RADIO Engineering

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

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Edited by
M. B. SLEEPER

JULY 1925

VOL. V NO. 7

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RADIO ENGINEERING

Edited by M. B. SLEEPER

Associate Editor, Alfred A. Ghirardi

Fifth Year

Vol. V, No. 7

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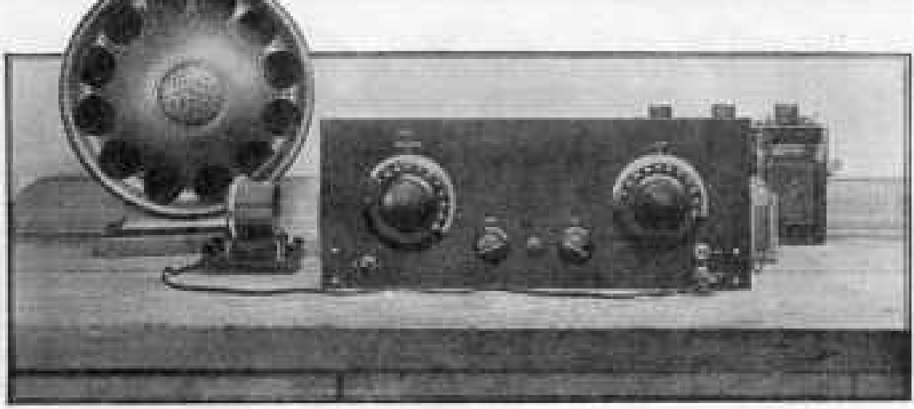

Fig. 1. This is the way we set up the Super-Autodyne to try it out on the antenna and ground, using the secondary of a pickle-bottle coil in place of the loop.

The Super-Autodyne

Complete assembly and operating instructions for the 6-tube Super Autodyne. This is official data, O. K'd. by McMurdo Silver, by whom the design was developed.

THOSE who have watched the development of the super from its first inception by Major Armstrong down through the 8, 7, and finally 6 tube stages, cannot help marvelling at the great strides made in a comparatively short time. This set at once removes the three strong objections which the average man has always had against the old form of superheterodyne. First, the cost of the tubes and set is no longer prohibitive. Second, the reduction in the number of tubes, and the use of a negative bias on both the audio amplifiers and the first two stages of intermediate frequency amplification has reduced both the A and B battery consumption to a point where a "power house" is not required for operation. Third, the design of the set has been so worked out that the average man will have no trouble in assembling the outfit as it should be done.

The circuit is shown in Figs. 3 and 4. You will see that the first tube acts as both oscillator and first detector. Following this we have two stages of intermediate frequency amplification, detector and two audio stages.

Design Details of the Set The front panel, measuring 7 by 18 ins., 3/16-in. thick, carries the oscillator condenser on the left, and the loop tuning condenser on the right. In the lower center we have the potentiometer or oscillation control, filament switch and rheostat. At the extreme lower left is the jack switch for cutting in either all or part of the loop. At the right are the two output jacks. The tube panel is made of ¼-in. Formica and is supported at each end by a Benjamin panel support bracket. The six Benjamin sockets come already fastened to the tube panel in their proper positions. At the rear of the tube panel are the two A.F. transformers and three long wave transformers. Next we have the two Midget condensers and the three loop binding posts. In front of these is the coupler. A 0.5 mfd. by-pass condenser is fastened under the panel support bracket at each end of the front panel. The fixed mica condensers are all fastened to the tube panel by means of screws and nuts. Flexible leads are used to connect directly from the batteries to the proper parts of the set.

Standard Parts Required The parts required for building this set are: One 7 by 18 in.-Formica panel, 3/16-in. thick. The key items are the two Silver-Marshall 210 and one 211 long wave transformers and the coupler, the two 0.0005 mfd. S. L. W. condensers, Silver-Marshall gang sockets, Continental Lo-loss Junior condensers, Benjamin panel support brackets and two 0.5 mfd. by-pass condensers.

In addition to these items are two 4-in. Kurz-Kasch knobs and dials, one Benjamin filament switch, one United Scientific Laboratories rheostat, one potentiometer, a 3-spring Carter jack switch, one open circuit jack and one closed circuit jack, one ¼-megohm and one 2-megohm Durham gridleaks, two 0.00025 mfd., one 0.0075 mfd., and three 0.002 mfd. Muter mica condensers, two Thordarson 3½ to 1 A. F. transformers, three binding posts, varnished tubing, bus bar, flexible leads, lugs, screws and nuts.

Assembly and Wiring Figs. 3 and 4 give the picture wiring diagram in which the various parts and connections have been drawn exactly as they were arranged in the original receiver. The tube panel is shown tipped down, and all wires under the tube panel represented by dotted lines. The various connections are indicated by numbers, etc. Take your time and follow each step in the assembly instructions religiously. They have been prepared in the exact sequence to make the work as simple as possible. See that all joints are soldered firmly, for it is a very difficult matter to locate a defective joint after the set is completed.

1. Connect 1, on the coupler, to 7. Connect 2, the other rotor terminal, to 8. Connect 3, on the coupler, to 9. Connect 4, on the coupler, to 10, a lug under the head of the screw which fastens the coupler to the tube panel. Connect 5, on the coupler, to 10, another lug under this same screwhead. Run a wire from 11, the —terminal of the right hand socket, to 12 on the extreme left hand socket, keeping it out about ½-in. from the edge of the panel. Connect points 14, 16, 18, and 20 on this wire to corresponding terminals 13, 15, 17, and 19 on the sockets. Also run a wire from 21, under the panel, to 22, a lug under the screw which fastens the 211 transformer to the panel. Connect 22 to 23, 24, 25, and 26. Connect 27, the +lug on the right hand socket, to 28, the +lug on the left hand socket, keeping this wire above the connections already made. Connect points 29, 31, 33, and 35, on this wire, to the corresponding lugs 36, 30, 32, and 34, on the sockets. Connect 37, the G terminal of the socket, to 38, the G terminal of the 211 transformer. Connect 39, the P terminal of the socket, to 40, the P terminal of the transformer. Connect 41 to 42, the G terminal to the transformer. Connect 43 to 44, the P terminal of the next transformer. Connect 45, a lug under the screw which fastens the 0.00025 mfd.

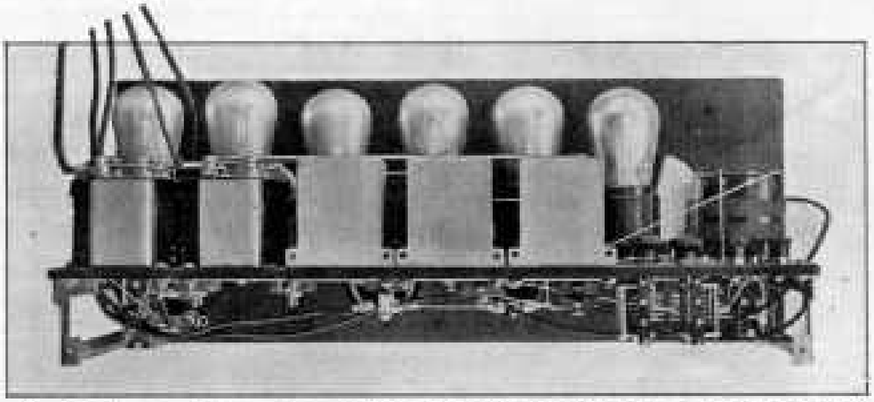

Fig. 2. The transformers are mounted along the rear of the tube panel. Note the arrangement of the balancing condensers.

condenser to the panel, to 46, the G terminal of the transformer. Connect 47 to 48, the P terminal of the first A.F. transformer. Connect 49, the G terminal of the transformer, to 50. Connect 51, the G terminal of the second A.F. transformer, to 52. Connect 53, the B terminal of the first A.F. transformer, to 54, the +B terminal of transformer 211. Run this wire along the top of the transformer cases and cover it with varnished tubing. Connect 54 to 55, a lug under the head of the fastening screw of the combination condenser. This is supplied with the Silver-Marshall 211 transformer. Connect 7, the lug under the other screw, to 56, the P terminal of the transformer, covering this wire with varnished tubing. Connect 57 to 58, the —A terminals of the transformers. Connect 59 to 60, the +B terminals of the second and third transformers. Connect 61, the —A terminal of the transformer, to 32. Turn the panel over so that you are facing the under side, and connect 62 and 63, the two rotor terminals of the 0.000022 mfd. condensers together. Connect 64, the stator terminal of the right hand condenser, to 65, a lug under the nut of the fastening screw of the 0.00025 mfd. condenser. Connect 66, the right hand binding post, to 67, a lug under the nut of the coupler fastening screw. Connect 68 to 69, on the 211 tuning condenser. This latter condenser is made up of several condensers supplied with the transformer bolted together. See that the connections from the fixed condensers to the socket eyelets under the panel have been made as shown by the dotted lines in the picture wiring diagram. These are, 70 to 71, 72 to 73, 74 to 75, 76 to 77, 78 to 79, 80 to 81, and 82 to 83.

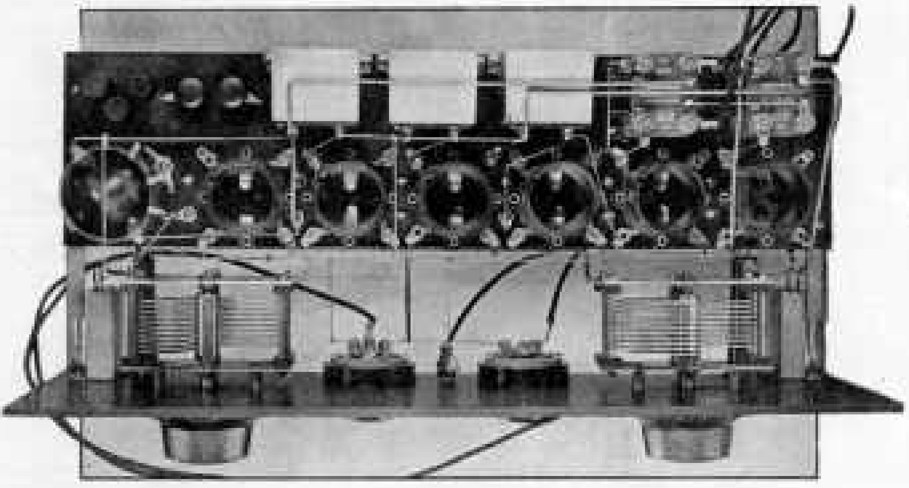

Fig. 5. Hardly a square inch of space is wasted, yet efficiency and ease of assembly have not been sacrificed.

2. Mount the filament switch on the front panel, in the center hole. Mount the rheostat and the potentiometer in the proper positions, and fasten the knobs on at the front of the panel. Next mount the jack switch at the left, keeping the frame pointing toward the bottom of the panel. Mount the open circuit jack in the lower hole at the right, and the two-spring jack above it, keeping the frames pointing downward. Now mount the two 0.0005 mfd. variable condensers in the positions shown, and put on the dials so that the 100 division mark on the dial coincides with the mark on the panel when the plates are totally interleaved. Tighten the locking nut, and screw on the knobs. Fasten the tube panel supports to the front panel with the ½-in. 6-32 R.H. screws and nuts provided, and slip the mounting lugs on one of the 0.5

