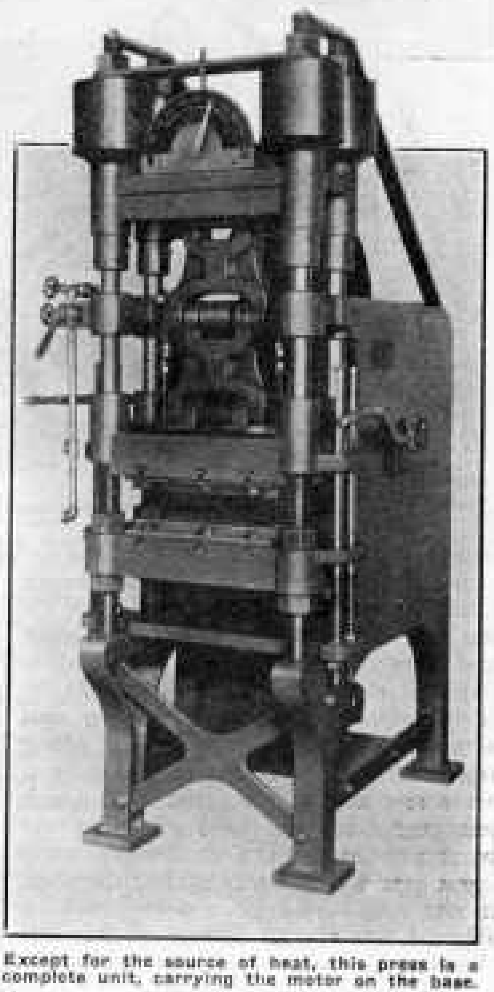
The idea of the mechanical molding press is not new. Other types have been designed in the past, but they have not been successful because they did not provide for continuous or follow-up pressure, such as is obtained in the hydraulic press. The secret of the Terkelsen type lies in the use of four powerful springs enclosed in the cylinders at the top of the machine. By applying the pressure thru the springs, the live pressure can be maintained during the curing process.

When used as a semi-automatic press, it can be handled by a woman operator. The molds can be of closed, semi-closed, or open design, filled with powder, brickettes, or plastic material. To operate the press, the operator grasps the curved safety release lever on the right, and the straight starting lever on the left. This throws in the motor on the base, normally running without load, and the horizontal arm on the toggle moves the upper die block downward, first quickly and then slowly for the last ⅜-in.

An automatic regulator throws out the clutch when the correct pressure is attained, allowing the motor to run free again. The springs then maintain the correct pressure, which can be set for one to fifty tons. Heat for curing is applied to the dies by steam or electricity. To release the press, the safety lever is again thrown out, and the starting lever opened. Thereupon the springs are let out, the upper die block raised, automatically lifting the extractor bar, the work is ejected, and the press stopped again at the full-open position. Touching a lever on the die block drops the extractor bar in place, and the molds are ready for reloading.

When used as a plain press, with hand operated molds, the machine can be run without delay in changing from one to another. Men are required for this work, however, as the weight of the molds is too great for women to handle.

Quite a number of radio manufacturers are now equipped with Terkelsen presses, and this fall many more will be turning out their own molded parts.



Except for the source of heat, this press is a complete unit, carrying the motor on the base.

RADIO ENGINEERING

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Vol. V MARCH, 1925 No. 3

EDITORIAL

ONE wonderful thing about radio is its everlasting newness. If it isn't a new circuit or a new instrument, it's a new argument. Even condensers come in for their share. The polish may have worn off the low-loss types, but now everyone is brightening up his wits to argue for or against their use in radio circuits.

Here at Radio Engineering we are firm believers in "Truth in Advertising," but, if exaggeration is on the forward side, we don't feel so much opposed to it. To illustrate: We notified the manufacturer of a complete receiving set that we could not continue to carry their advertising because we considered the advertising misleading, inasmuch as it was referred to as a "one dial set" when it is tuned by a knob and dial and a small knob, just as if a Neutrodyne had two of its condensers on a single shaft, controlled by a knob and dial, and the third condenser regulated by a small knob. The manufacturers described it specifically as a single control set, which this is not.

On the other hand, a tendency to exaggerate the advantages of low-loss condensers can be over-looked for there only a matter of degree is involved. Low-loss condensers will increase the signal strength and sharpness of tuning if they are used to replace types in which fairly large losses are present. At all events, every loss eliminated, even a small one, is a step ahead. Moreover, most men didn't think seriously about losses in inductances until condensers came into such prominence.

In this connection, we wonder if it was a coincidence that an excellent article was published on this subject, pointing out the far greater importance of reducing losses in coils, in a current magazine which carried a picture of a spider web coil on the cover. The spider web coil, as has been pointed out previously, is much less efficient than a single-layer coil on a tube. We don't mind if other publications copy our picture wiring diagram method of showing connections for, in publishing magazines as well as any other kind of business, the best man is the one who thinks fastest, but we can't help wishing that magazines would be more consistent in technical matters.

Still, one should not be too critical of what is found in radio magazines. No matter how sincere or how careful a man may be, with the diversified opinions, the conflicting points of approach, and the wide range of individual and special subjects covered in this business, it is possible to take exception to almost anything. In fact, it sometimes seems dangerous to think too hard about one thing for fear of forgetting something else, as indicated by a recent account of the high efficiency of mechanical rectifiers for charging storage batteries. The story was splendid as far as it went, but the writer considered only the electrical efficiency, forgetting mechanical limitations of this type which, in the opinion of many, offset the electrical advantages over tube and chemical rectifiers.

Thus the job of writing about radio is a matter of blundering along, which invites censure; pursuing personal convictions, creating controversy; being non-committal about everything, which is not constructive; or keeping to the things that are surely right and avoiding those that may not be, the fairest course to all concerned.

Unfortunately, the only way to be entirely safe from criticism is to write nothing, but then we would have no magazines.

M. B. SLEEPER, *Editor.*

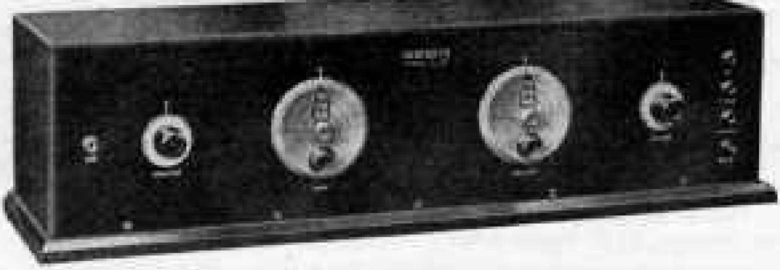


Fig. 1. The outer appearance of the Ultradyne has been improved greatly in the new design which also incorporates important changes inside

The Phenix Ultradyne

A modification of the Super-Heterodyne circuit which, because of its range and sharpness, has been very popular among set builders

THE theory of the original design for the Ultradyne circuit has been described in detail previously but there are a number of new features about the Model L2 which make the new type much improved both as to operation and appearance.

You will notice from the front view that the variable condensers are equipped with the Ultravernier controls, providing not only close settings for the condensers but an arrangement for logging various stations on the dials. On the upper half of the dials are three rings with corresponding indicators on the pointer. Therefore, even tho stations are very near together, they can be marked by using different rings. Still a forth section will be found on the lower half of the dial. The silver finish is just rough enough to take pencil markings readily, and the finish permanent enough so that the markings can be erased.

In place of the large and rather awkward coils with which these sets were previously equipped, spiderweb inductances are now provided. There are three units, the antenna coupling coil, oscillator coil, and variable coupling coil. The secondary of the antenna coupling coil is automatically connected to the grid of the first tube when the loop plug is removed. The primary of this unit goes to the antenna and ground binding posts. When the antenna plug is inserted, the secondary is disconnected and the loop cut in in its place. This is a decided advantage particularly for long distance reception. The tuning is just as sharp when the antenna and ground are used as with the loop.

It was found that the efficiency of the Ultradyne could be increased by using adjustable coupling for the oscillator unit. This is also of spiderweb design arranged for 45-degree angle mounting. To prevent hand capacity effects, the coils are shielded with a circular disc, grounded to the filament circuit. Two other spiderweb coils make up the oscillator inductance.

The regular Ultradyne kit contains three inductance units just described, a filter type Ultraformer, three intermediate Ultraformers, and four matched fixed condensers. In addition to these items there are required two 0.0005 mfd. Hammarlund variable condensers, two Ultravernier knobs and dials, coupler and potentiometer knobs, eight Na-Ald vacuum tube sockets, a Pacent potentiometer, eight 1A Amperites, two double-circuit jacks, double-circuit and single-circuit filament control jacks, Cutler-Hammer filament switch, two Thordarsen amplifying transformers, a variable gridleak, seven binding posts, a 0.0005