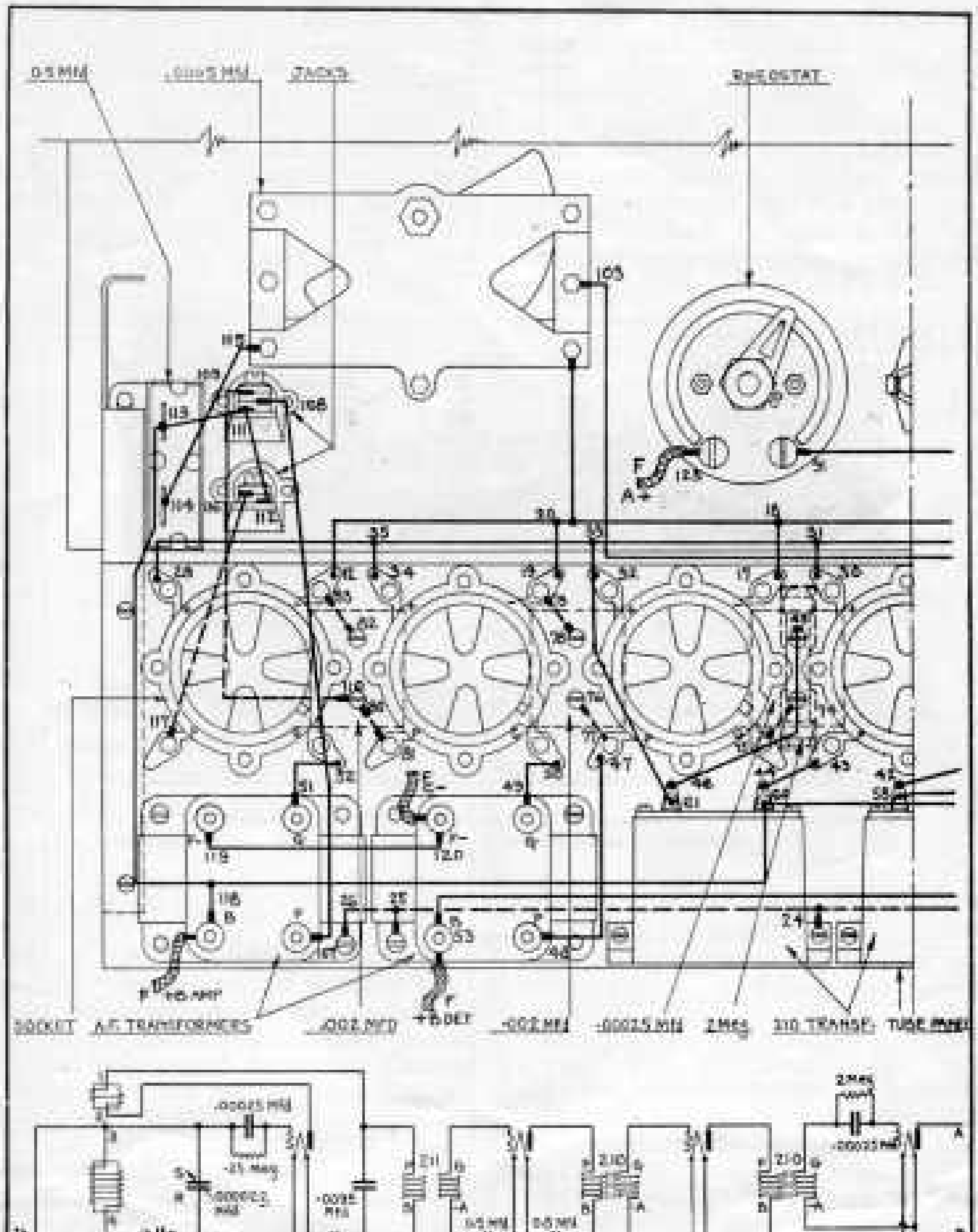

Fig. 3. Left hand half of the picture wiring diagram, looking at the set from the rear, with the tube panel dropped down.

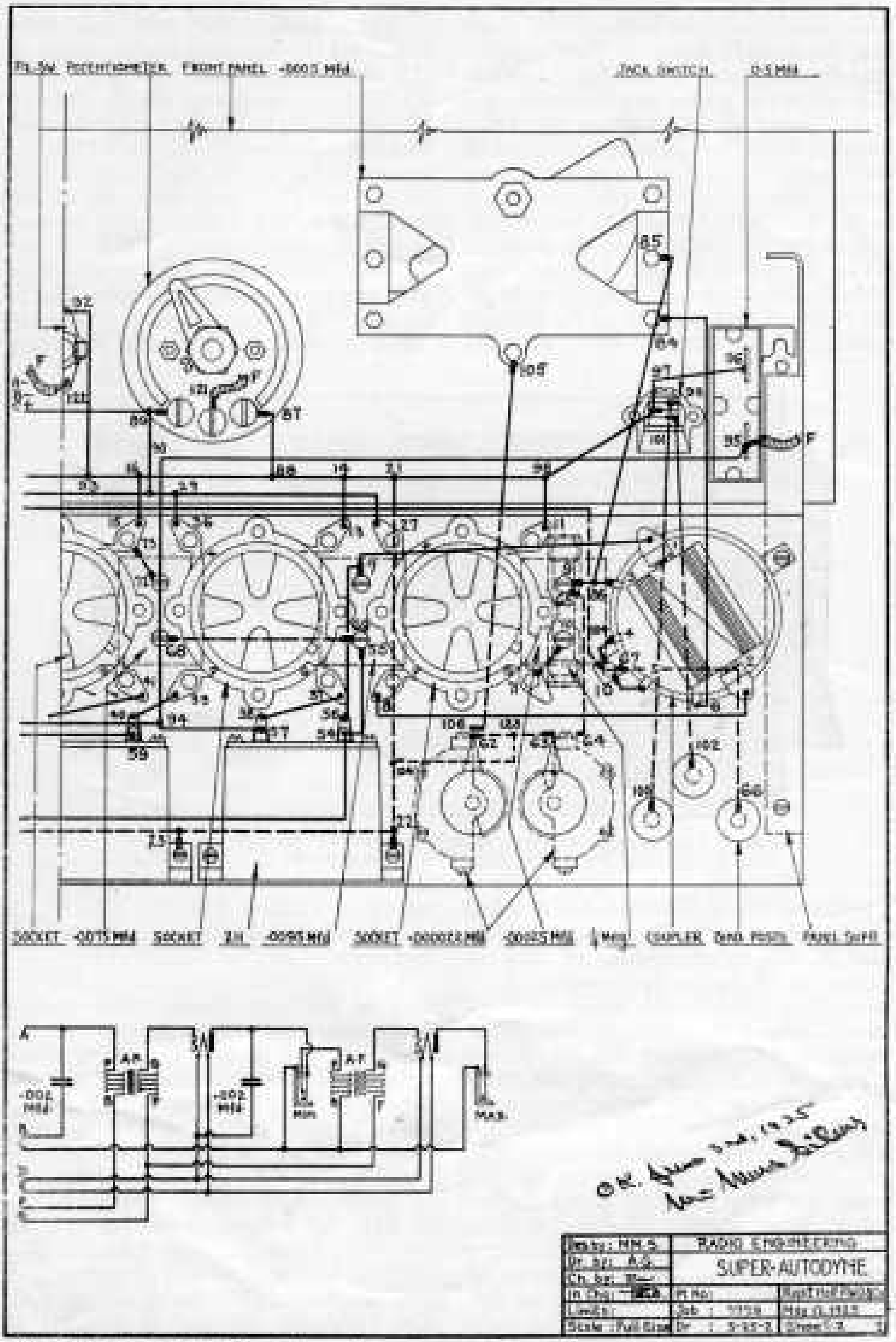

Fig. 4. Left hand half. Check the wiring, also, against the schematic diagram as you proceed. Note that these drawings have been O.K'd by Mr. Silver.

mfd. condensers, in between the panel and the bracket flange in each case, so that the condenser is held firmly in position when the screws are tightened up.

3. Connect 6, the remaining lug on the coupler, to 84, the end plate terminal of the oscillator condenser. Connect 85, the stator terminal, to 86, a point on wire 3 to 9. Connect 87, the right hand terminal of the potentiometer, to 88. Connect 89 to 90, and cover this wire with varnished tubing. Also connect 89 to 91 on the rheostat. Connect 92, on the filament switch, to 93. Connect 94, a point on to 110, on the 0.002 mfd. condenser. Connect 111, the remaining terminal, to 112, on the lower jack, and 113, on the 0.5 mfd. condenser. Connect 114, on this condenser, to 115, on the 0.0005 mfd. variable condenser. Connect 116, the remaining lug on the lower jack, to 117, the eyelet of the P terminal of the socket. Connect 118, the B terminal of the second A.F. transformer, to 113, on the 0.5 mfd. condenser. Cover this wire with varnished tubing. Connect 118 to 60, the +B terminal of the 210 transformer. Cover this wire with varnished

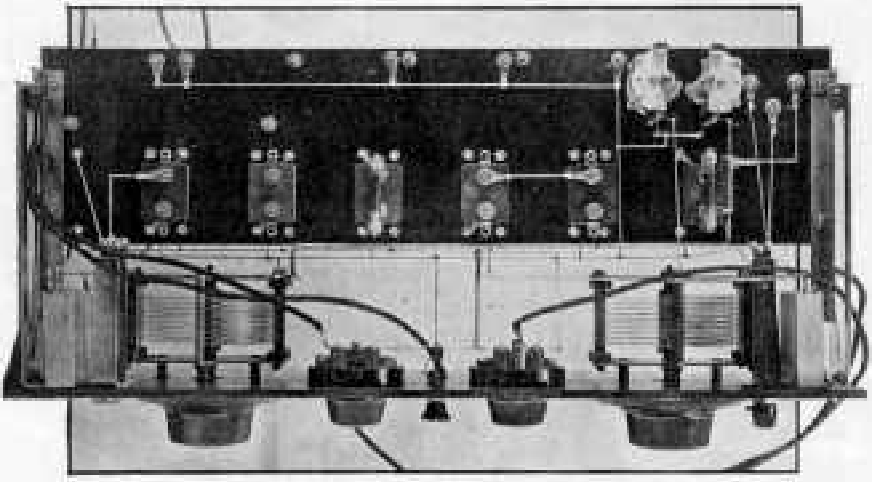

Fig. 6. This shows the wiring on the underside of the tube panel, and the layout of the fixed condensers.

wire 57 to 58, to 95, the lower terminal of the 0.5 mfd. fixed condenser. Connect 96, the upper terminal of the condenser, to 97 on the jack switch. Connect 97 to 98, on the minus filament bus. Connect 99, the upper lug of the switch, to 100. Connect 101, the remaining lug, to 102. Conect 103, the stator terminal of the loop tuning condenser, to 104. 104 is a lug under the nut of the coupler fastening screw. Cover this wire with varnished tubing. Connect 105, the lower end plate terminal of the oscillator condenser to 106, the stator terminal of the left hand 0.000022 mfd. condenser. Connect 107, the plate terminal of the left hand A.F. transformer, to 108, the middle terminal of the 2-spring jack. Cover this wire with varnished tubing. Connect 109, the upper lug of the jack, tubing. Connect 119 and 120, the F—terminals of the A. F. transformers together.

4. Scrape the insulation from the ends of the seven flexible battery leads, for a distance of about ½-in. Tin the wires well and connect one to the lower terminal of the right hand 0.5 mfd. condenser, at 95. The wire is indicated by an F. Connect another at 121, the middle terminal of the potentiometer. Connect one at 122, the lower terminal of the filament switch. Connect one at 123, the left hand terminal of the rheostat. Connect one at 120, the F—terminal of the first A.F. transformer, and another at 53, the B+ terminal. The remaining one goes to 118, the B terminal of the second A.F. transformer. Connect 123 to 124.

Fig. 7. Mr. Silver came on to New York with the Super-Autodyne working with WD-12 tubes, built into a portable case, as you see it illustrated here. The loop is wound in a pancake form on the inside of the cover, protected by a three-ply veneer board. Altho he used phones, the set operated an Amplion Dragon-fly beautifully.

This completes the wiring of the set.

Testing and Operating Check over each connection carefully against both the picture wiring diagram and the schematic diagram. Connect the A battery to the two flexible leads. (See picture wiring diagram.) Connect the lead from the center arm of the potentiometer to that from 95 temporarily. Now insert the six tubes and pull out the filament switch. When the rheostat knob is turned up, they should light. Keeping only the negative side of the A battery connected, touch the two +B leads to the +terminal of the A battery. The tubes should not light up when this is done. If everything is all right connect the A battery back correctly and connect on the B battery, of 90 to 120 volts, with a 45-volt tap for the detector. Try 4½ volts C battery across the C battery terminal. Use a 6-volt storage battery. The B batteries should be of the large type such as the Eveready No. 770, as they are the most economical, in the long run, for a set of this type. For a home installation a Balkite B, operating on 110 volts A.C., or a 90-volt Gould Unipower B can be used. The C batteries should be of the 4½-volt Eveready type, with taps.

If a loop is to be used, either a Silver-Marshall or Carter type is recommended. The two outside terminals go to the two rear binding posts on the tube panel. The tap goes to the center post. This makes it possible to use the full loop for the high wave lengths, by snapping the jack switch over to the L side, or using half of the loop on the lower wave lengths, by switching over.

Pull out the filament switch and turn up the rheostat until the tubes light up to normal brilliancy. Set the potentiometer at about the center and starting with the loop tuning condenser at 100, rotate it one small division at a time. For every position of this condenser, rotate the oscillator condenser over a considerable portion of its scale in the vicinity of this setting. If this is done very carefully and slowly, the entire range of the set can be covered and the stations logged. When you pick up a station, try rotating the loop to various positions and adjust the rheostat. This potentiometer can be used as a volume control and as a control for oscillation. When turned too far to the left,

For the Set Builder

The parts listed below are those which have been chosen for use in the Super-Autodyne set. They are not recommended to the exclusion of other good, equivalent parts, but are listed for the benefit of those working from our construction blue prints which show the correct panel drilling for the original set as it was built at the Darien laboratory.

2—Silver-Marshall 305A variable condensers
2—4-in. dials
1—U. S. L. 6-ohm rheostat
3—Binding posts
1—101 Carter jack
1—102A Carter jack
1—Silver-Marshall 211 filter with matched capacity
2—Silver-Marshall intermediate transformers
2—Thordarson 1 to 3½ A. F. transformers
1—Silver-Marshall 101B coupling unit
1—Special 6-gang socket shelf
2—0.002 mfd. Muter condensers
1—0.0075 mfd. Muter condenser
2—0.00025 mfd. Muter condensers
2—Vernier condensers
1—0.25-meg. grid leak
1—2.0-meg. grid leak
1—No. 3 Carter jack switch
1—Benjamin filament switch
1—Belden color cable
1—Pair Benjamin brackets
2—0.5 mfd. by-pass condensers
1—Bakelite panel 7x8x3-16 in.

i. e., to the negative side, a pluck will be heard, followed by squeals, and the set will be oscillating. Keep the setting just below this point. Squeals should never be heard in proper operation. If the potentiometer does not seem to affect the reception, connect a C battery with the positive terminal to the flexible lead at 121 and the lead at 95 going to the negative tap which gives best control.

The range of the set can be increased considerably by the use of an aerial about sixty feet long and a ground. This should be connected to the receiver through an ordinary coupling coil as shown in Fig. 1. The aerial and ground go to the primary, the two secondary terminals are connected across the two rear binding posts of the set, and the jack switch thrown over to the L position.

How to Balance the Circuit Unless the autodyne circuit is balanced by means of the two .000022 mfd. condensers, clicks will be heard as the two dials are rotated when tuning. Balancing can be best accomplished by removing all tubes but the first detector-oscillator, which should be left in place. A pair of phones should be connected in series with the 45 volt B plus lead, the rheostat barely turned on, the loop condenser set at 50 with the switch in the "L" position, and the oscillator condenser rotated. Assuming both small balancing condensers to be set all in, a click will be heard as this is done. If one balancing capacity is turned out slowly, rotating the oscillator will fail to produce a click, though it may be necessary to reduce the setting of the other instead. Generally one balancing condenser will remain entirely interleaved, while the other will be pretty well all out.

Details of the Oscillator Coupler For the benefit of those who want to construct the oscillator coupler, the following data is given on the dimensions of the former and the size of the wire. The oscillator coil is wound on a Formica tube 2 ins. long by 2 ins. in diameter. The winding, of No. 28 D.S.C. wire, is started 5/16 in. from the end of the tube. This is the lead going to the terminal marked 3. Put on 28 turns, and bring a lead out to terminal 4. Leave 1/16 in. space and start another section of 28 turns. The start of the winding goes to terminal 5 and the end to terminal 6.

Mounted inside, at the exact center of the outer tube, is a tube 1½ ins. in diameter by 1 in. long. This carries the coupling coil, of 28 turns, divided at the center by a ⅛ in. space so as to allow for the bearings. One end of the roter goes to terminal 1 and the other to terminal 2. All the coils should be wound in the same direction.

Making the Antenna Last Longer

Mr. A. S. Lindstrom, head of one of the largest radio distributing organizations on the Pacific Coast, brought an interesting idea to New York, one which is worth passing on because it has been tried out successfully up and down the West Coast.

Whether oxidization of the antenna wires, evidenced by black coating, actually affects the reception of signals or not, it is unquestionably true that it does bring on corrosion, eventually weakening the wire until it breaks. This is particularly true of stranded bare wire, for the corrosion, eating through two or three of the small wires, reduces the strength and the conductivity.

To prevent this action, almost every one out West is using No. 14 enameled wire. Enamel is apparently impervious to weather conditions and protects the copper. Obviously, corrosion cannot set in as long as the wire is covered by the enamel.

Service companies who are replacing bare wire with the enameled conductor are, at the same time, eliminating all contact joints by soldering them securely. This is the only protection against corrosion where the insulation must be removed.

Much trouble can be avoided in this way, for the average B.C.L. blames his set or tubes when things go wrong, never thinking that the fault might lie in the antenna.

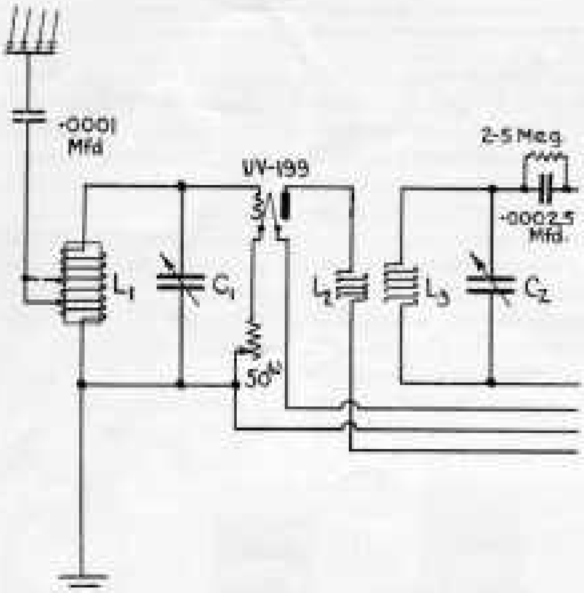

Fig. 3. The RX-1 receiver, tho it has a 20-turn primary in the R. F. transformer, has no neutralizing condenser or reverse feed-back coil

Some Angles on Tuning Circuits

Explaining the line of reasoning followed in planning the tuning end of the RX-1 non-regenerative receiver.

IF IT were possible to do it, I'd like to take a whisk-broom and brush away the accumulated dust of mistaken ideas about distorted magnetic fields, condenser losses, distributed capacity, neutralizing, and half a dozen other things which, however real, have assumed distorted proportions by reason of arguments brought forward by manufacturers whose sets, not good enough to overcome any of the common troubles, have been described as mastering difficulties which never did exist.

Forget everything you ever knew, except Ohm's Law, and start all over again. You'll be surprised to see how differently you will feel about tuning circuits when you go through the few simple steps which follow. Also, you'll understand the circuit arrangement for the RX-1 receiver.

A tuning circuit comprising a coil and variable condenser, has four factors to be reckoned with—inductance, capacity, inherent distributed capacity in the coil, and resistance. The wavelength is determined by the capacity of the condenser plus the distributed capacity of the coil and the inductance.

$$\lambda = 59.6 \sqrt{L \times (C_c + C_d)}$$

where λ = wavelength in meters,
L = inductance in cms.[1]
C_c = capacity of the condenser,
and C_d = distributed capacity of the coil.

Since the primary purpose of a tuning circuit is to regulate the wavelength, let us consider this phase first. In Fig. 1 are four curves which illustrate the control obtained by a variable condenser connected to a fixed coil, as in the ordinary receiving set. If a straight-line-capacity condenser, of 0.00035 mfd. maximum, is connected to a coil of 0.25 mh., if there is no distributed capacity in the coil, the wavelength as the dial is rotated will be given by Curve A. If the coil is wound on a tube, even though it is not shellaced, it will have a distributed capacity of perhaps 0.00005 mfd. Spider web and woven coils which are shellaced may have as much or more distributed capacity. Then, with 0.00005 mfd. added to the capacity of the variable condenser at any point, the wavelength is shown at B.

Plotting these two curves against frequency instead of wavelength, the frequency curves are shown at A and B in Fig 2. These curves show that distributed capacity greatly limits the wavelength range which can be covered by the condenser.

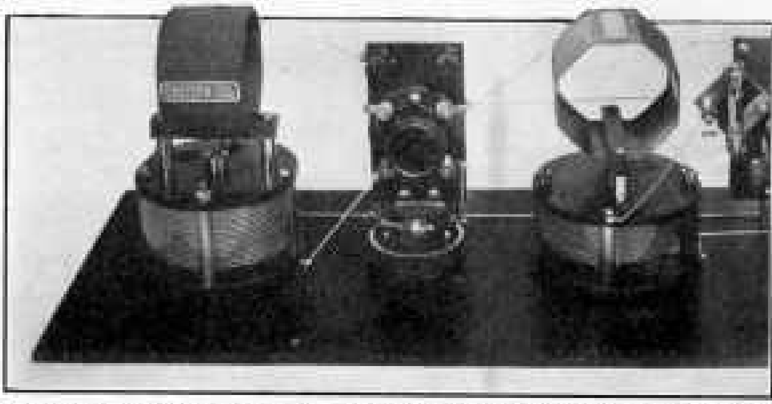

Fig. 4. Rathbun condensers are used because it seems more important to prevent losses from dust than insulation

Curves C and D in Figs. 1 and 2 are plotted for a straight-line-frequency condenser which gives the S. L. F. tuning when the coil has no distributed capacity. In Figs. 1 and 2, curves C and D are for wavelength and frequency respectively when the distributed capacity of the coil is zero, and with 0.00005 mfd. in the coil, the curves change to D and D. This is very serious, for it upsets the S. L. F. characteristics of the condenser.

The efficiency, which is determined by the resistance of the circuit, is not affected by the distributed capacity, but it is necessary to reduce this factor, as shown by the curves, in order to get the best tuning characteristics.

Now for the efficiency of the tuning circuit. That is a matter of resistance, as circuits are now designed. Since we don't tap coils any more, there are no dead-end losses, and condensers are generally so efficient that, barring any of the old ones built with molded mud end-plates, any standard make is all right.

A circuit of zero electrical resistance would oscillate forever, just as a wheel, turning without mechanical resistance, would keep on turning always. We can't make a circuit of zero resistance, but for greatest efficiency we must work to approach it. Losses in variable condensers show up as resistance. However, the radio frequency loss in a good condenser is so small that it can be neglected.

The big losses come in the inductance. They are caused by leakage between turns, due to moisture and poor insulation, resistance in the wire itself, and by the tubing on which the coil is wound.

Leakage can be reduced to practically zero by using well insulated wire, and by winding the coil in such a way that no shellac or other binder will be needed. Although most people do not want cotton-covered wire, cotton actually absorbs less moisture than silk.

The resistance due to the wire itself is determined by the diameter and the length of wire used to produce the required resistance. The least resistance for a given inductance is obtained when the diameter is approximately 2.46 times the length.[3] Other factors, however, must be considered. The single layer coil is the most efficient of all types. Spacing the turns, as is done in basket weave or spider web coils, decreases the inductance, requiring more wire for a given inductance.

Tubing introduces losses which show up as resistance. Red rope fibre tubing, for example, causes greater losses than Formica tubing, but, if possible, tubing should be eliminated entirely.

So much for the instruments. Now for the operation. If you have an oscillating receiver, whatever the type, you know how disconcerting it is to have it squeal at every setting, and how much trouble it is to readjust the tickler or rheostat for each station. It is popularly assumed that a set must do these things, because of the inefficiency of plain, non-regenerative circuits, but the ideal set is one that works as quietly as a crystal set.

There are two ways to design a set— Either to make it in such a way that it oscillates unless resistance is introduced to stop it, which is not an efficient method, or to make the set non-regenerative, of high efficiency, which is more reasonable.

Regenerative sets cannot give the undistorted quality of a non-regenerative circuit. There is no need to argue further against the interstation interference caused by radiation, even when the detector is preceded by a stage of tuned R. F.

It has become customary to make sets with two stages of tuned R. F. Actual tests will show that practically any tuned R. F. or neutrodyne set works a little better if the first stage of tuned R. F. is eliminated. This is because the R. F. transformers are made with only 4 or 6 turns on the primaries. Above 350 meters, such transformers produce little amplification, if any, and the reception is almost entirely dependent upon the regeneration obtained by adjusting the rheostat on the R. F. tubes to a point just under oscillation.

What can we do to make a better set than the ordinary types—a set which cannot regenerate or oscillate, which does not radiate, that gives still better quality, range equal to or greater than other sets, lower A and B battery current consumption, only two tuning controls, and real mechanical simplicity?

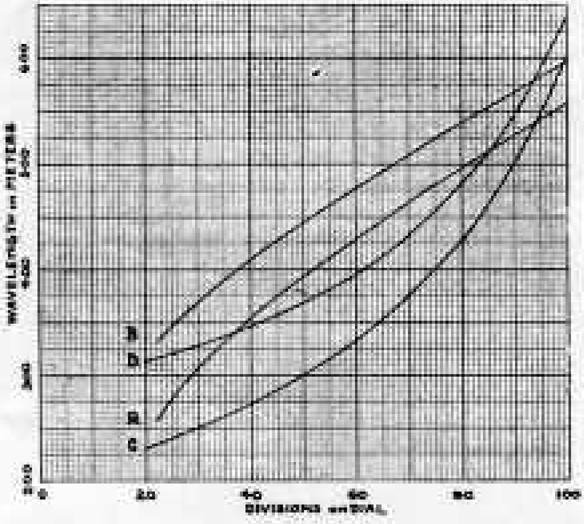

Fig. 1. Showing how a distributed capacity of 0.00003 mfd. alters the wavelength curves of S. L. C. and S. L. F. condensers

Let's tackle the tuning circuit first. In Fig. 3 is a schematic wiring diagram of a tuning circuit. There is nothing unusual about it as far as the method of connections is concerned but if you will look at Fig. 4, illustrating the way in which the diagram is applied you will see that there is something very different.