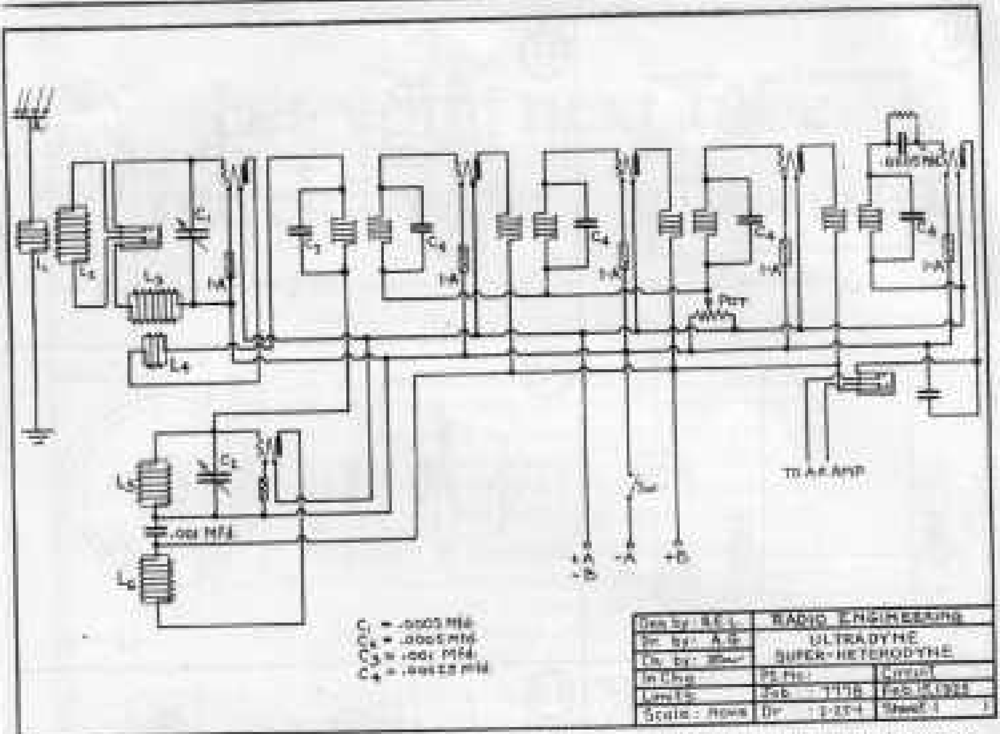


Fig. 2. This shows the circuit system of the Ultradyne, except for the audio frequency amplifier which is connected in the usual way

mfd. grid condenser with gridleak mounting, two 0.001 mfd. condensers and one 0.005 mfd. condenser. These are in addition to the four condensers furnished with the kit. These condensers are of the special Dubilier type which are tested for exact and constant capacity. The front panel measures 7 by 30 by 3/16-in. and the baseboard, 7 by 30 by ½-in.

The schematic wiring diagram in Fig. 2 shows the connections except for the audio frequency amplifier which, for lack of space, was omitted. It is of the usual design, equipped with filament control jacks.

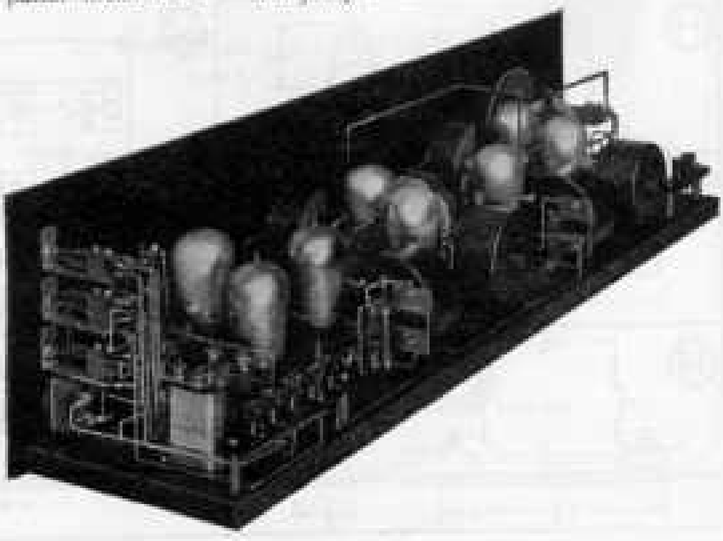
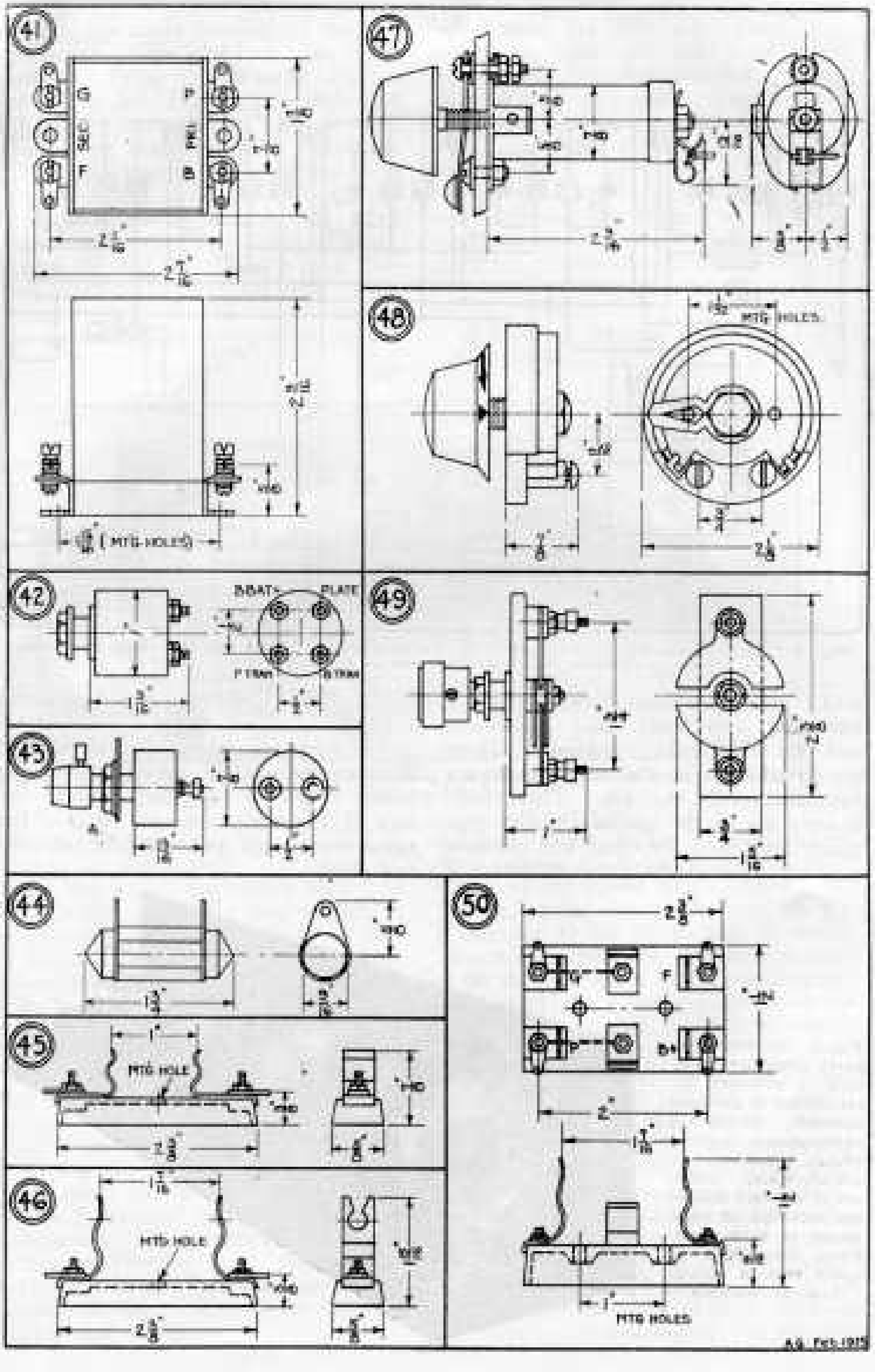


Fig. 3. By fitting the parts together carefully a compact arrangement is achieved without introducing objectionable coupling effects. Moreover, the Ultraformers, which are of air-core design, are mounted at right angles to each other. Each Ultraformer is tuned with a special type of Micadon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A.G. Feb. 1925

Data Sheet No. 6

41. PACENT IMPROVED AUDIOFORMER NO. 26: This audio transformer has a ratio of 3½ to 1 and may be used in either the first or second stage of audio amplification. It is designed to give a high degree of amplification over the entire audio frequency range. Both soldering lugs and binding posts are provided for connection, and are located near the bottom, so that the wiring is kept close to the baseboard of the set. The case is of brass with a satin nickel finish, and is grounded to the core.

42. TRI-JACK: The Tri-Jack can be used either as a single or double circuit jack. The springs, entirely enclosed in the bakelite case, are connected to the four terminals at the rear. Its very small size makes it convenient in many sets where very little space is available. One hole ⅜ in. diameter is required for mounting.

43. CARTER IMP BATTERY SWITCH: This A battery snap switch is extremely small, and mounts in a 7/16 in. hole drilled in the panel. A silvered name plate and pointer are provided to show when the battery is on or off. Two nickeled binding posts are provided at the rear for connection.

44. TELOMEG GRIDLEAK: This gridleak is of the cartridge type, and fits in standard sized gridleak mountings. The resistance element is enclosed in a bakelite case fitted with two cone-shaped nickeled brass end pieces. Two soldering lugs are also provided for connection. It is made in various resistances.

45. DAVEN FIXED CONDENSER MOUNTING NO. 52: This mounting is made to take the standard size fixed mica condensers. The base is of bakelite, ribbed for strength. The two spring clips which hold the condenser are of nickeled brass. It can be mounted with a screw passing through the center mounting hole.

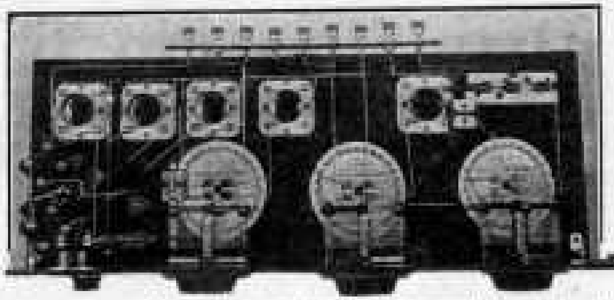
46. DAVEN RESISTANCE MOUNTING NO. 50: The mounting is designed to take tubular resistance untis of standard length. The spring clips are bent over on the bakelite base to prevent them from turning around. A mounting hole is provided at the center.

47. FILKOSTAT: This rheostat can be adjusted to any resistance from 0 to 30 ohms by turning the knob. This feature, and the fact that it gives very fine vernier control, makes it suitable for all types of tubes. The resistance element consists of a very finely divided metallic powder, and the construction is such that the rheostat is absolutely non-microphonic. Fahnestock spring clips are furnished for connection. The rheostat can be obtained either plain or with a battery switch which mounts on the front panel as shown in the drawing.