The first variable condenser carries a pickle bottle coil 2¼ inches across the flats, wound with fifty-eight turns of No. 22 D. S. C. wire, tapped on the fifteenth turn. The tap goes to the antenna, putting fifteen turns in the antenna-ground circuit. This is connected to a UV199 tube which serves as the radio frequency amplifier. The plate of the first tube goes to the primary of the second pickle-bottle coil. This unit is made up of a pickle-bottle coil 2¼ inches across the flats, wound with seventy turns of D. S. C. wire for the secondary, with a primary winding inside of twenty turns of No. 40 D. S. C. wire bunched closely together. It is located at the filament return end of the secondary winding.

Although a rheostat was employed for the first tube in the original model of this set, announced as the RX-1 receiver, an Amperite serves the purpose equally well, for the operation of the R. F. amplifier tube is independent of the filament current. Instead of overloading the filament, as is ordinarily done to bring the R. F. amplifier just under regeneration, the 199 in this set can be operated at a little less than three volts on the filament.

Because of the high inductance in the primary of the R. F. transformer, it might seem that the tube would oscillate. This is not the case in practice for the slight loss introduced by connecting the antenna circuit conductively is sufficient, with the low capacity of the 199, to prevent oscillations. Losses in the grid circuit of the first R. F. amplifier in any set are not particularly important owing to the high losses which are inherent in the antenna circuit.

Unlike any other set in which a large number of turns is used for the primary of the R. F. transformer, there is no balancing, neutralizing, or reverse feedback arrangement to stop the detector from oscillating. The reason that these devices, all of which introduce losses, are not required will be disclosed a little later. The immediate concern is with the effect of the tuning arrangement.

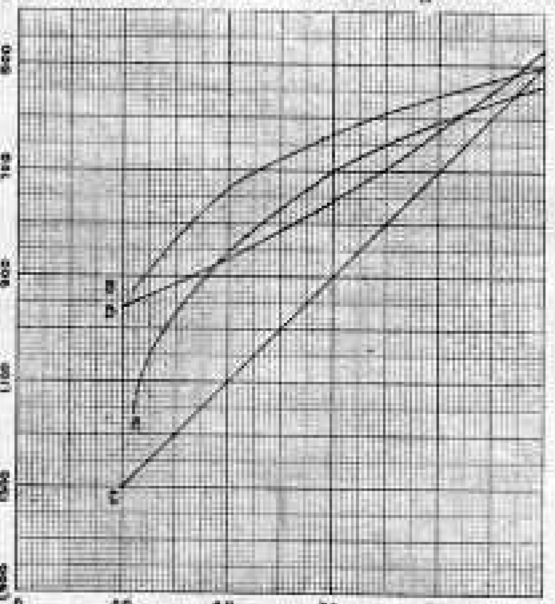

Fig. 2. The effect of 0.00005 mfd. distributed capacity on the frequency curves of S. L. C. and S. L. F. condensers

The ordinary non-regenerative receiver, as it has been constructed in the past, does not produce very loud signals nor is it sharp in tuning. In this set, we have not only eliminated the losses due to balancing methods or a potentiometer but we have gone to the other extreme of making the circuit as efficiently electrically as possible through the use of a 20-turn primary and a secondary circuit employing the most efficient type of inductance.

[1] 1,000,000 cms.=1 millihenry.

[2] Page 290, Bureau of Standards Circular No. 74, 2nd. Edition.

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EDITORIAL

WHAT will the next season do for the radio set builder? Wait a minute now— You're interested in this, even tho you have been telling everyone that the set builder is a sort of nuisance, and a very unprofitable one at that.

With all the discussion in progress this summer about dealers' franchises, sales plans, consolidations, and a dozen other things that complete set manufacturers have been thrashing out, not a word has been said about parts and the set builders who buy them.

Walter Eckhardt, Jean McDonald, General Harbord, Atwater Kent, Paul Ware, or Powell Crosley don't seem to know what a set builder is, or where he fits into the picture, yet to each one of these men the set builder is as important a factor in the conduct of his business as his bank balance or advertising agency.

A set builder, a development of the pre-broadcast experimenter, is a boy or man who knows the how's and why's of radio from practical experience. He may be short on theory, but he's long on practice, not simply with one kind of set but with most all of them because he has built them, repaired them, learned their good points and their shortcomings.

The set builder put radio broadcasting across in the beginning, simply through sheer enthusiasm in radio as an endless source of problems which are fun to solve. While manufacturers were putting out junk that would not do justice to the experienced set builder, during that difficult period when they really didn't know what it was all about, the set builders kept things going by assisting the innocent victims of the manufacturers' advertising literature, by writing articles for the newspapers and magazines, and by interesting their friends and acquaintances.

In the last two years, they have done more service work for the manufacturers than the manufacturers have done themselves. They have popularized new circuits on which manufacturers have made hundreds of thousands of dollars, and put them across in months where manufacturers' advertising would have taken years. Every improvement has been initiated and sold to the public by radio set builders. The first knowledge the public had of battery eliminators was from articles written by set builders. They put across the Neutrodyne circuit, the super-heterodyne circuit, tuned R.F., resistance coupled amplification, and they have told the manufacturers more about their equipment than their engineers have been able to do.

They have passed judgment impartially on one new idea after another and on their acceptance or rejection hangs the manufacturers' success.

Radio set builders talk more about the Crosley Radio Company than the Crosley Radio Company talks about itself. If, when the Crosley Cone came out, radio set builders had not accepted it, the dozen Crosley prospects whom every set builder knows would have heard that the Crosley Cone was a failure. However, they O.K.'d it, and its future is assured. If Paul Ware's new set sells successfully, it will not be due as much to the sales plan as to the fact that every set builder who knows about it will tell the B.C.L.'s that it is a good set to buy.

Yet these manufacturers, concentrating on the sale of complete sets, are not only producing nothing of use to the set builders in pursuing his hobby but they are discouraging the parts manufacturers by doing everything possible to force the

(Concluded on page 349)

Selenium and Photo Electric Cells

Chapter 1. The discovery of Selenium and a description of its characteristics—by Samuel Wein

EDITOR'S NOTE.—*In this issue of Radio Engineering we present the first of a series of articles on selenium and photo-electric cells, written by Samuel Wein. Mr. Wein has devoted the last eighteen years to research on this subject, covering not only the chemical and mechanical development of these devices, but their practical application as well.*

When Mr. Wein first started this work, he had the scientist's determination to carry through a thorough investigation in a field concerning which there is almost no information of practical value. At that time, Mr. Wein himself had very little idea of the application which he would find for the research he was doing but, as it often happens, developments in other fields brought out uses for selenium and photo-electric cells which did not exist even five years ago.

Today, Mr. Wein's photo-electric cells are in use in widely different kinds of devices such as radio and wire telephotography, tele-vision, talking motion pictures, and transatlantic cable communication. The latter is one of the most important commercial applications, for it is saving thousands of dollars a year by speeding up transoceanic telegraphy.

The principal reason for publishing this series, however, lies in the fact that the development of the three element photo-electric cell has opened up a new field for radio investigation and for the application of these cells and, to understand the use of the photo-electric cell in radio, a general knowledge of the entire subject is necessary.

The Discovery of Selenium. In the year of 1817 John Jacob Berzelius[1] and Gotlieb Gahn made an examination of the method of preparing sulphuric acid in use at Gripsholm, Sweden, and during the course of their examination, they observed in the acid a sediment of a partly reddish, partly clear brown in color, which, under the action of the blowpipe, gave out a peculiar odor like that attributed by Klaproth to tellurium. As tellurium was an element of extreme rarity, Berzelius attempted its production from this deposit, but was unable to obtain further indications of its presence. He found plentiful signs of sulphur mixed with mercury, copper, zinc, iron, arsenic and lead, but no trace of tellurium.

It was not in the nature of Berzelius to be disheartened by this result. In science, every failure as well as every success advances the boundary of knowledge, and Berzelius felt that if the characteristic odor that has been observed did not proceed from tellurium, it might possibly indicate the presence of some substance unknown to the chemists of that time. Urged on by this hope, he returned to his work with renewed ardor.

He collected a great quantity of the material and subjected the whole to various chemical processes, succeeding in separating successively the sulphur, mercury, copper, tin, and the other known elements whose presence had been indicated by his tests. After all had been eliminated, there still remained a residue which proved upon examination to be what he had sought—a new element.

The chemical properties of this new element were found to resemble those of tellurium in such a remarkable degree that Berzelius gave to the new element the name of "Selenium," from the Greek word "selen" the moon, tellurium as is well known being derived from "tellus" the earth.

Although selenium and tellurium are alike in many respects, they differ in their electrical properties, tellurium being a good conductor of electricity, and selenium, as Berzelius showed, a non-conductor.

Where Selenium Is Found. Selenium is considered to be one of the rare elements. Berschlag, Krusch, and Voigt[2] estimate that it forms about 0.0002 per cent of the known rocks. This may be compared with estimates by the same authors of 4.5 per cent of iron, 0.001 per cent lead, 0.001 per cent zinc, and 0.0000001 per cent of gold. It is possibly too high.

As would be supposed from these figures, minerals carrying selenium are uncommon and are found only in small quantities widely distributed. The following selenium minerals (metallic selenides) are listed by Dana[3].

Aguilarite	$Ag_2S.Ag_2Se$
Berzelianite	Cu_2Se
Chalcomenite	$CuSeO_3$
Clausthalite	PbSe
Crookesite	$(Cu,Tl,Ag)_2$ Se
Eucairite	$Cu_2Se.Ag_2Se$
Guanajuatite.........	Bi_2Se_3
Lehrbachite	PbSe with HgSe
Naumannite	(Ag_2,Pb) Se
Selenolite	(SeO_2)
Tiemannite	HgSe
Zorgite	PbSe

Selensulphur, native sulphur containing selenium in unknown proportions, has been found on the Islands of Volcano and Lispari. Seleniferous sulphur has also been found at Kilauea, Hawaii, and in Japan. Minerals containing selenium are also found in Hawaii, Japan, the Hartz Mountains, the Vesuvian region, Hungary, Mexico, Australia, Spain, several parts of South America, California, the Paradox Valley, Colorado, and at Thompsons, Utah.

Extraction[4]. The commercial sources of selenium are from the flue dusts of metallurgical processes using sulphide ores, and from the anode muds or slimes of the electrolytic copper refineries. The rapid development of the electrolytic methods has made the latter the most important source of supply in the United States. The method used in extraction depends upon the source of material.

Annual Production[5]. There are only three firms in the United States producing selenium. The following annual production figures are accredited to the American Smelting & Refining Co., the United States Smelting Refining Co., and the Raritan Copper Works:

Year	Pounds	Valued At
1917	39,630	$70,000
1918	103,690	206,540
1919	60,025	125,966
1920	92,141	175,808
1921	55,978	89,148
1922	123,565	177,542
1923	60,000	134,400

The production of selenium could be considerably increased if the demand were sufficient to justify its separation. Over 60 per cent of the yearly output is consumed in the glass and ceramic industries.

Selenium as ordinarily placed on the open market, is an amorphous brilliant black substance, looking much like pitch or one of the asphalts. It is sold in small pigs, sticks ½ inch thick, and about 4 inches long, or in fairly course or fine powder.

Purification of Selenium. That variety of selenium such as is purchased on the open market, is claimed by the manufacturers to be 99.5 per cent pure. This product is sufficiently pure for the manufacture of selenium cells, as well as for the such other commercial uses as it finds application to in commerce. Some experimenters however, prefer to have an absolutely pure grade of selenium. It is for such workers that the method devised by Dr. Lenher[6] for the purification of selenium is included in the text.

This method consists in dissolving selenium in nitric acid. The resulting selenious acid is evaporated to dry hardness, the dioxide formed being dissolved in distilled water, and barium hydrate added until a permanent precipitate is no longer formed. After filtering, the solution is boiled to dryness in an evaporating dish, and the residue covered by an inverted funnel whose base fits snugly upon the inside of the evaporating dish. Continued heating brings about a sublimation of the dioxide upon the inner walls of the funnel in the form of white needles. The slightest amount of impurity imparts to the selenium dioxide a reddish color and it is necessary to repeat the process of sublimation until the pure white needles are obtained. These are dissolved in distilled water, and the solution acidified with hydrochloric acid and acid sodium sulphite is added, bringing about a liberation of SO_2, which in turn precipitates the selenium in the form of a red powder. By boiling the mass for a few minutes the selenium forms into a hard black lump, which, when washed and dried, is ready for use.

Chemical And Physical Characteristics. Selenium, like sulphur, exists in several allotropic forms; of these, five are the most interesting.

(1) Amorphous selenium is a finely divided brick red powder prepared by passing sulphur dioxide into a solution of selenious acid, or by reducing the latter with any suitable agent such as zinc or stannous chloride. Heated to a temperature of 40° to 50° C. this red powder becomes agglomerated into a soft mass, which is hard and brittle when cool. Its specific gravity is 4.26; it is soluble in carbon disulphide, quinoline and aniline. These solvents convert the amorphous selenium to the metallic variety. Amorphous selenium is a non-conductor of electricity.

(2) Semi-colloidal selenium is obtained amorphous or in a semi-colloidal condition as a red solution, which on dilution shows an orange color, by heating solutions of dextrose and selenious acid together. At 100° C. it is partly transferred into the black variety.

(3) Vitreous selenium is formed by heating amorphous selenium to 217° C. and then cooling it rapidly. A brittle glassy mass is obtained, of a brownish black color, which has a specific gravity of 4.28 and is soluble in carbon disulphide. It is a non-conductor of electricity, and has dielectric properties, being electrified, like glass, by friction.

(4) Metallic selenium is produced when selenium is cooled rapidly to 210° C. and kept at that temperature for some time, when the metallic form, with a melting point of from 210° to 219° C. is obtained. It can also be prepared by fusing the vitreous variety between carbon plates and allowing it to cool slowly, or by cooling a solution of selenium in potassium hydroxide at 230° C., when long monoclinic needles separate, melting at 219° C. This modification is much more stable than the others, less chemically active, and a better conductor of electricity.

Samuel Wein, author of this series of articles and inventor of the cold vacuum tube

(5) Grey crystalline metallic selenium exists in two modifications, round granular crystals, stable at 140° C. in the dark, and a non-conductor of electricity. A variation can be obtained by heating it to 200° C. for some time or by exposing it to light. It has longer crystals, somewhat less soluble in carbon disulphide, and is a good conductor of electricity.

The boiling point of selenium[7] is 690° C., its atomic weight is 79.2, and the chemical symbol is Se.

The density[8] of selenium varies from 4.259 to 4.805 in the different varieties.

It is this latter variety of selenium that is of interest to us, and which is the subject of the present writing.

Discovery of Light Sensitivity In Selenium. Willoughby Smith, an electrician, in 1873, being desirous of obtaining a more suitable high resistance for use at the shore station in connection with his system of signalling during submersion of long submarine cables, was induced to experiment with bars of selenium. Several bars were obtained, the sizes varying from 5 to 10 cms., and of a diameter of 1 to 1½ mm. Each bar was hermatically sealed in a glass tube with a platinum terminal wire projecting from each end.

The early experiments did not place the selenium in a very favorable light for the purpose required, although the resistance was all that was required—some of the bars giving 1400 megohms absolute—yet there was a discrepancy in the tests, and seldom did different operators obtain the same results. While investigating the cause of such great differences in the resistances of bars, it was found that the resistance altered materially according to the intensity of light to which they were subjected. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained very constant, fulfilling all the conditions necessary to the experiments, but immediately the cover of the box was removed, the conductivity increased from 15 to 20 per cent. When the light was intercepted by glass of various colors, the resistance varied according to the amount of light passing through the glass.

To ensure that the temperature was in no way affecting the experiments, one of the bars was placed in a trough of water for the light to pass through, but the results were the same; and when a strong light from the ignition of a narrow band of magnesium was held about 9 inches above the water, the resistance immediately fell more than two thirds, returning to its normal condition immediately the light was extinguished.

It followed naturally that such an important discovery was the subject of discussion by scientists. As a matter of fact, the scientific literature at that time was replete with many papers on the general characteristics of selenium, and many interesting scientific and industrial applications were described at that early period.

REFERENCES

[1] Berzelius, Schweigg Jour. vol. 23, pages 309, 430, 1808.

[2] Berschlag, Krusch & Voight. Die Lagerstatten der nutzbaren Mineralien und Gestein, etc. vol. 1, 2nd. edit. page 157, 1914.

[3] Dana. System of Mineralogy, 6th. edit. 1909.

[4] Dennis & Koller. Jour. Amer. Chem. Soc. vol. 41, page 949, 1919. Eng. & Min. Jour. vol. 106, page 443, 1918.

[5] Hess. U. S. Geological Survey, Annual Reports. Washington, D. C.

[6] Lenher. Jour. Amer. Chem. Soc. vol. 20, page 555, 1898.

[7] Berthelot. Compt. Rend. vol. 134, page 705, 1902.

[8] Schaffgotsch. Jour. f. Prakt. Chem. vol. 14, page 108, 1848.

[9] Smith. Jour. Soc. Teleg. Eng. vol. 2, page 31, 1873. Amer. Jour. Sci. (3) vol. 5, page 301, 1873.

(*Continued from page* 345)

sale of parts out of the dealer's stores, back to the mail order houses.

It doesn't seem right for successful set manufacturers to treat their very best friends in this way. If every set builder in this country should suddenly drop radio and go in for amateur photography, who would sell the fifteen or twenty million dollars' worth of Atwater Kent equipment this fall? Dealers? Oh, no. Invariably the dealer so confuses the customer that he has to go to a set-builder-friend to get the plain, simple truth. Who will install those sets? The dealer? No, again, for the B.C.L. goes to the set builder not only because he trusts him but because it's cheaper. And what about service? Why, all the dealers in the country couldn't service the output of Atwater Kent alone, nor would the public spend money for the hundred little helps that the set builder gives so freely to his less experienced friends.

If the R.C.A. hadn't had the set builders to service their equipment and keep their customers satisfied they never would have lived down their mistakes, yet R.C.A. has fought the set builder and parts sales from the start.

It's time for the manufacturers to realize that they have a genuine obligation to meet, for they need the continued assistance of the set builder as much as ever.

M. B. SLEEPER.
Editor.

Factory of the Kodel Mfg. Corp., in Cincinnati, O.

WHO'S going to do the big parts business this fall? The only company we have heard about that is planning to put across parts and kits in a big way is Samson Electric, in Canton, Mass. Not content with perfecting the helical wound transformer, they have had some of the best engineering skill in New England at work on a complete line of parts and a brand new kit.

Benjamin Electric, in Chicago, has a new variable condenser which is just as clever as their balloon tire sockets—just the sort of thing that makes you feel that you'd like to build it into a set.

David Grimes Corp. is going to sell direct to dealers under the sales guidance of Harry Taplin, formerly of the Atwater Kent Company. This experiment, also undertaken by two or three other manufacturers, will be watched with much interest. One season ought to decide its success or failure.

With all the radio magazines there is only one which makes a serious attempt to be funny. That's Staunton's Wireless Bulletin, a little paper which reports on radio securities. Almost every report says, "We understand that the ——— Company has now disposed of its excess stocks and, if this is so, they should be in sound financial condition." But when the first dividend period arrives we'll know, without asking, how expensive it was to dispose of those excess stocks.

The Sterling Electric Company has just put out a handy little instrument. It has a milliammeter and socket mounted together, from which comes out a four-wire cord and plug. To measure the current thru any tube in an assembled set the tube is put into the meter, and the cord plugged into the set where the tube belongs.

Speaking of meters, the Jewell Electrical Instrument Company has asked us why the A— and B—terminals shouldn't be connected together. Since there isn't any good reason for not doing it, we're going to wire our sets that way, making it possible for our readers to use a double-range meter for measuring A and B voltage. If everyone adopts that practice, Mr. Eby will have to get out a binding post with the new marking.

Fansteel Products have just announced two new and very clever items—the Balkite Trickle Charger and the Balkite B, the former retailing at $10.00, and the latter at $35.00. The Balkite B with which we are already familiar will be continued, but it is now designated as Balkite B H. The Trickle Charger is for small storage batteries or it can be used with big batteries if allowed to float on the line. The B is a small unit, about the size of a 45-volt B battery, for 4- or 5-tube sets.

Specifications for Batteries, Chargers, and Eliminators

DRY CELL A BATTERIES

Manufacturer	Dimensions	Weight	Open Circuit Volts	List Price
Burgess Battery Co.	2½ diam. x 6 ins.	2 lb.	1.5	$0.50
Burgess Battery Co.	1⅝ diam. x 7	10 oz.	4.5	.50
Burns Boston Battery Works	2½ diam. x 7½	2¼ lb.	1.5	1.25
Burns Boston Battery Works	2½ diam. x 6	2 lb.	1.5	.75
Burns Boston Battery Works	4 diam. x 8½	8 lb.	1.5	2.50
Champion Carbon Manufacturing Co.	2½ diam. x 6	2 lb.	1.5	.45
Manhattan Electric Supply Co.	2½ diam. x 6	2 lb.	1.5	.60
Manhattan Electric Supply Co.	5½ x 2⅝ x 7½	5 lb.	1.5	1.00
National Carbon Co.	2½ diam. x 6	12 oz.	1.5	.40
Stuart Products Corporation	2½ diam. x 6	2 lb.	1.5	.60

STORAGE A BATTERIES

Manufacturer	Dimensions	Weight	Voltage	Container	A.-H. capacity	Chg. Rate	List Price
Advance Battery Mfg. Co.	——	——	6	Solid	60	5	$15.00
Advance Battery Mfg. Co.	——	——	6	Solid	85	7	18.00
Electric Storage Battery Co.	4⅝ x 6¾ x 6¾	5 lb.	2	Hard rubber	24	2	5.40
Electric Storage Battery Co.	4⅝ x 6¾ x 6¾	6 lb.	4	Hard rubber	12	1	7.30
Electric Storage Battery Co.	6⅛ x 6¾ x 9	24½	6	Hard rubber	30	3¾	14.00
Electric Storage Battery Co.	8¼ x 6¾ x 9	33½	6	Hard rubber	75	6	16.90
Electric Storage Battery Co.	9⅝ x 6¾ x 9	42½	6	Hard rubber	100	8	19.15
General Lead Batteries Co.	5⅜ x 7⅛ x 9½	30	6	Wood or rubber	40	3	——
General Lead Batteries Co.	6⅜ x 7⅛ x 9¾	38	6	Wood or rubber	60	5	——
General Lead Batteries Co.	8⅝ x 7⅛ x 9¾	55	6	Wood or rubber	90	7½	——
Gould Storage Battery Co.	10⅛ x 9⅛ x 7⅞	38½	6	Wood or rubber	80	5-7½	21.00
Gould Storage Battery Co.	10⅛ x 11⅜ x 7⅞	52	6	Wood or rubber	120	5-10	24.00
Hartford Battery Mfg. Co.	7⅜ x 6⅞ x 9½	——	6	Rubber	50	5	17.60
Hartford Battery Mfg. Co.	8½ x 6⅞ x 9½	——	6	Rubber	70	7	19.80
Hartford Battery Mfg. Co.	9⅝ x 6⅞ x 9½	——	6	Rubber	90	9	23.10
Hartford Battery Mfg. Co.	11⅛ x 6⅞ x 9½	——	6	Rubber	110	11	27.30
Liberty Battery Co.	——	——	6	Rubber	60	5	——
Liberty Battery Co.	——	——	6	Rubber	80	5	——
Marko Storage Battery Co.	6⅝ x 7⅝ x 9	29	6	Wood	50	3¾	12.50
Marko Storage Battery Co.	9⅜ x 7⅝ x 9	41	6	Wood	80	6	16.00
Marko Storage Battery Co.	11 x 7⅝ x 9	50	6	Wood	110	8¼	20.00
Marko Storage Battery Co.	9⅜ x 6⅝ x 9⅜	45	6	Rubber	90	6¾	17.50
Marko Storage Battery Co.	10⅝ x 6⅞ x 9⅜	53	6	Rubber	120	9	22.00
National Lead Battery Co.	7⅜ x 7¼ x 8⅝	30	6	Wood	50	2-3	12.50
Philadelphia Storage Battery Co.	——	1½	2	Glass	12	——	2.00
Philadelphia Storage Battery Co.	6 1/16 x 9¼ x 10	28	6	Wood	60	——	14.50

STORAGE A BATTERIES

Philadelphia Storage Battery Co.	9¾ x 8¼ x 16	45	6	Rubber	90	—	24.00
Philadelphia Storage Battery Co.	4⅝ x 10 x 6¾	20	6	Glass	30	—	16.00
Philadelphia Storage Battery Co.	2⅝ x 6⅝ x 6¼	8	4	Glass	15	—	8.00
Prest-o-lite Co., Inc.	2 1/16 x 4½ x 6½	6	2	Hard rubber	30	2	4.75
Prest-o-lite Co., Inc.	9¾ x 7⅝ x 9	35	6	Wood	65	4	13.20
Prest-o-lite Co., Inc.	10¾ x 7⅝ x 9	40	6	Wood	80	5	12.95
U. S. Light & Heat Corporation	2⅝ x 7 1/16 x 9 1/16	8	2	Rubber	20	2¼	6.20
U. S. Light & Heat Corporation	3 1/16 x 7 1/16 x 9 1/16	16	2	Rubber	60	7½	7.60
U. S. Light & Heat Corporation	5¼ x 7⅜ x 9½	20½	6	Rubber	30	2¼	14.00
U. S. Light & Heat Corporation	9¼ x 6⅜ x 9½	42	6	Rubber	75	4½	18.00
Victor Storage Battery Co.	———	43	6	Rubber	75	8	16.00
Western Cable & Light Co.	———	45	6	Wood	60	5	6.70
Western Cable & Light Co.	———	58	6	Wood	90	6	8.95
Westinghouse Union Battery Co.	7⅛ x 6⅜ x 8⅝	28¼	6	Composition	60	5	—
Westinghouse Union Battery Co.	10⅝ x 6⅜ x 9½	40	6	Composition	100	8½	—