48. DE JUR RHEOSTAT: The drawing shows the main dimensions of this rheostat. It is constructed of bakelite throughout and has two terminals at the rear. Either one hole mounting or screw mounting can be used. For the former a ⅜ in. hole must be drilled in the panel. The contract arm is of unique design, giving a very smooth movement. The knob has both an idex mark and a direction arrow engraved on it for the convenience of the operator.

49. MARCO NEUTRALIZING CONDENSER: This is a very efficient and useful variable condenser of low capacity. It has two stationary and two movable semi-circular plates of nickeled brass. Binding posts are provided for connection. The entire unit is mounted on a Formica strip, and mounting is accomplished by drilling a 5/16 in. hole in the panel.

50. DAVEN RESISTO-COUPLER, NO. 41: This unit is almost indispensable in resistance-coupled amplifiers as it holds the two resistors and fixed condenser necessary for each stage so compactly. The connection between the G terminal and one condenser clip and that between the P terminal and the other clip is already made by brass strips under the bakelite base.



A new type of receiver equipped with Summit toroidal coils

THE Radio Corporation, apparently, has no monopoly on patent suits. The Pacent Electric Company is taking action against a number of concerns who are manufacturing telephone plugs. Also, the Central Radio Laboratories have brought suit against an alleged infringer of their patents on the design of rheostats and potentiometers. The Carter Radio Company, by the way, has been granted a license by the Central Radio Laboratories.

Ansonia, Conn., has been chosen for the site of a new plant for the manufacture of the Mohawk One-Dial set. The Mohawk Electric Corporation is a Chicago concern. They have announced that, in the new plant, five hundred sets a day will be produced. The capitalization of the company has been increased from $100,000 to $300,000.

A very interesting circular is being distributed by the Stanley Manufacturing Company of Dayton, Ohio, describing their name plates. Two kinds of labels are manufactured by this concern, one employing very thin metal which can be fastened with tacks or rivets. All kinds of designs, some in color, are embossed on these name plates. The gummed types look like regular metal labels and hold fast on bakelite or hard rubber as well as wood or glass.

Quite a number of radio concerns are using the Meg Ohmmeter, manufactured by James G. Biddle of Philadelphia, Pa., for testing the insulation of condensers and transformers and the resistance of gridleaks. The ohmmeter is direct reading from a pointer and scale. A very important feature is that, if the testing terminals are shortened, as when a short circuited condenser is being tested, the meter is in no way injured.

The Adler-Royal Company have just got into production on a new loud speaker of the cabinet type. Built by a phonograph and musical instrument manufacturer, it has several features which contribute to the exceptional quality of the tone and prevents overloading or ravettling under heavy load. The cabinet itself is a very handsome affair.

Everybody is wondering what is inside the case of the Bosch Nobattery. This is a B battery substitute for either alternating or direct current. The instrument is very simple and attractive, and the price reasonably low.

The most complete data on super-heterodyne sets of various types and designs is given in McMurdo Silver's book entitled "The Portable Super-Heterodyne." This book is published by Silver-Marshall, Inc., South Wabash Avenue, Chicago. Fourteen photographs, two panel patterns, and five diagrams are used to illustrate the data given.

Manufacturers and Designers

Reference Data on

TRANSFORMERS

The data presented have been carefully compiled with the assistance of the manufacturers represented. By removing these pages from the magazine you will have a complete reference file on audio, radio, and super-heterodyne transformers. Next month this section will be devoted to rheostats, potentiometers, and resistances.

THE *Summit* TOROIDAL RADIO FREQUENCY TRANSFORMER

used in exactly the same manner as the open radio frequency coils — they are self balanced and self neutralized. They have no stray fields nor leakages, nor can they feed back, thus assuring the radio set builder of correct operation without howling or squealing.

One builder using these Transformers in the SUMMIT circuit received 54 stations in two nights travelling West to Denver and South to Mexico City. This circuit with instructions for building enclosed with each set of Transformers.

List Price (Set of 3 mated Units) $10.00

Distributors and Jobbers Wanted

SUMMIT RADIO MFG. CO., Inc.
481 Broad Street
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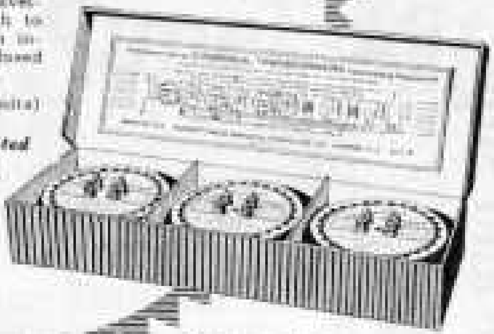

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The Latest Achievement in Audio Amplification

Type 285

Price $7.00

Discriminating radio listeners—this instrument has been designed for you. It is an achievement of which the designing engineers are justly proud; it is an instrument which merits the admiration of trained radio ears.

High and low notes are amplified evenly over the whole audio range so that instrumental or vocal tones are reproduced individually or in combination with a naturalness which delights the most critical radio listener.

Seldom is more than one transformer necessary to operate a loud speaker with good volume.

If you want the best there is in transformer design, the type 285 should be your choice.

Ask for them by Name
At all Reliable Radio Dealers.

GENERAL RADIO Co

CAMBRIDGE, MASS.

Specifications for Audio, Radio and Super Transformers

Note: Dimensions are given in the order: Height, Width, Thickness. Tuning of radio frequency and super-heterodyne transformers is indicated as Self, V. C., or F. C., indicating Self-tuned, Variable Condenser, or Fixed Condenser.

AUDIO TRANSFORMERS

Manufacturer	Over-all size	Mounting	Terminals	Ratio	Case	List price
Acme Apparatus Co	2 7/8 x 2 5/8 x 2 1/2	Open	Front side	1-4 1/2	Closed	$5.00
" "	2 7/8 x 2 5/8 x 2 5/8	"	"	Vari.	"	7.00
All-American Radio Co	2 3/4 x 2 5/8 x 2 1/4	Metal case	Top	1-3	"	
" "	2 3/4 x 2 5/8 x 2 1/4	"	"	1-5	"	
" "	2 3/4 x 2 5/8 x 2 1/4	"	"	1-10	"	
" "	3 7/8 x 2 1/2 x 2 1/2	"	Side	1-10	Shell	9.00
Andrea, F. A. D., Inc.	3 1/4 x 2 1/4 x 1 7/8	Bake. case	Top	1-3 1/2	"	5.00
Federal Tel. & Tel. Co.	3 3/8 x 2 x 2	Open	"		"	
" "	3 x 1 1/4 x 1 5/8	"	"		"	
Electrical Research Labs.	2 3/4 x 2 3/4 x 1 3/4	Metal case	"	1-3 1/2	"	
" "	2 3/4 x 2 3/4 x 1 3/4	"	"	1-6	"	
Ford Mica Co.	3 1/4 x 2 x 1 7/8	Open	"	1-5	Closed	5.00
General Radio Co	3 1/2 x 2 1/2 x 3 1/8	Metal case	Bottom	1-5.95	Shell	7.00
Jefferson Elec. Mfg. Co	2 3/4 x 2 1/2 x 1 3/4	"	Top	1-1 1/2	Closed yoke	
" "	2 3/4 x 2 1/2 x 1 3/4	"	"	1-3	"	
" "	2 3/4 x 2 1/2 x 1 3/4	"	"	1-3.7	"	
" "	2 3/4 x 2 1/2 x 1 3/4	"	"	1-6	"	
Jos. W. Jones	2 3/4 x 1 1/2 x 1 3/4	Brass case	Side	1-4	Closed	5.00
Karas Electric Co.	2 5/8 x 3 x 2 1/2	Metal case	Ends	1-4	"	7.00
Kellogg Sw'b'd & Supply Co	2 1/8 x 2 1/2 x 1 3/4	Brass case	Top	1-4 1/2	Shell	
" "	2 1/8 x 2 1/2 x 1 3/4	"	"	1-3	"	
" "	2 1/8 x 2 5/8 x 1 1/2	Open	"	1-4 1/2	"	
" "	2 1/8 x 2 5/8 x 1 1/2	"	"	1-3	"	
" "	2 3/4 x 2 5/8 x 1 1/2	"	"	1-4 1/2	"	
" "	2 3/4 x 2 5/8 x 1 1/2	"	"	1-3	"	
Martin-Copeland Co.	2 1/2 x 1 7/8 x 1 5/8	Brass case	Base	1-3 1/2	"	5.00
National Trans. Mfg. Co	2 5/8 x 2 1/4 x 2	Metal case	Side	1-3 1/2	Closed	4.00
" "	2 5/8 x 2 1/4 x 2	"	"	1-6	"	4.50
" "	3 1/8 x 2 1/2 x 1 3/4	Open	"	1-3 1/2	"	3.75
" "	3 1/8 x 2 1/2 x 1 3/4	"	"	1-6	"	4.25
" "	2 x 2 1/4 x 1 1/4	"	Plain leads	1-3 1/2	"	
" "	2 x 2 1/4 x 1 1/4	"	"	1-6	"	
New York Coil Co.	2 1/2 x 2 1/4 x 1 3/4	Metal case	Side	1-4 1/2	Shell	3.75
Pacent Electric Co.	2 1/2 x 1 3/4 x 2 1/2	"	Base	1-3 1/2	"	5.00

AUDIO TRANSFORMERS—Continued:

Manufacturer	Over-all size	Mounting	Terminals	Ratio	Core	List price
Premier Electric Co	1½ x 2¼ x 1¾	Open	Ends	1-3	Hedgehog	$3.50
" "	1½ x 2¼ x 1¾	"	"	1-4	"	3.50
" "	1½ x 2¼ x 1¾	"	"	1-5	"	3.50
" "	1½ x 3 x 1¾	"	"	1-10	"	4.50
Radio Receptor Co	2¾ x 2 x 2	Metal case	Sides	1-3	Shell	....
" "	2¾ x 2 x 2	"	"	1-5	"	....
Samson Electric Co	3⅛ x 2½ x 1⅞	"	Top	1-3	"	5.00
" "	3⅛ x 2½ x 1⅞	"	"	1-6	"	5.00
Sterling Mfg. Co.	2¾ x 2¾ x 1¾	"	Base	1-4	"	6.00
Thordarson El. Mfg. Co.	2½ x 2⅞ x 1¾	"	Top	1-2	"	5.00
" "	2½ x 2⅞ x 1¾	"	"	1-3½	"	4.00
" "	2½ x 2⅞ x 1¾	"	"	1-6	"	4.50