DRY CELL B BATTERIES

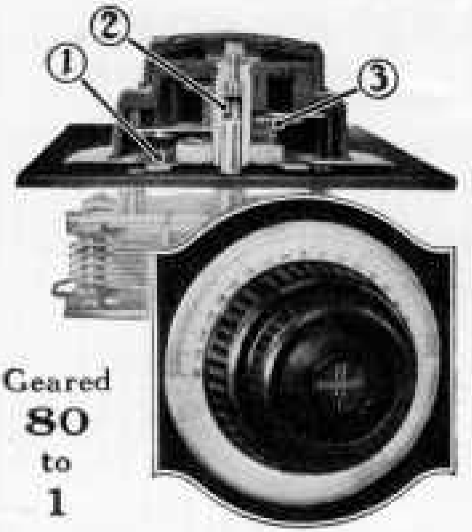
Manufacturer	Dimensions	Weight	Voltage	List Price
Burgess Battery Co.	3⅝ x 2 x 2⅝	1 lb.	22½	$1.30
Burgess Battery Co.	2 1/16 x 4½ x 2¾	1 1/16	22½	1.75
Burgess Battery Co.	2½ x 3⅝ x 6	2	22½	1.75
Burgess Battery Co.	4⅝ x 3⅝ x 7	5	22½	2.00
Burgess Battery Co.	6⅝ x 4 x 3	5	22½	2.00
Burgess Battery Co.	2⅝ x 4¼ x 5⅝	3¼	45	3.25
Burgess Battery Co.	7⅝ x 6⅝ x 3	9⅝	45	4.00
Burgess Battery Co.	3⅝ x 8 1/16 x 7	9⅝	45	4.00
French Battery & Carbon Co.	3 1/16 x 2⅝ x 2⅝	1	22½	1.50
French Battery & Carbon Co.	4⅝ x 2¼ x 2 13/16	1⅝	22½	1.90
French Battery & Carbon Co.	5⅝ x 3¼ x 2⅝	2⅝	22½	1.75
French Battery & Carbon Co.	6⅝ x 4¼ x 3⅝	4⅝	22½	2.00
French Battery & Carbon Co.	7⅝ x 4¼ x 3⅝	4 13/16	22½	2.00
French Battery & Carbon Co.	8¼ x 6⅝ x 3½	9⅝	45	3.75
French Battery & Carbon Co.	8 x 7¼ x 3¾	9⅝	45	3.75
French Battery & Carbon Co.	6⅝ x 4¼ x 4¼	6 13/16	22½	2.50
French Battery & Carbon Co.	8¼ x 4 1/16 x 7¼	14	45	4.75
National Carbon Co.	3⅝ x 2 x 2 1/16	13/16	22½	1.50
National Carbon Co.	4 1/16 x 2 1/16 x 2¾	1½	22½	1.90
National Carbon Co.	3¼ x 2⅝ x 5⅝	2½	22½	1.75
National Carbon Co.	6¾ x 4½ x 3¾	5	22½	2.00
National Carbon Co.	8 x 6¾ x 3 1/16	8 13/16	45	3.75
National Carbon Co.	8 1/16 x 3¾ x 7¼	9	45	3.75
National Carbon Co.	8 1/16 x 4 1/16 x 7 1/16	13¾	45	4.75

BATTERY CHARGERS

Manufacturer	Overall Dimensions	Weight	Operates from D.C. or A.C.	Charging Rate	Current Consumed by Charger	Type	List Price
The Acme Electric & Manufacturing Co.	5 x 7 x 10	8 lbs.	Both	2½	75 W.	Bulb	8.50
	7¼ x 8½ x 9¼	16	Both	6	175 W.	Bulb	15.50
	5 x 7 x 10	8	Both	2½	75 W.	Bulb	12.50
	7¼ x 8½ x 9¼	10	Both	6	175 W.	Bulb	20.50
Acme Engineering Co.	6 x 5 x 5	17	A.C.	5	60 W.	Bulb	12.00
Apco Manufacturing Co.		6	A.C.	7½	60 W.	Vibrating	18.50
		6	A.C.			Vibrating	
The Butler Bulb Electric Co.	8 x 7 x 6½	22	A.C.	7	60 W.	Vibrating	18.00
The Electric Storage Battery Co.		4	A.C.	½	75 W.	Chemical	2.00
Fansteel Products Co., Inc.	6 x 6¾ x 8½	21	A.C.	2.8	100 W.	Electrolytic	19.50
Fore Electric Manufacturing Co., Inc.	6½ x 8½ x 7½	18	A.C.	6	75 W.	Vibrating	18.50
Forest Electric Co.	13 x 10⅞ x 12		A.C.	6		Bulb	130.00
	13 x 10⅞ x 12		A.C.	6		Bulb	155.00
	15 x 15 x 15½		A.C.	6		2 bulbs	220.00
The France Manufacturing Co.	6½ x 6½ x 9	15	A.C.	5–8	80 W.	Vibrating	22.00
		7¾	A.C.	8		Vibrating	20.00
		7	A.C.	6		Vibrating	16.00
General Electric Co.	7½ x 7¼ x 5½	10	A.C.	2	70 W.	Bulb	18.00
	9 11/16 x 7 3/16 x 6 3/16	15	A.C.	5	160 W.	Bulb	28.00
Interstate Electric Co.	8 x 7 x 6½	11	A.C.	7	60 W.	Vibrating	18.00
	8 x 7 x 6½	17	A.C.	7	60 W.	Vibrating	16.00
King Electric Manufacturing Co., Inc.		12	A.C.	2½	90 W.	Bulb	18.00
		19	A.C.	6	200 W.	Bulb	29.00
Liberty Electric Corp.			A.C.	4	90 W.	Vibrating	20.00
			A.C.	8	80 W.	Vibrating	18.00
Philadelphia Storage Battery Co.			A.C.	1		Chemical	15.00
			A.C.	½		Chemical	9.75
The Radio Ra-Bat Co.		4	A.C.	½	60 W.	Chemical	4.80

B BATTERY ELIMINATORS

Manufacturer	Overall Dimensions	Weight Lbs.	Operates from D.C. or A.C. House Current	Voltage Delivered	Current Consumed	List Price
Acme Engineering Co.	8½ x 7 x 4½	26	A.C. or D.C.	D-0-30 A-0-140v.	5 Watts	$32.50
Apco Manufacturing Co.	5 x 6¼ x 12	16	A.C.	D-22-45 A-0-130v.	10 W. per hour	50.00
Audiola Radio Co.	8 x 9 x 4	31	A.C.	D-15-50 A-90-100v.	Depends on load	34.50
The Dubilier Condenser & Radio Corp.	8½ x 5½ x 10		A.C.	D-15-20 A-90	25 Watts	47.50
	6¾ x 6 x 10	16	D.C.	D-13-20 A-90	6–10 Watts	30.00
Fansteel Products Co., Inc.	6½ x 7¼ x 9	19	A.C.	D-20-50 A-100-130	19 Watts	55.00
Kellogg Switchboard & Supply Co.			A.C.			50.00
MacFadden & Co.	5 x 8 x 8		A.C.			35.00
Timmons Radio Prods. Corp.	8¼ x 7 x 5	8½	A.C.	D-22-45 A-45-130v.	15 Watts	35.00
Valley Electric Co.	6 x 6¾ x 6	15	A.C.	D-22 A-90	15 Watts	30.00



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3

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The fine, clear tone and volume of the Kellogg Symphony Reproducer is due to the Kellogg unit with the magnetic diaphragm control.

This exclusive Kellogg principle has produced wonders in the accurate reproduction of voice and music; piano music is unusually fine, the lowest tones of the saxaphone to the highest of the violin are as clear as a bell, the soprano voice can really be admired.

Observe the rigid construction of this unit, the exactness of every detail, the size of the magnets. The *unit* is *the* reason.

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for both circuits

U. S. Patent Mar 25, 1924

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Balkite "B"—replaces "B" batteries and dry cells. Operates from light socket.

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Balkite *Radio Power Units*

BALKITE BATTERY CHARGER — BALKITE "B" PLATE CURRENT SUPPLY

Manufactured by FANSTEEL PRODUCTS COMPANY, *Inc., North Chicago, Illinois*

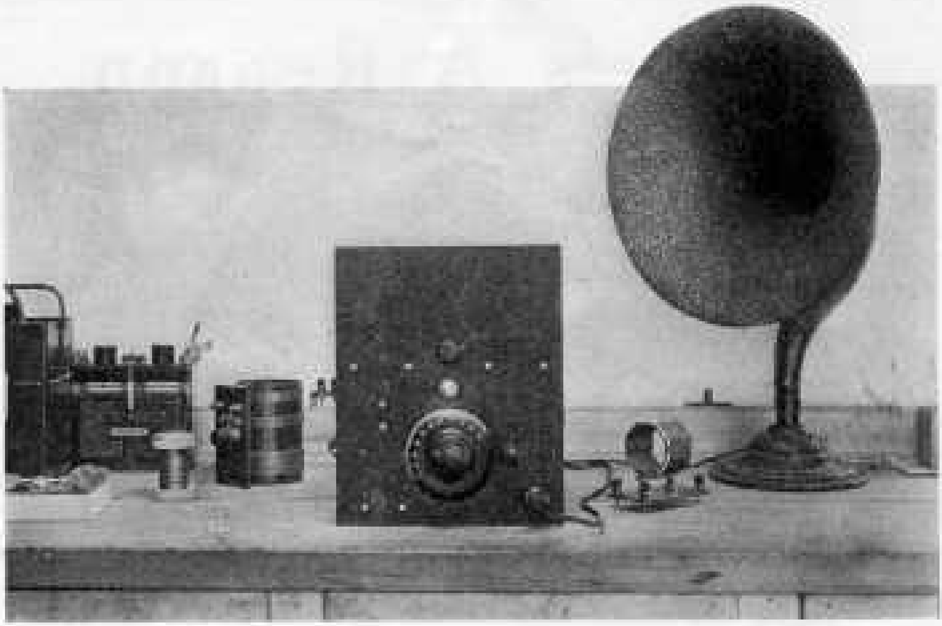

Fig. 1. Hooked up to a Kellogg loud speaker, ready for the final testing

4-T 3-C Receiver

Four-tube, three-circuit tuner, with resistance coupled amplification, a set to use out in the country for getting lots of distance with first-class volume and quality.

WE had two things in mind in planning the design for what we have called, for sake of brevity, the 4-T 3-C Set. There has been much interest in equipment for permanent installations in the country. Where there is plenty of space between one station and another, a regenerative receiver is quite satisfactory. It gives a long range, and brings in the signals with enough strength that, amplified by three stages of resistance coupling, broadcasting is loud enough and clear enough for most anyone. The design of this outfit, type 7800, presents these advantages in an extremely simple form which can be built easily at small expense.

At the same time, we wanted to bring out some ideas in mechanical design. Not long ago an announcement was made concerning the possibility of establishing a new series of panel sizes, about five in number, to supersede the great variety which have been employed in the past. To determine intelligently whether or not the 12-in. height offers definite advantages, it is necessary to see how designs will work out in practice. The type 7800 set illustrates typically the possibilities of the 12-in. panel. We also wanted to show how the Browning-Drake coils can be used for a simplified type of 3-circuit tuner and to illustrate the use of the new Walbert Panelite, a new accessory which, tho not an essential, is a very handy thing to have.