RADIO TRANSFORMERS

Manufacturer	Over-all size	Mounting	Terminals	Ratio	Core	Wave length	Tuning	List price
Acme Apparatus Co.	1¾ x 3⅞ x 1½	Bakelite case	Top	....	Iron	200-600m.	Self	$5.00
All-American Radio Co.	1¼ x 3½ x 2⅜	"	Sides	1-10	"	225-550	"	(199 tubes)
" "	1¼ x 3½ x 2⅜	"	"	1-10	"	225-550	"	(201a tube)
" "	3⅛ x 3 x 2¼	"	"	1-10	Air	225-550	V. C.	....
Chas. A. Branston, Inc.	2 x 4 x 2¼	Metal case	Side	1-3	Iron	200-600	Self	4.50
Brooklyn Met. St. Co.	2⅛ x 2¼ x 2¼	Molded case	Top	1-4	Air	200-600	"	2.00
Electrical Research Labs	1¾ x 3 x 1⅞	Bakelite	Ends	....	Iron	200-700	"	....
" "	1¾ x 3 x 1⅞	"	"	....	Air	200-700	V. C.	....
Federal Tel. & Tel. Co.	1⅛ x 4⅛ x 1⅛	Open	"	....	Iron	175-300	Self	....
" "	1⅛ x 4⅛ x 1⅛	"	"	....	"	275-600	"	....
" "	1⅛ x 4⅛ x 1⅛	"	"	....	"	220-550	"	....
Kellogg Sw'b'd. & Supply Co.	3¼ x 2¾ x 2¼	"	Top	....	Air	225-600	V. C.	....
National Trans. Mfg. Co.	2¼ x 1⅝ x 1⅝	Bakelite	"	....	"	225-550	Self	4.00
Premier Electric Co.	1½ x 1⅞ x 1¾	Molded case	Ends	....	"	200-600	"	1.50
Radio Receptor Co.	3 x 2¾ x 2¾	Metal case	Top	1-3	....	200-600	"	....
" "	3 x 2¾ x 2¾	"	"	1-5	....	200-600	"	....
Sterling Mfg. Co.	2⅞ x 2 x 1½	"	"	....	"	200-575	V. C.	3.50

SUPER-HETERODYNE TRANSFORMERS

Manufacturer	Over-all size	Mounting	Terminals	Ratio	Core	Kilo-cycles	Tuning	List price
Acme Apparatus	2⅝ x 2⅝ x 2½	Open	Side		Iron	30	Self	$5.00
All-American Radio Co.	3⅛ x 3 x 2¼	Bakelite	Sides	1-10	Air	30	F. C	
" "	2⅝ x 2⅝ x 2¼	Metal case	Top	1-10	Iron	75-15	Self	
Chas. A. Branston, Inc.	2 x 4 x 2	"	Side		"	60	"	13.50
" "	2 x 2¼ x 2	"	"		"	60	F. C.	4.50
Brooklyn Met. St. Co.	2⅛ x 2¾ x 2¾	Brass case	Top	1-3½	Air	53	F. C	5.00
" "	2⅛ x 2¾ x 2¾	"	"	1-2.7	"	53	Self	5.00
General Radio Co.	1⅞ x 2½ x 2½	Metal case	Base	1-3	Iron	30	"	
Jefferson Elect. Co.	2¾ x 1¾ x 1½	"	Top		"	30	"	
" "	2¾ x 1¾ x 1½	"	"		"	30	F. C	
Kellogg Sw'b'd. & Supply Co.	1¾ x 2½ x 2½	Brass case	"			46	F. C	
Phenix Radio Corp.	3 x 3 x 2½	Bakelite	Side	1-2	Air	81	"	5.00
" "	3 x 3 x 2½	"	"	1-2	"	81	Self	5.00
Samson Electric Co.	2¼ x 2¼ x 2¼	"	Base	1-3	"	60	"	4.50
" "	2¼ x 2¼ x 2½	"	"	1-3	"	60	F. C.	4.50
Silver-Marshall	2⅜ x 3½ x 2½	Metal case	Top			60	Special	
"	2⅞ x 2⅝ x 2½	"	"		Iron	60	Self	
"	2⅞ x 2⅝ x 2½	"	"		Air	60	F. C	

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The full, rich, natural musical quality of radio reception amplified by Karas Harmonik Audio Frequency Transformers is the result of radical improvements in transformer design, accomplished by Karas engineers.

There are seven distinct, scientific reasons why Karas Harmoniks deliver such a surprising volume of natural musical sounds. Here they are:

1. *High Inductance*—Due to the many thousands of turns of wire used.
2. *Large Iron Core*—Offering an easy path for the lines of magnetic force to influence the secondary windings.
3. *Very High Impedance*—Able to accommodate ALL impedances of all amplifier tubes—at all frequencies.
4. *Controlled Air Gap*—Insuring high amplification of the low frequency, volume carrying fundamental harmonics. One reason why Karas Harmoniks give greater amplification with low ratio than cheap transformers do with high ratio.
5. *Low Hysteresis Loss*—Which increases volume by utilizing all the energy for amplification.
6. *Scientific Circular Shielding*.—Which prevents howling due to electro-magnetic or electro-static coupling, however close together the two transformers may be placed.
7. Perfectly matched in all factors, which insures uniform values of amplification in the two stages.

However good your present quality of reception may seem, the change to Karas Harmoniks will improve it tremendously. You have a treat in store for you when you hear your speaker pour forth a wealth of more beautiful music than you ever heard from a radio before.

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for this wave length

1 Samson Oscillator Coupler

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A T a recent test, made in the heart of New York City, broadcasters in Chicago, Atlanta and Canada were brought in on the RASLA Circuit for Three Tubes in the early evening. All the locals were going. Receiving conditions were not favorable. And yet all stations were heard with a loud speaker!
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TRANSFORMER
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FIXED DETECTOR

Pure, clear tones from your speaker, must *start* with your transformers

You want more than noise from your loud speaker.

You want *pure* tones, clear, mellow reproduction.

But no speaker can be *better* than your A. F. transformers.

And *any* speaker will be improved when you use transformers that are designed for loud speaker use!

Transformers that produce the greatest possible *amount* of amplification unfortunately also introduce imperfections in the tone. And the speaker magnifies such imperfections.

Fortunately, however, when the tone is *clear*, you don't need anywhere near so much *volume* of sound.

In designing MAR-CO transformers, an amplification ratio has been used, which provides the *most* volume that is consistent with absolute purity of tone. And, of course, they are built, like all other MAR-CO parts, with the famed MAR-CO precision that stops leaks and conserves radio energy!

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Providence, R. I.

RATIO
3½ : 1
PRICE
$5.00

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AUDIO RADIO PRODUCTS FREQUENCY
TRANSFORMERS

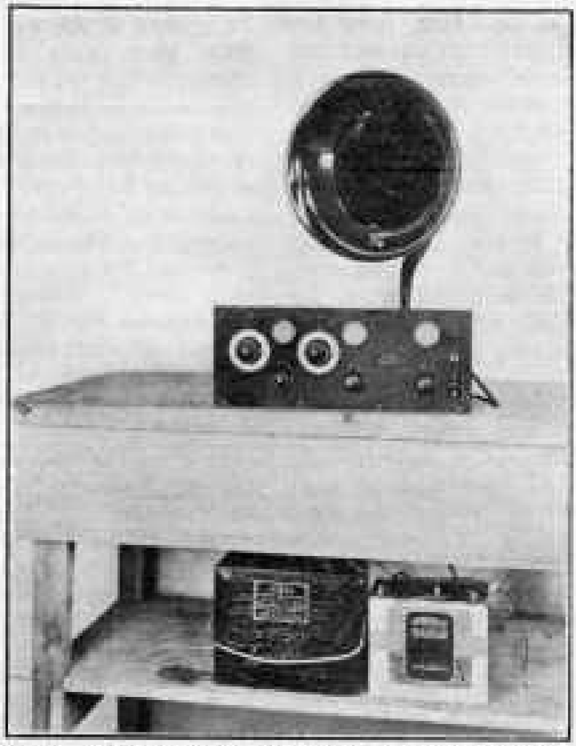

Fig. 1. The Erla set, operating an Ethovox loudspeaker.

How to Assemble the Erla Superflex Receiver

In this set maximum amplification is obtained from the three tubes by means of the duo-reflex principle

NOW that the question of the cost of set upkeep and operation is being considered seriously by radio engineers, the reflex type of receiver is coming more and more into its own. The Erla Superflex set, shown in the accompanying illustrations, employs the principle of duo-reflex amplification to obtain maximum results from the three tubes and crystal detector. Two controls are used for tuning. It provides two stages of tuned radio frequency, detector, and two stages of audio frequency amplification. A single circuit antenna coil, called a Selectoformer, having two antenna taps, is tuned by a 21-plate variable condenser. The two interstage radio frequency transformers are of a special type developed for reflex work. Fig. 3 shows a schematic wiring diagram of the circuit. The first A. F. transformer has a 1 to 5 ratio, and that of the second is 1 to 3½.

The Erla Circuit

Examination of the schematic wiring diagram shows that each tube is controlled by a separate rheostat. A phone jack is provided for plugging in on the first A. F. stage and one is also used in the last step. The primary of the first A. F. transformer is shunted by a .001 mfd. by-pass condenser, and the secondary by one of .00025 mfd. capacity. This latter value is critical and it is always well to try values of capacity smaller than this to find what gives best results. The set performs best with an aerial from 100 to 125 feet long, although in locations near powerful broadcasting stations it may be necessary to cut the aerial down to about 75 ft. on account of interference. It can be operated on an indoor antenna, with slightly less volume.

Design Details of the Set A front panel measuring 7 by 18 ins., 3/16 in. thick, carries the three rheostats, two variable condensers, and bezels for observing the brilliancy of the tubes. On the right are the two jacks and toggle type filament switch. The two condensers are provided with silvered dials. The transformers and sockets are supported at the rear on a wooden base panel 7¼ by 17⅜ ins. Special angle supports are used to connect the fixed condensers to the A. F. transformer. The aerial and battery binding posts are supported on composition strips elevated from the baseboard by small pillars. The set can be assembled entirely without soldering by means of the tee connectors for butt joints and the ball connectors used for fastening the bus bar to the jack springs.

Parts Required for the Set The parts contained in the kit are: One panel 7 by 18 ins., 3/16 in. thick, one wooden baseboard, a 21-plate Erla variable condenser and dial, one 11-plate condenser and dial, three rheostats and knobs, three bezels, one Connecticut toggle switch, one Premier double circuit jack, one Premier open circuit jack, an Erla Selectoformer type A, one Duo-Reflex, one Reflex and one R. F. transformer, one 1 to 5 A. F. transformer, one 1 to 3½ A. F. transformer, three sockets, one .001 mfd., one .002 mfd., and one .00025 fixed condenser, six binding posts and two mounting strips, together with the bus bar, screws, nuts, solderless connectors, and angle mountings.

Assembly And Wiring Fig. 3 shows a picture wiring diagram of the set, in which the connections have been drawn exactly as they were arranged in the original receiver. The diagram is drawn looking down on the set. Connections were made by loops in the ends of the wires. A pair of Rance pliers are very handy for this work. Butt joints in the wires, shown by heavy dots, were made with the "tee" connectors. The set may also be assembled with soldered connections, in which case lugs must be put on the terminals of the various instruments. Use either Kester or Belden rosin core solder, or plain soft solder with Nokorode paste put on very sparingly. Have the iron thoroughly clean and hot enough to make the solder flow freely. When soldering wires to the lugs on the R. F. transformer and crystal detector terminals, do not keep the iron on long enough to heat them excessively, as the instruments will be damaged.

1. Turn the wooden baseboard so that the small locating holes, punched in it, face upward. Mount the selectoformer on the left, as shown in the picture wiring diagram, with the small R. H. wood screws provided. Keep the terminals in the position shown. Next mount the Reflex 2 and Reflex 1 transformers in the same way. Mount the three sockets with their terminals as shown. Fasten one of the angle mounts to the G terminal of the Reflex 1 transformer. Fasten the crystal detector to this mounting with one of the short machine screws and nuts. Fasten the Ant and Gnd binding post strip to the baseboard temporarily.

2. Form wire 1 to 2 from the G binding post hole to the GR terminal of the Selectoformer. Also form wire 3 to 4, from the ANT binding post hole to the top or AN terminal. Now fasten these wires under the heads of the binding post screws and tighten up the nuts. Mount the terminal strip on the baseboard with two wood screws slipped thru the two composition pillars. Connect 2 and 4 to the Selectoformer terminals. Connect 5, the P terminal of the left hand socket, to 6. Connect 7, the P terminal of the middle socket, to 8.

3. Mount the two A. F. transformers on the baseboard with the short R. H. wood screws. Keep the terminals in the positions shown. Unscrew the collar nuts on the three rheostats and fasten them on the front panel, keeping the terminals toward the lower edge. Insert the three bezels and screens in the holes provided for them. Mount the filament

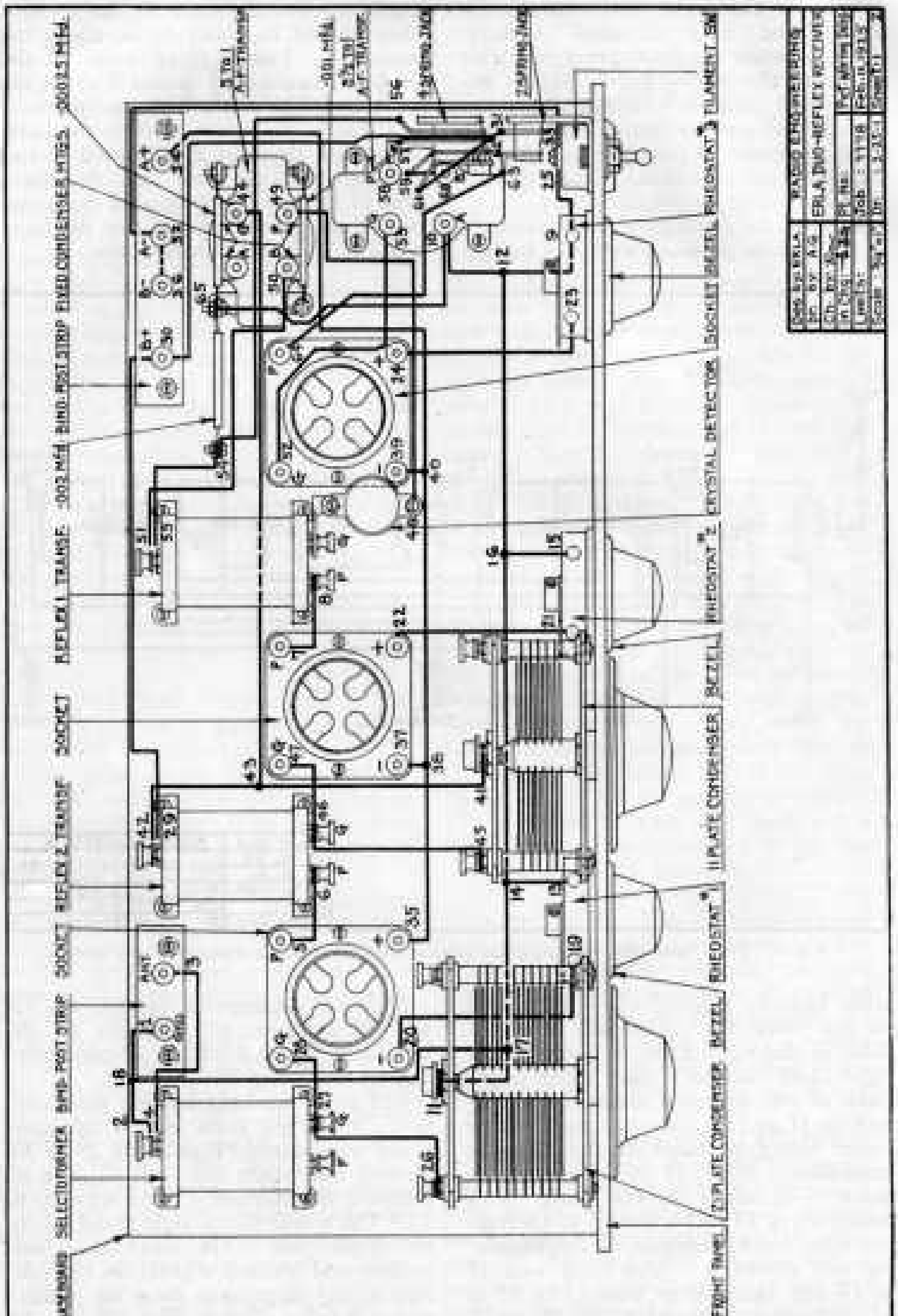

Fig. 3. Picture wiring diagram of the Erla set, drawn looking down on the tube panel.

switch on the right with the F. H. screws and nuts provided. Directly above it, mount the four-spring jack with its frame toward the right. Mount the two-spring jack in the same manner directly above the other. Fasten the 21-plate condenser in place on the left with the collar nut provided. Mount the 11-plate condenser in the same way.

4. Place the front panel and baseboard in the relative positions they will occupy minals of the rheostats to the sockets. They should be about ¼-in. above the baseboard. Fasten these wires at the rheostat terminals. Connect 9 to 25, the lower terminal of the filament switch.

5. Fasten the front panel to the baseboard with the four F. H. wood screws provided, making sure that the lower edge of the panel is flush with the under face of the baseboard, and that the baseboard is centered with the panel.

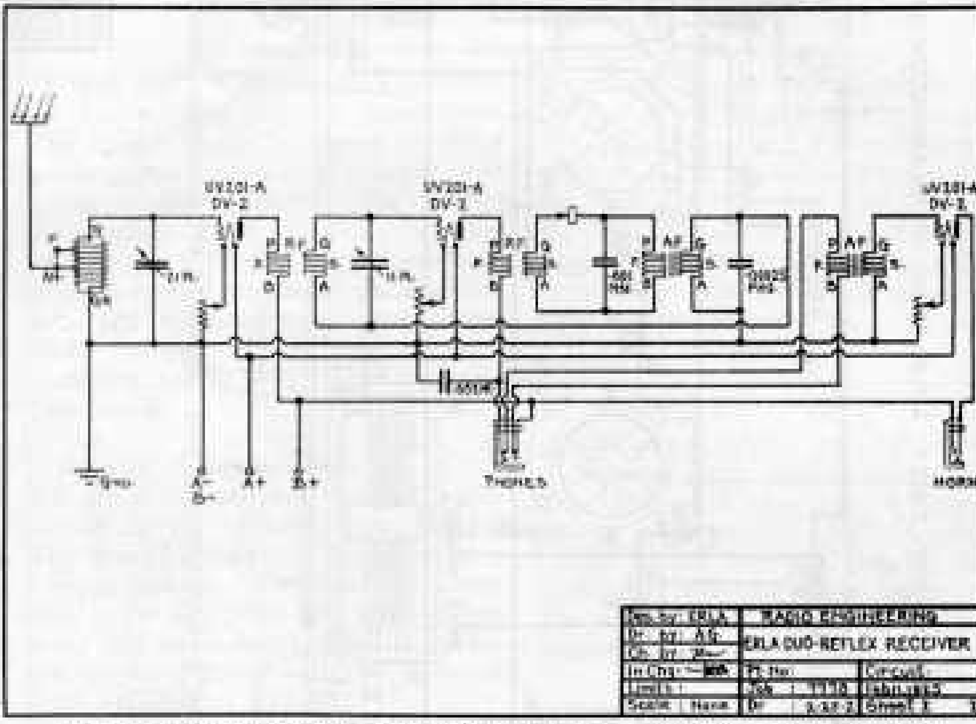

Fig. 3. Check this schematic diagram against the set as you proceed with the wiring.

when fastened together and form a piece of bus wire for connection 9 to 10. Nine is the right hand terminal of the right hand rheostat. Take a full-length piece of bus wire and shape it for connection 11 to 12. Eleven is the rotor or lower center terminal of the 21 plate condenser. Wire 11 to 12 should be about ¼-in. above the baseboard. Now fasten wires 13 to 14, and 15 to 16 from the right hand terminals of the remaining two rheostats. Also form wire 17 to 18 and fasten it to wire 11 to 12 at 17. Make up wire 19 to 20, 21 to 22, and 23 to 24, from the left hand ter-

6. Make connections 18, 14, 16, 12, and 20 permanently. Connect 26, the left hand terminal of the 21-plate condenser, to 27, and 28.