The accompanying illustrations, with the picture wiring diagram and schematic in Fig. 3, show how the design worked out. When the 12-in. panel idea was first discussed, it was pointed out that a special advantage lay in the two-level arrangement of the instruments, that is, the tubes and coupling transformers or resistances across the top, with the tuning controls centrally located at the bottom. The panel for this set measures 10 by 12 ins. A little figuring will show that a similar outfit on a 7-in. panel would have to be at least 24 ins. long. Comparing the areas, a 7-in. panel requires an increase in area of 40%. That would increase the cost of the panel about one dollar. Where the 12-in. panel can be mounted on a small cabinet suitable for The outside area of a 7 by 24-in. cabinet, 7 ins. deep, is 602 sq. ins., against 428 for a 10 by 12-in. cabinet, 7 ins. deep. This represents an increase of 41% over the 10 by 12-in. cabinet. The saving in material may be only a small part of the gross price of the cabinet, but weight and space must be considered by the manufacturer, jobber, and dealer in deciding whether or not it is worth while to rearrange the front of the set so as to

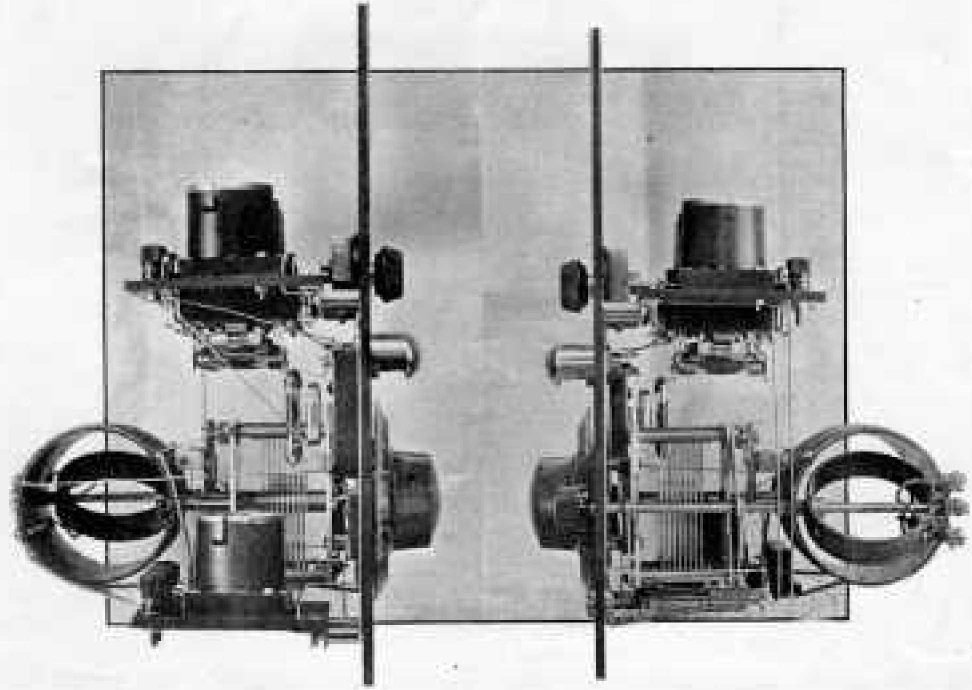

Fig. 3. Left and right hand side views of the set, illustrating the two-level design system

setting up inconspicuously, a 24-in. set generally occupies a whole table all by itself.

As sets are generally built, the tuning controls are at the extreme left of the set tho they are operated with the right hand. Using the 2-level design, the controls are centrally located so that they can be reached in a natural position.

Cabinet design lends itself more to the high, narrow panel than to the long, low shape. This is particularly true if the panel is to slant back. The 7-in. size looks very awkward unless it is vertical. The high cabinet is cheaper to build. reduce the volume of the cabinet. Another factor—12-in. panels are more economical to cut than the 7-in. size, saving by eliminating waste material.

Circuit of the Type 7800 Receiver As you will see in Fig. 4, this outfit employs one of the conventional hookups. Of course, the Browning-Drake tuned R. F. transformer was not designed as a 3-circuit tuner but it works out very well in this set. The primary winding is not used at all. The leads from the coil to the terminals are cut off right at the tube, and those lugs employed to support connections from the tickler coil. Instead, the antenna is connected at the neutralizing tap, and the ground brought off at the filament end of the secondary coil. This gives enough coupling for strong signals, yet it is sufficiently loose to make the tuning sharp. Since the coil is mounted right on the variable condenser, the complete unit is very compact and handy.

The front panel carries the tuning unit, the filament control jack, Panelite, and rheostat, with the first resistance coupling unit at the back. The upper tube panel, fastened to the front panel by angle brackets and short pillars, has three binding posts, three sockets, 0.75 ampere Daven ballast resistance, and the second and third coupling units, while below is a small panel, similarly mounted, carrying the detector socket and four binding posts. Detailed views of the set are given in Figs. 2 and 3, with a front view in Fig. 1. The single rheostat controls the detector tube, while the amplifier tubes, since they are not critical in adjustment, are handled by the ballast resistance.

Standard Parts Required In the set as we built it at the Darien laboratory, the following parts were used: A front panel, 10 by 12 by 3/16-in., upper tube panel 3½ by 3/16-in., lower tube panel 3½ by 3½ by 3/16-in., National Browning-Drake transformer unit, four Walbert sockets, three Electrad resistance coupling units, three 0.006 mfd. Micadons, one 0.001 mfd. Micadon, one 0.00025 mfd. New York Coil grid condenser with mounting clips, a 0.00025 mfd. gridleak, a 0.75 Ampere Daven filament ballast, Walbert Panelite, 3-spring Carter jack, 20-ohm Howard rheostat, the small size, seven Eby Ensign binding posts, six coil mounting pillars, 5/16-in. diameter by 11/16-in. long, threaded for 6-32 screws, and six 1-in. angle brackets.

Equivalent parts of good design can, of course, be substituted by changing the drilling accordingly.

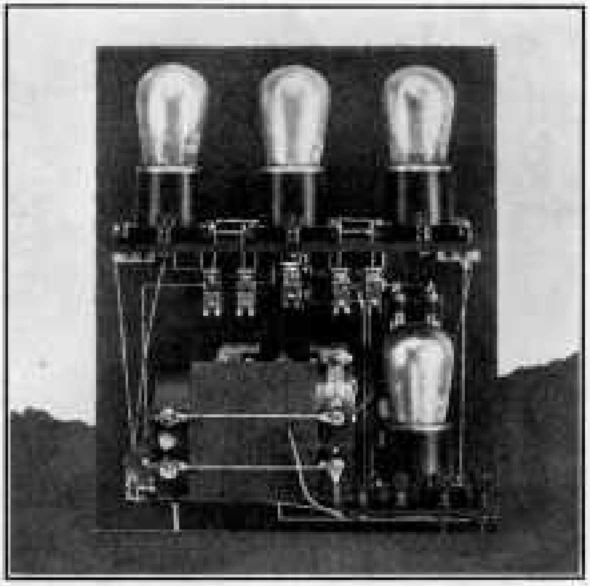

Fig. 3. Here you can see how, by making the panel 5 ins. higher, we can make it 14 ins. shorter. Note the trim and clean-cut appearance of the set

Assembly And Wiring To make the assembly and wiring as easy as possible, the front panel, upper tube panel and lower tube panel should be put together and wired individually, before the three panels are fitted together. Wiring can be followed out easily from the picture wiring diagram and schematic in Fig. 4. Because the second and third coupling units are mounted beneath the panel instead of above it, the terminals are just

(*Concluded on page 361*)

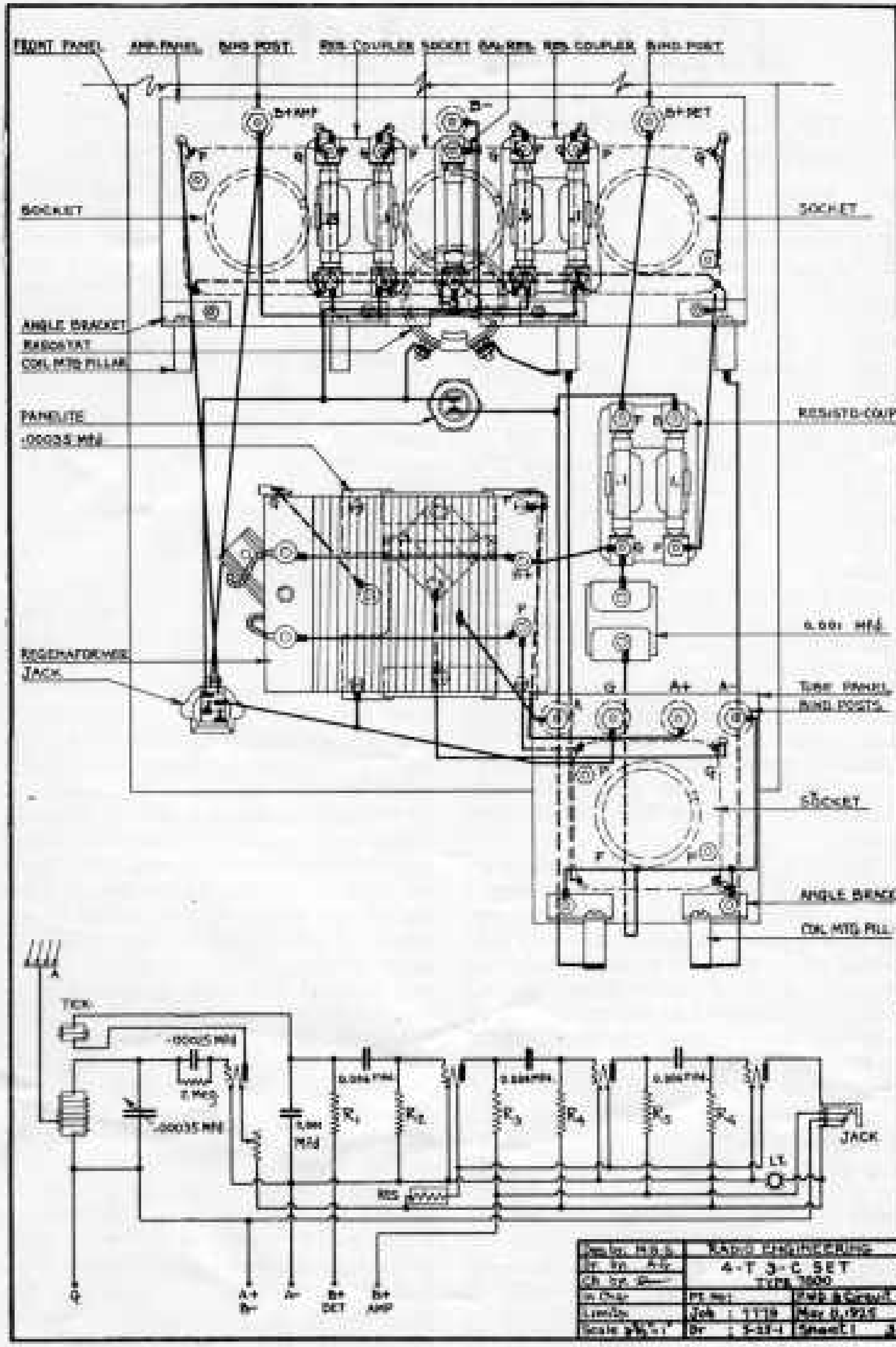

Fig. 3. To make the wiring more clear, the tube panels are shown tipped up. The schematic will clear up any points which are not plain in the picture wiring diagram

A Vacuum Tube Working from Light Instead of Heat

The three-element Photo-electric cell, used as a radio detector or amplifier, follows practically all the laws which apply to the hot-filament tube.

IN working to perfect a device which has an inherent fault there are two methods to pursue—one is to reduce the effect of the fault to a minimum, the other to work for a device, serving the same purpose, which does not have that fault. If anyone had suggested that the solution of the A battery problem was not to use dry cells, and not to use an A.C. operated heater, but to make a tube which required no heating at all, the answer would have been, "Try to do it!"

Just about the time that Dr. de Forest made his first audions, Samuel Wein, a New York boy who came here from some place no one ever heard of in the middle of Europe, started to eliminate heat from the vacuum tube. He didn't know it. He was too busy thinking about selenium cells and the chemistry and physics of light to be concerned with filaments altho, oddly enough, he has recently produced some remarkable low-current filaments for the ordinary type tubes.

In the last eighteen years, while pure research led him from selenium to photo-electric cells, radio forged ahead, picking, as it progressed, from almost every field of science. And just as the demand for the elimination of the A battery became insistent, Samuel Wein started to wonder why the photo-electric cell fitted with a third element, wouldn't give the answer. And it did.

We had planned to have a construction article ready in time for this issue, showing the Actinion, as Mr. Wein calls it, in actual use, but, at the last minute, we were delayed. However, that will be ready next month. Perhaps you will keep busy, in the meantime, thinking about the operation of the cell itself.

The two-element photo-electric cell is a little easier to understand, so let us consider that first. This is made up of a plate, about 1 in. square, with a wire grid, of about the same dimensions, parallel to the plate and separated by perhaps ⅛-in. However, the plate is the filament, and the grid is the plate. The filament, as we shall call it to make the action clear, is coated with a chemical compound. When light shines thru the plate onto the filament, electrons are thrown off. If, then, a B battery is connected across the filament and plate, current flows between the elements of the photo-electric cell.

In the darkness, no current flows, but the moment a light is thrown on the plate the current increases with the strength of the light until, at least in the present types, the tube becomes ionized, and turns red.

Many uses have been developed already for the two element cell which, because of its instantaneous response, can be operated where the slower selenium cell is impractical. It excels as a high speed telegraph relay, for example. Dots are made by sending the current thru the line in one direction, and dashes in the other. A mirror on a string galvanometer throws a light on either one of two photo-electric cells, depending upon the polarity of the current in the line. When the light shines on one tube, current flows thru it and a dot is recorded; on the other tube, and a dash is made. Thus dots and dashes are reduced at the sending end to the same time periods, and all spacing is eliminated.