7. Fasten the long binding post strip to the rear right hand side of the baseboard temporarily. Form wire 29 to 30. Twenty-nine is the top or B terminal of Reflex 2 transformer. Form wire 30 to 31. Thirty-one is the right hand tab of the upper jack. The jacks have been broken and shifted slightly in the picture wiring diagram to show the connections clearly. Form wire 32 to 33. Thirty-two is the A— binding post hole,

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and 33 is the upper terminal of the filament switch. This wire runs close to the baseboard. Form wire 34 to 35. Thirty-four is the A+ binding post hole and 35 is the + terminal of the left hand socket. See that this wire clears the A. F. transformers. It should run close to the baseboard. Now fasten these various wires from the binding post strip together with the four binding posts. Connect 32 and 36, the A— and B— posts, together. Fasten the strip to the baseboard with R. H. wood screws slipped into the two composition support pillars.

9. Fasten the .001 mfd. fixed condenser to right and left hand angle mounts with two of the short R. H. machine screws and nuts. Fasten these under the binding post nuts of the B and P terminals of the 5 to 1 A. F. transformer. Fasten the .00025 mfd. condenser to two angle mounts in the same way and also fasten the .002 mfd. condenser as shown in the picture wiring diagram. These mounts should now be held under the A and G binding posts of the transformer.

10. Connect 54, the free end of the .002 condenser, to 55, the upper or B

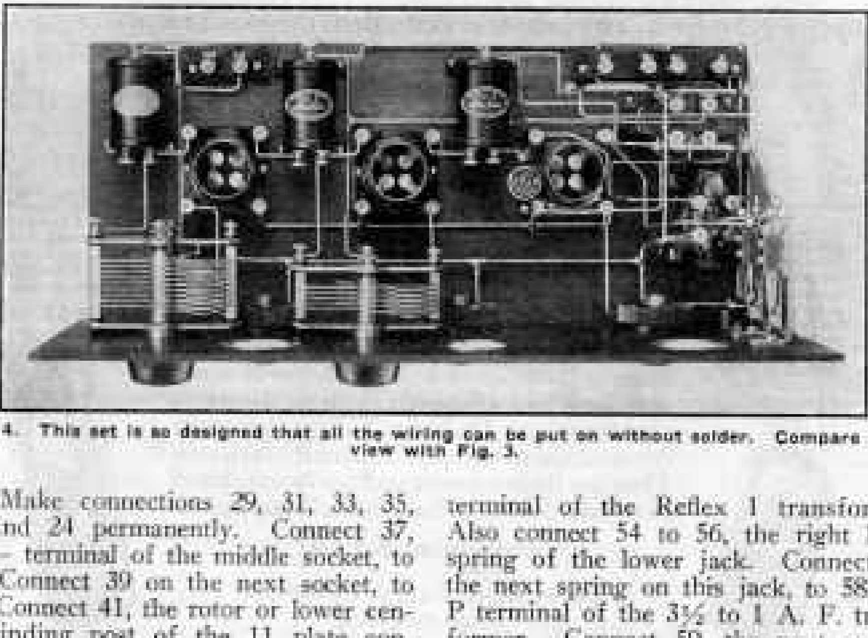

Fig. 4. This set is so designed that all the wiring can be put on without solder. Compare this view with Fig. 3.

8. Make connections 29, 31, 33, 35, 22, and 24 permanently. Connect 37, the — terminal of the middle socket, to 38. Connect 39 on the next socket, to 40. Connect 41, the rotor or lower center binding post of the 11 plate condenser, to 42, the lower or A terminal of Reflex 2 transformer. Keep this wire ¼-in. above the baseboard. Connect 43, a point on this wire, to 44, the G terminal of the 5 to 1 A. F. transformer. Run this wire under Reflex 1 transformer. Connect 45, the left hand terminal of the 11 plate variable condenser, to 46 and 47. Connect 48, the remaining terminal of the crystal detector, to 49, the P terminal of the 5 to 1 A. F. transformer. Connect 50, the B terminal of this transformer, to 51, the lower or A terminal of the Reflex 1 transformer. Connect 52, the G terminal of the right hand socket, to 53.

terminal of the Reflex 1 transformer. Also connect 54 to 56, the right hand spring of the lower jack. Connect 57, the next spring on this jack, to 58, the P terminal of the 3½ to 1 A. F. transformer. Connect 59, the next spring, to 60, the B terminal to the transformer. Connect 61, the remaining spring of the jack, to 62, a point on the wire connected to the right hand spring of the upper jack at 31. Connect 63, the left hand spring of the upper jack, to 64, the P terminal of the right hand socket. Finally, connect 65, the junction of the .002 mfd. and .00025 mfd. fixed condensers, to 10. Fasten the three rheostat knobs on the shafts by means of the set screws so that the arrows engraved on the faces point down when the rheostat arms are turned all the way to the left. Fasten the two silvered dials on the variable condenser shafts so that the

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100 marks coincide with the vertical reference lines engraved on the panel when the condenser plates are totally interleaved.

This completes the wiring of the set.

Testing And Operation After the set has been wired, go over each connection carefully, checking it against the picture wiring diagram. Put the filament switch at the OFF position. Connect a 6-volt A battery across the A+ and A— binding posts. Insert the three tubes in the sockets, and put the filament switch at the ON position. Turn up the rheostats above three-quarters of the way. This should light the tubes. To test the B battery circuit, disconnect the battery from the A+ binding post and connect it to the B+ binding post. The tubes should not light in this position. Now connect the A battery back properly and connect a 90-volt B battery to the set. Connect the antenna and ground, light the tubes, and plug in the phones or loud-speaker.

To locate a station, rotate the condenser dials in unison, starting at zero and increasing. When a station is heard, rotate each dial slowly in both directions until maximum signal strength is obtained. Once a station has been logged, it will always come in on the same dial setting. Adjustment of the rheostats may also aid in bringing a station in clear and sharp. It will be worth while to try fixed condensers of various capacities down to .0001 mfd. in place of the .00025 mfd. condenser, using the one which gives best results. Where selectivity is not very important and greater volume is desired, the aerial lead can be connected directly to the F terminal of the Selectoformer.

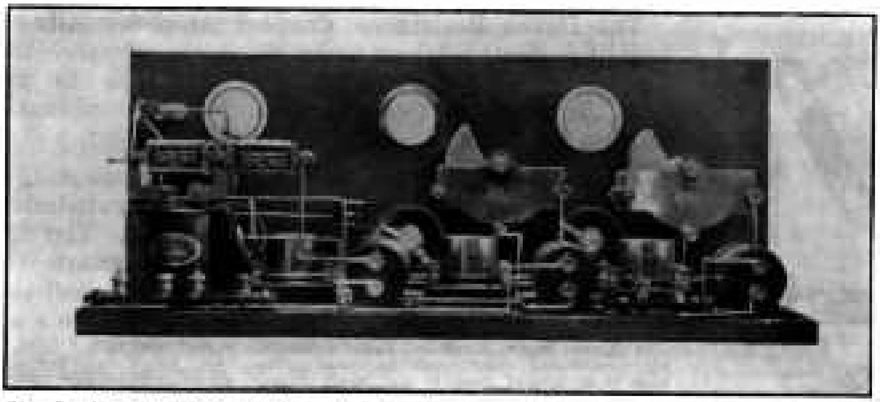

Fig. 5. Here you can see how the transformers and fixed condensers are mounted

STANDARD 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.

Complete Parts for the Type 7200 Cotton Super-Heterodyne

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8645	8-UV201A Sockets	$8.00
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	Allen D. Cardwell Co., 81 Prospect St., Brooklyn, N. Y.	
	2-.0005 Cardwell Condensers	10.00
	Carter Radio Co., 209 S. State St., Chicago, Ill.	
101	1-Open circuit jack	.70
104	2-Double circuit jacks	2.00
	Chelton Elec. Co., Philadelphia, Pa.	
	1-Chelton Midget vernier	1.25
	Daven Radio Corp., 9 Campbell St., Newark, N. J.	
50	3-Resistor mountings	1.20
	2-.5 megohm resistors	1.00
	1-.05 megohm resistor	.75
	Diamond State Fibre Co., 423 Broome St., New York, N. Y.	
	1-7X28X3/16 Black Celeron panel	4.59
	1-7X27X3/16 Black Celeron panel	4.42
	Dubilier Condenser & Radio Corp., 48 West 4th St., New York, N. Y.	
601T	2-.001 mfd. Micadons	1.00
601	1-.005 mfd. Micadons	.60
601	2-.0005 mfd. Micadons	.70
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EN	8-Eby Ensign plain binding posts	1.20
	James Goldmark Co., 83 Warren St., New York, N. Y.	
W	1-100 ft. spool Wirit	.90
	Mitchell-Rand Mfg. Co., 18 Vesey Street, New York, N. Y.	
7	3-lengths No. 7 Varnished tubing	.45
	Mydar Radio Co., 9 Campbell St., Newark, N. J.	
R	1-Accuratune Rheostat dial	.75
	Pacent Elec. Co., 91 Seventh Ave., New York, N. Y.	
88A	1-400 ohm Potentiometer	1.25
85C	3-20 ohm Rheostats	3.00
	Samson Elec. Co., Canton, Mass.	
HWA2	1-Samson 6 to 1 A. F. Transformer	5.00
HWA2	1-Samson 3 to 1 A. F. Transformer	5.00
	1-Samson Super kit	22.50
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131	2-Panel support pillars	.60
62	1-pkg 10-½ in. 6-32 R. H. nickeled screws	.12
63	6-pkgs 10-½ in. 6-32 R. H. nickeled screws	.72
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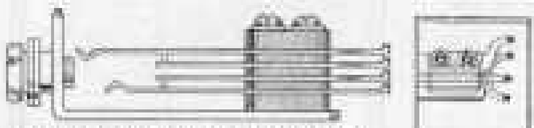
who also make B. M. S. TRI-COIL, ($2) TRI-JACK, (90c), and TRI-PLUG (75c).