Adding another coarse screen of wires, located between the plate and filament, makes the three-element Actinion. This grid, connected in the usual manner, controls the flow of electrons from the big plate just as the grid regulates the electrons given off by a heated filament.

Since the Actinion is not simply a variation of the hot filament tube, but a device operating on an entirely new principle, much development work lies ahead. The shape of the elements, their spacing, the best kind of light to produce maximum emission, these and other factors are still to be determined.

Another problem, tho one easy of solution, is the supply for the lighting bulb. Probably the simplest arrangement is a combination 2-volt storage battery and charger which can be left floating on the line. Or a B battery eliminator could be made with a 2- or 4-volt tap from the A.C. supply to run the bulbs.

These matters will be discussed in other articles which will appear from month to month on this most interesting subject—the heatless tube.

4-T 3-C Receiver

(Continued from page 358)

opposite from what they are marked, and the gridleaks should be changed accordingly. Reading from right to left, the values should be 0.1, 0.5, 0.1, and 0.25 megohm. The left hand resistor in the first unit should be of 0.1, and the second 1.0 megohm. Values for the fixed condensers are given on the drawing.

Testing And Operating Insert the tubes and connect the 6-volt storage battery to the A+ and A— terminals. The tubes should light when the phone plug is put into the jack. Then disconnect the lead from the storage battery to the A— binding post and touch it to the B+ Det and B+ Amp post. The tubes should not light. If they do, there is a short in the plate circuit. If everything is O. K., put the storage battery back on the A binding post, connect two 45-volt B batteries in series, run the — terminal of the first battery to the B— binding post, +45 on the first battery to the B+ DET post, and +45 of the second B battery to B+ AMP. You may find it necessary to use the full voltage on the detector binding post altho that is not required ordinarily. Connect the ground to the GND terminal and the antenna, a single wire about 50 to 100 ft. long, to the ANT post. Adjust the variable condenser and turn the tickler coil until you pick up a station. Then get a close adjustment with the condenser and bring the signals to maximum strength by turning the tickler a little farther.

If the signals do not seem to be up to full strength, increase the voltage on the detector tube.

A POSITION OPEN AT THE DARIEN LABORATORY

We need a man at the Darien Laboratory who can learn to handle the design and construction of radio equipment, and to take charge of the new laboratory when it is completed. Preference will be given to those who can fill all the following requirements, altho considerable latitude will be allowed in making the final decision.

Age—18 to 20.

Experience—High School education, ability to make good mechanical drawings and operate wood and metal lathes, and grounding in mathematics. Must be able to write plain English correctly. General knowledge of radio, and experience in handling radio telegraph communication up to 20 words a minute.

Personality—We would prefer to have an inexperienced man who is able to learn quickly. We'd rather not have a man who knows too much. Most important of all, we want a man who will put forth a sincere and unselfish effort to make a success of his job. We are willing to pay all that the job is worth and, working under the personal supervision of Mr. Sleeper, a capable man can earn a very handsome income over a period of time, but an increase in salary must be earned before it will be paid.

Every opportunity to gain experience and knowledge will be made available. This position offers far more opportunity than the routine of a commercial laboratory, thru acquaintance with the engineers of the radio companies, and the encouragement of original work.

During the first six months, a very small salary will be paid, with an increase at the end of that period, again in six months, and yearly thereafter, the amount depending entirely upon the value of the work performed.

Applications will be accepted until August 1st, and the appointment made on August 15th. Any questions concerning this position should be addressed to M. B. Sleeper, A-52 Vanderbilt Avenue, New York City. This is an exceptional opportunity for a young man as a start to make a big future in the radio industry

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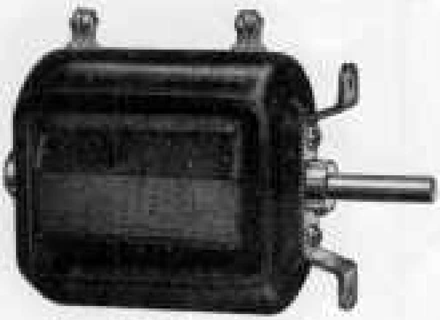

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THE most efficient radio instrument can perform no better than is permitted by the poorest connection in its circuit.

INSTRUMENTS, only, that employ Lastite Terminals have a sure chance to function as they are designed to function.

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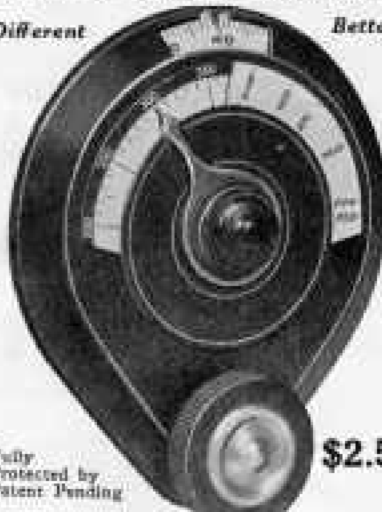

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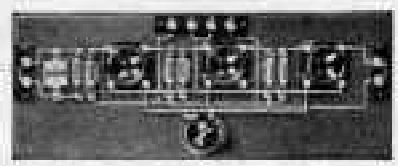

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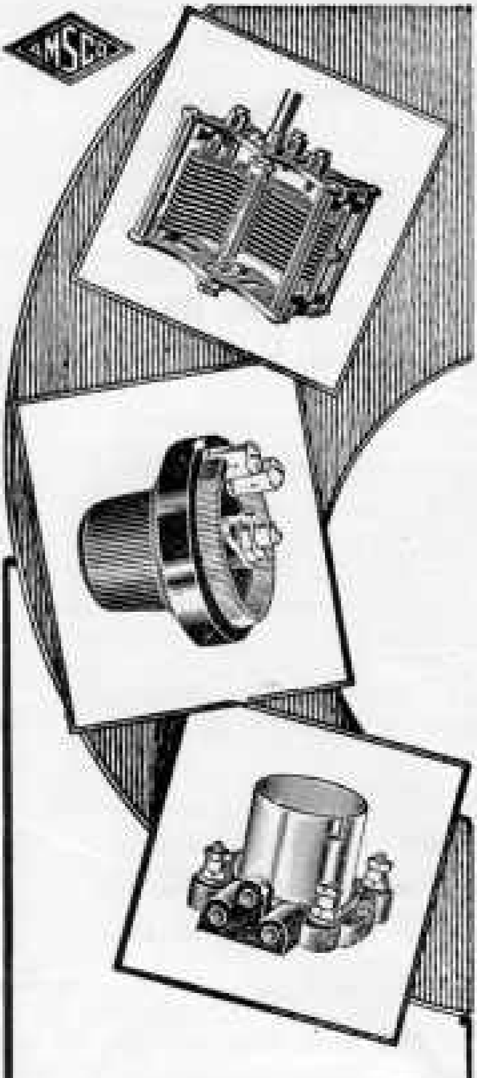

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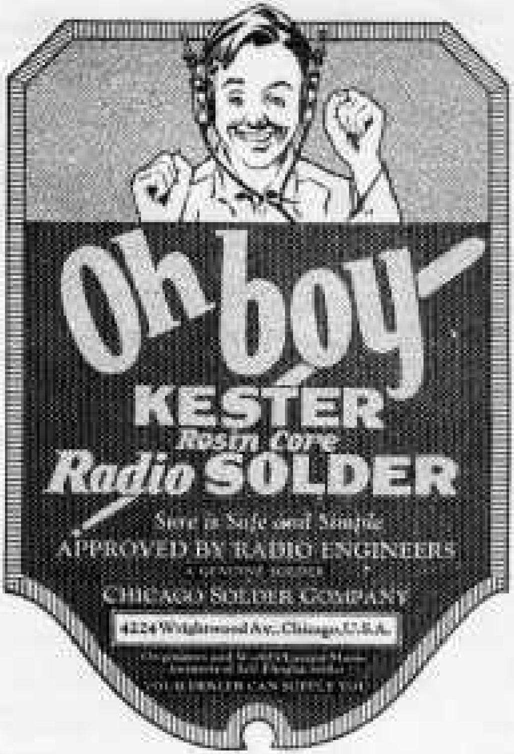

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OUR RADIO LABORATORY

—*and what it is all about*

IN the past few months we have had a number of letters, some from new readers and some from our old-timers who have been subscribers for the last five years, criticising the articles in Radio Engineering. They have all said, "Give us more original stuff in the Magazine, articles on new things worked out in the laboratory, solid, down-to-the-ground ideas that we can apply to the work we are doing."

It's a serious matter when a lot of readers ask for the same thing, and we got busy to find out how to do the job in the best way. We found that our laboratory was the stumbling block. Original work calls for laboratory and shop facilities. That means equipment and space to install it.

Take a comparatively simple article like the one on Tuning the Antenna Circuit, in the June issue. This data presents some very interesting information on receiver design. You don't need a laboratory to make use of this data, but to get it called for the construction of an oscillator, a wavemeter to calibrate it, and measuring instruments for making the tests.

That's the sort of thing we like to do, and of which we want to do more. For the designer and constructor we have been working for the last three months on the RX-1 set, for which you will find the first preliminary data in this issue, with the construction article in September. And there's the cold vacuum tube, on which we have planned a whole series of practical articles.

But the old laboratory has reached the point where if we have all the equipment necessary there won't be room for anyone to work, and if we have as many men working there as we need, the equipment will be squeezed out.

We found that the cost of a first class laboratory building and the complete equipment and machinery for it comes to about $25,000. Frankly, we can't dig into the bank balance for that amount. That's why we worked it out on a 50–50 basis. Radio Engineering isn't a charitable institution—It's a business organization, so we can't ask for contributions.

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Subscriptions sent in to help build the Laboratory should be addressed to Our Radio Laboratory, M. B. Sleeper, Inc., A-52 Vanderbilt Avenue, New York City.

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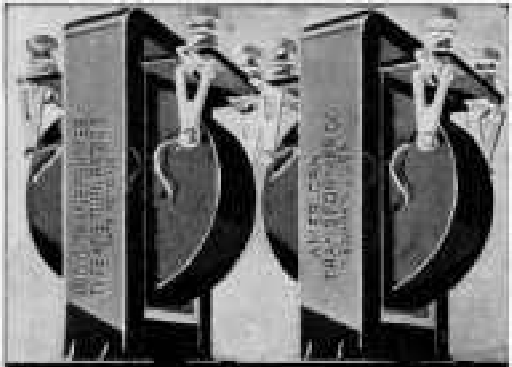

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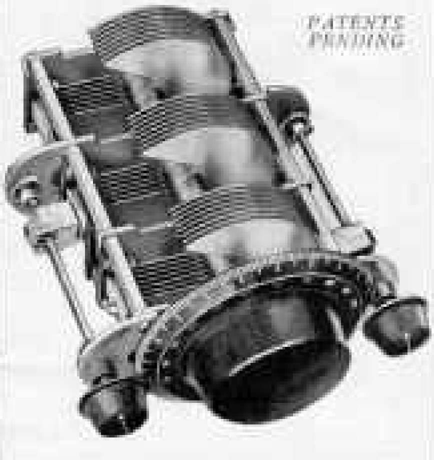

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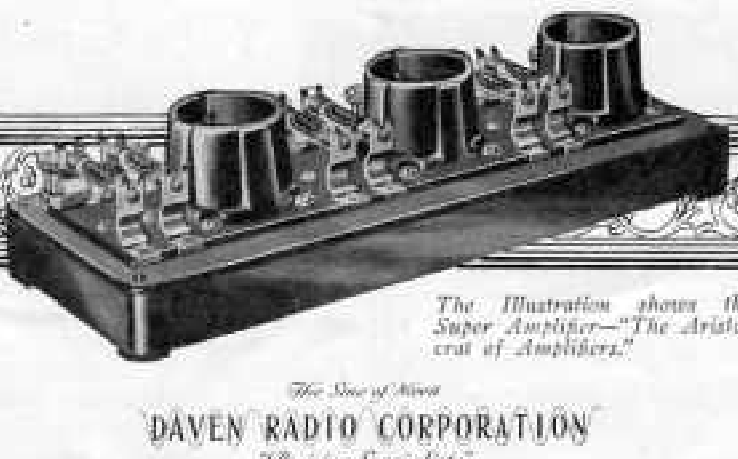

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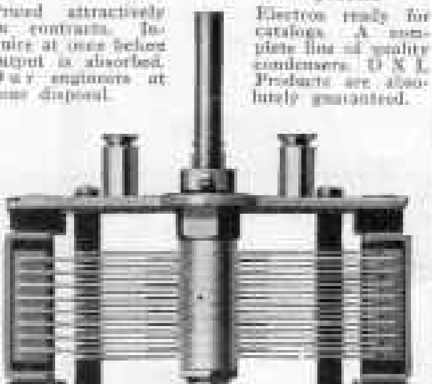

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