204 DOUBLE CIRCUIT CLOSED

Made in 9 styles. At all good dealers.

MANUFACTURERS:

ACCURATE Screw Machine PRODUCTS

REJECTED screw machine products mean increased production cost. Save time, trouble and money with guaranteed accurate screw machine products. Where required, our BROWN and SHARPE equipped plant can turn out a part for a condenser, jack, switch, etc., with a guaranteed accuracy of 1/1000" to 2/1000".

Estimates gladly quoted—

Kindly submit sample, blue prints or other specifications. We have done precision work for radio manufacturers everywhere in the United States.

COLUMBIA
Metal Products Co.
Accurate Screw Machine Products
357-365 East Ohio St.,
CHICAGO, U. S. A.

PUDLIN SCIENTIFIC RESISTANCE

WILL STAND THESE TESTS

Put a Pudlin Resistance in a glass of water for any length of time, or, submit to a heat test of 300° Fahrenheit. Then compare with any grid leak on the market.

Our Resistance elements are super-impregnated—our own laboratory development. Endorsed officially by leading Universities and Experts throughout the world.

Beautiful Metal and Glass Cabinet furnished to Dealers and Jobbers FREE with every purchase of 100 Grid Leaks.

Send for Our Resistance Booklet

PUDLIN ENGINEERING CO., Inc.

91 Seventh Ave. **New York City**

KESTER *Radio* SOLDER

Oh boy it sure is Safe & Simple

Here's the solder that contains the flux recommended by radio engineers! The pure resin core inside of Kester Radio Solder is a natural flux and can leave no harmful chemical or electrical action on delicate parts or joints. It requires only heat.
In developing radio frequency, it was found that all fluxes, except rosin, spatter, fume and ruin your delicate parts and joints. This causes leakage and makes the best insulation as poor as a grid leak.
Solder with Kester Radio Solder. You will have no need to go over and wipe away surplus flux. Leave what rosin may remain — it is a good insulator!
There you have it: Kester Radio Solder is a safe and simple solder with which any set can be quickly, neatly, safely and substantially soldered. Get a handy can of Kester from your dealer.

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

So Inexpensive!

The New and Improved

'Read'em' Binding Posts

"The Knobs Cant Come Off."
18 Styles Engraved—A Post for Every Requirement

Improving the Appearance of Over 40 Leading Sets

The Utmost in Quality at the Lowest Price

At Your Dealers or Sent Postpaid 15c Each

MARSHALL–GERKEN CO.
Toledo, Ohio

Perfect Filament Control

Howard Rheostats with dial control satisfactorily meet every radio requirement. Conveniently designed for single hole mounting, the bases are of special heat resisting materials preserving shape and finish under all operating conditions. Slide contacts are phosphor bronze, insuring perfect electrical connections and the resistance elements constructed of special non-corrosive resistance wire, accurately spaced by precision machines and wound under tension on a seasoned fibre strip so that the turns cannot come loose. Carrying capacity is 1.5 amperes. Made in resistances of 6½, 25, 40 and 60 ohms. See them at your dealer's or write us direct.

Other Howard Parts:—

Phone Plugs
Switch Levers
Binding Posts
Soldering Lugs
Fixed Condensers
Potentiometers
Dials
Sockets

Howard Radio Co. Inc. Chicago U.S.A.
451-469 E. Ohio Street

The Most Efficient Inductance System For Tuned R. F.

The results obtained from tuned R. F. circuits incorporating Henninger Aero Coils cannot otherwise be equalled. The facts explain:

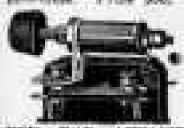
90% air dielectric and absence of dope on windings eliminate resistance losses.
Proper air spacing between turns minimizes capacity losses.
Large wire (No. 22 D. C. D.) minimizes circuit resistance.
Wide air spacing of primary and proper separation between primary and secondary gives full transfer of energy.

RESULTING IN:

Extreme sensitivity; high amplification of even low frequencies and such selectivity as was never thought possible with the principle of tuned R. F.
Manufacturers! Look into our proposition. Fans! You will find complete satisfaction and will be amazed at the results obtainable from this inductance system sold by leading dealers and jobbers, or direct.
Set of three Aero Coils $10.00. Single coil $3.50.

HENNINGER RADIO CO.
1772-74 Wilson Ave., Chicago

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 plug in on any electric light line, no need of outdoor or indoor aerials. Simplest, neatest, most efficient on market. Price [illegible]

INDORADIAL. Hang or lay anywhere, roll up when not in use. Wonderful directional effects, cuts out local stations. Use as ground. Price $2.45.

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.

VARIOHM, a variable grid leak will give you exactly the correct grid resistance. Any resistance from ¼ to 10 megohms. Once set is permanent. Price $1.25, mounted $1.50.

ELECTRAD

428 Broadway, New York

Laurence M. Cockaday and M. B. Sleeper Specify

CICO PRODUCTS

For his improved DX Regenerative Receiver in March Popular Radio, Mr. Cockaday specifies CICO double circuit and single circuit jacks.

For his Rasla Reflex II hook up in February Radio Engineering, Mr. Sleeper specifies CICO rheostats. Products good enough for radio authorities, are not too good for you.

CICO Radio Jacks are moulded of pure bakelite. Their contacts are sterling silver. Their nickeled phosphor bronze springs are widely separated, which—with the fact that they require no soldering—ends dangers of weakened reception from soldering flux leaks.

CICO "All Voltage" Rheostats are of advanced design. Resistance element is tapped for 6-10-20-30 ohms, accommodating all tubes. Enclosed in bakelite, the resistance is protected from dust, injury, warping and uneven contact. Single hole mounting.

All CICO Radio Parts Are Unqualifiedly Guaranteed

Designed for perfect efficiency, CICO Jacks, Plugs and Rheostats must be perfect in materials and assembly or we back your dealer in refunding your money.

CONSOLIDATED INSTRUMENT CO. OF AMERICA
41 East 42nd St., New York

CICO BAKELITE JACK

No. 30-Single circuit open . $.80
No. 31-Single circuit closed . .85
No. 32-Double circuit 90
No. 33-"A" Battery Switch . .90

CICO BAKELITE RHEOSTAT

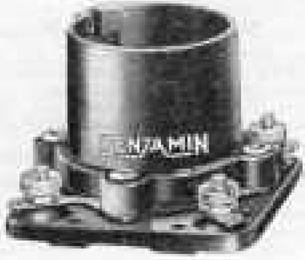
Plain $1.00 Vernier $1.25
2 OHM $1.25

Balloon Tires for Your Tubes

Delicately adjusted springs, at the base of a Benjamin Cle-Ra-Tone Socket, do the same for the radio tube that balloon tires do for the automobile—absorb jars and shocks.

Outside rumbling traffic, inside footsteps, mechanical and human activities amazingly vibrate floors of buildings—as finely adjusted scientific instruments have proved. This comparatively small shaking of the tube develops a very perceptible noise in the filament, and very often breaks this hair like wire when it is cold.

Benjamin Cle-Ra-Tone Sockets "float" above their base and so escape this ever-present trembling. More sensitive experiments are thus possible and distant, faint signals come in much clearer. Stiff bus wiring does not affect the flexibility of Cle-Ra-Tone Sockets. They are adaptable to every hook up and especially desirable in portable sets. No rubber parts to deteriorate. Bakelite is used wherever possible to insure sturdiness and long life. Contact points to tube terminals are perfect and permanent. Terminal lugs for soldering.



Made in two sizes: standard base, and a base for tubes similar in terminals to the UV-199

BENJAMIN
CLE-RA-TONE SOCKET
CLEARER RADIO TONE

Spring Suspended—Shock Absorbing—Accepted by leading manufacturers and radio engineers

Benjamin Electric Mfg. Company

120-128 S. Sangamon St., Chicago, Ill.
247 W. 17th Street, New York
448 Bryant Street, San Francisco

THE N&K TRIO

Reg. U. S. Pat. Off.

Fast Sellers!

A SALES quality which can never be surpassed—TONE—clear, rich, mellow, distinct Tone;

And the presentation of this quality in a choice of three popular forms—

1. Phones that are highly sensitive—and surprisingly comfortable to wear.

2. A Loudspeaker of unusual, space-saving shape and artistic appearance.

3. A Phonograph Unit, every proportion and feature of which has been specially designed to co-ordinate with the phonograph.

And the entire line backed by widely read National Advertising.

Stock the *entire* N & K Line. It moves.

N & K Imported Phones

have large size diaphragms and ear caps, bringing new comfort to the wearer. Sanitary, leather covering on head bands. Generous length of cord. Retail list $8.50. In display cartons of ten individually packed phone sets.

N & K Imported Loudspeaker

The specially designed sound chamber *filters* the sound. Made of burtex, a scientific material which unlike wood or *metal, eliminates false vibrations*. 14 in. high. Choice of artistic color effects. Retail list $27.50. Shipped in threes, each speaker in display carton.

N & K Imported Phonograph Unit

Attaches instantly, without screws or other device, to Victrola or other standard phonograph, giving the inexpensive equivalent of a fine loudspeaker. Retail list $7.50. In cartons of twelve, each unit in gold embossed leatherette box.

Th. Goldschmidt Corp.
Dept. K-1.
15 William St., New York

FIL-KO-LEAK

$2.00

$2.90 in Canada

SCIENTIFICALLY CORRECT VARIABLE GRID LEAK

its calibrated

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

Every FIL-KO-LEAK is guaranteed to be perfect electrically and mechanically, and to be accurately calibrated over the operating range for all tubes 1½ to 5 megohms. This calibration is doubly checked.

> FIL-KO-LEAKS are specified for the Hoyt SYSTEM OF SIGNAL AUGMENTATION by the inventor, FRANCIS R. HOYT. We have a limited number of blue printed copies of Mr. Hoyt's original laboratory notes on this new system together with nine circuit sketches, which will be sent free on receipt of four cents postage.

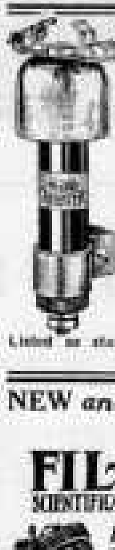
FIL-KO-ARRESTER

LIGHTNING

$1.50

$2.10 in Canada

SCIENTIFICALLY CORRECT RADIO LIGHTNING ARRESTER
with the $100.00 Guarantee



Absolutely warranted to protect your set from lightning, with a guarantee to pay you $100 or to repair your set, should it be damaged through faulty operation of the arrester.

The "umbrella" shield keeps dust, moisture, etc., from the Bakelite insulation, preventing leakage losses from aerial to ground. This makes certain that all radio impulses reaching the antenna pass through your set, which assures maximum reception.

Listed as standard under re-examination service of Underwriters' Laboratories.

NEW *and* IMPROVED

FIL-KO-STAT

$2.00

$2.90 in Canada

SCIENTIFICALLY CORRECT RADIO RHEOSTAT
with Battery Switch

Tune your tube filament with FIL-KO-Stat and receive stations you never heard before. Get greater distance, louder signals, sharper tuning, freedom from tube noises. FIL-KO-Stat is the only rheostat that permits adjustment over the entire operating range of all tubes and enables you to get maximum audibility in phones or loud speaker. And now the improved model is fitted with battery switch that attaches to the regular mounting screws. Distinctly signals "on" and "off" and enables you to break circuit without changing FIL-KO-Stat adjustment. FIL-KO-Stat fits any type tube in any hook-up. Unconditionally guaranteed.

Send 2c stamp to Dept. RE325 for interesting literature on improved rheostat.

DX INSTRUMENT CO. HARRISBURG, PA.

I and M REGISTRY

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.

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

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

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 Kellng Ave. Tel. Bal. 9525

Mich., Detroit—J. E. JOHNSON
91 Gladstone Ave., Tel. Empire 8581 J

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

Neb., Omaha—W. J. F. SACKRIEDE
2622 Jaynes St. Tel. Kenwood 5628

N. J., East Rutherford—D. R. DOREMUS
116 Hackensack Street

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—HERBERT MULLER
954 Lexington Ave. Tel. Rhldr. 3905
154 Nassau St. Beek. 8040

N. Y., New York—RONALD MAAR
470 W. 157 St. Tel. Wads. 9799

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., Buffalo—L. A. JEWELL
69 Leslie St. Tel. Lan. 9234

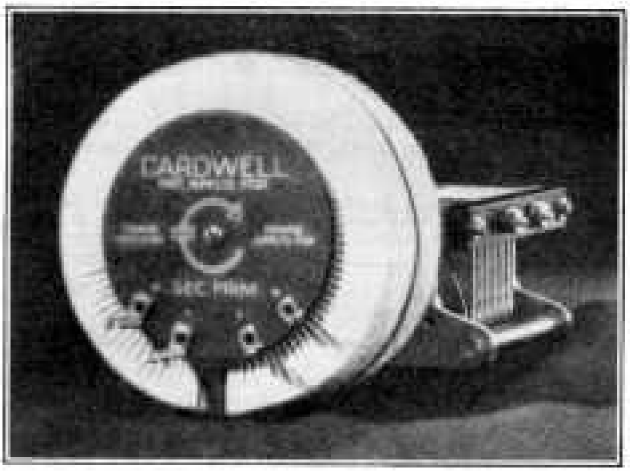
N. Y., New York—RADIO CONST. LABS
71 W. B'way. Tel. Walker 2143

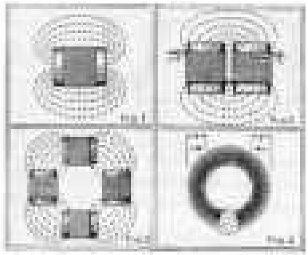
N. Y., New York—J. ROEMISCH
841 Lexington Ave. Tel. Lex. 4420

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

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

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





General Theory of the Toro-Tran

Figure 1 shows how the field of the ordinary coil extends into space and increases losses due to stray field. Figure 2 shows a "double series" winding, which restricts the field somewhat. Figure 3 shows a "four series" winding and the field almost enclosed. In Figure 4 (the Toro-Tran) the field is entirely enclosed and the losses due to stray fields are eliminated.

Note that a stray signal passing through the coil at "X"—not introduced from the aerial or the tube—is balanced out at "Y" by the reversed polarity of the winding. This rejects undesirable signals, while the concentrated internal field builds up the tuned signal. Hence maximum distance and selectivity.

—and now the TORO-TRAN!

CARDWELL, whose pioneer "low-loss" condenser established new standards of radio efficiency, is now introducing the Toro-Tran*—the ideal ***balanced*** coupling inductance for all radio frequency work.

* TRADE MARK
Registration applied for

The Toro-Tran eliminates signal energy picked up by ordinary coils from nearby stations. It eliminates magnetic feed-back in multi-stage radio frequency circuits, thus removing the most active factor in causing howling and distortion, and thereby increasing selectivity and distance. It rejects almost entirely the interference effects caused by electrical power machinery, elevators, door-bells, arc stations, etc.

The Toro-Tran winding confines the field to the inside of the coil in a small area and thus avoids one of the greatest sources of loss known to radio receivers—that of stray magnetic fields, which result in the absorption of signal energy and reduce the efficiency of the receiver tremendously.

Note these unusual advantages in assembly and operation

1. Compactness. The coils do not require spacing or angular mounting. They occupy less space than your condensers.

2. Permit exact nullification for tube and stray capacity without guesswork or tedious testing.

3. Closed magnetic field eliminates magnetic feed-back in tuned radio frequency amplifiers.

4. Low distributed capacity, due to air spacing of each winding and to low voltage drop per turn of small diameter wire.

5. Maximum coupling and high ratio of voltage increase due to concentrated field with zero leakage.

6. Absence of all supporting insulation in the field of the coil. This is one of the greatest loss factors in the ordinary circuit and is not remedied by "skeleton" or so-called "low-loss" windings.

7. Ease of neutralizing oscillation due to tube capacity by means of rotating control, which anyone can "balance."

8. Low capacity between primary and secondary, affording maximum transfer of energy to succeeding grid circuit.

The Toro-Tran has a lower "circuit resistance" (i.e., effective resistance as assembled in a set and not as isolated in the laboratory for theoretical measurements) than any inter-stage tuned transformer made and has a correspondingly higher amplification factor, its ratio exceeding ten.

To appreciate the many remarkable advantages of the Toro-Tran, write for our two free booklets: "The Torodyne Circuit" and "The Most Interesting Radio Frequency Transformer Ever Invented."

Toro-Trans are ready to mount in any tuned radio frequency circuit. Replace your ordinary coils with Toro-Trans. You will be astonished with the results. Most .00035 mfd. variable condensers will tune them, but by using Cardwell Condensers you get maximum efficiency.

Order from your dealer or direct

CARDWELL TORO-TRAN WITH BALANCING POTENTIODON	$ 4.00
Cardwell .00035 Condenser for tuning	4.75
Cardwell .00035 Vernier Condenser	6.25
Cardwell .00035 Dual Condenser (two-in-one)	8.00
Cardwell .00035 Triple Condenser (three-in-one)	10.00
Cardwell Audio Trans (improved audio transformer)	5.00

The Allen D. Cardwell Manufacturing Corp.
81 Prospect Street, Brooklyn, N. Y.

Williams Press, Inc.
Albany — New York

EASTERN LOW-LOSS COILS

(The Famous Pickle Bottle Type)

IMPROVE ANY CIRCUIT!

LANSING MICHIGAN

Jan. 29, '25.

Eastern Coil Corp.,
N. Y. City.

Gentlemen:

I live less than ½ mile from station WREO and can easily tune them out and hear some of following stations: WMC Memphis, CFCF Montreal, WJZ New York, WFAA Dallas, Texas, WHAS Louisville, Ky., and many others over 325 meters.

With the aerial disconnected I can get stations on loud speaker better than 1000 miles distance. Everything comes in very clear and so loud that people across street can hear music very plain with doors closed. You have my permission to print this statement.

Very truly yours,
R. V. Eggleston

All tubing, shellac and loss producing material eliminated

3 Circuit Tuner $6.00

1925 Model D X Superdyne 8.00

Tuned R. F. Circuits—A—for .0005—23 plate condensers—set of 3 .... 6.00
B—for .00035—17 plate condensers—set of 3 .... 6.00

Harkness $4.00

Radio Broadcast Knockout Roberts 8.50

SPECIFIED BY M. B. SLEEPER IN THE FOLLOWING CIRCUITS IN RADIO ENGINEERING

R D X Reflex Set Type 6400
Pickle Bottle Transformer ....Price $2.00
Radio Frequency Coupler (on genuine bakelite tubing) ....Price 3.75

Complete $5.75

Portable Tuned R. F. Receiver Type 8800
Set of two Pickle Bottle Coils required ....Price complete $4.00

No-Loss Regenerative Set
Type 6300 Pickle Bottle Coil ......Price $2.50

D X Reflex Circuit (Improved Acme)
Type 6300 Pickle Bottle Coil ......Price $2.50

These Type A or Type B Coils also make excellent Antenna coupling coils for any Super-Heterodyne Circuit.

Each Pickle Bottle Coil furnished with brackets which can be adjusted for any make condenser.

Mail orders filled *Order by circuit or type number* *Dealers write*

EASTERN COIL CORP.

22 Warren St. **Dept. R. E.** **New York**