Approved Radio Designs

All M. B. Sleeper Dataprints Are Approved by the Manufacturers of the Equipment Used and Are Recommended by Them for Your Use. Here Is a Complete Selection.

FOR A. C. OPERATION

01–ABC: The only eliminator providing A, B, and C voltages for 201-A tubes and 112 or 171 power tube. Uses S-M and Tobe parts. Complete Dataprints, postpaid.....$1.00
(Radio Mechanics, Jan., 1927, for instructions, 25c)

TC on A. C.: Famous TC receiver, an exceptionally beautiful design, built for operation from the 01–ABC eliminator. Uses Samson parts. Complete Dataprints, postpaid.....$1.00
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VICTOREEN SOCKET POWER SUPER: The first A. C. operated, 8-tube, single-dial loop super-heterodyne. The ultimate receiver. Uses Victoreen parts. Runs on 01–ABC eliminator. Complete Dataprints, postpaid.....$2.00
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ECLIPSE: A beautiful super built for extra range and sharpness. Uses H. F. L. parts. Complete Dataprints, postpaid.....$1.00
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MAN O' WAR: The battle-ship super. Uses S-M parts. Complete Dataprints, postpaid.....$2.00
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VICTOREEN: Described above. Full A. C. operation. Complete Dataprints, postpaid.....$2.00

SHORT WAVE SETS

All these sets can be used for broadcasting, also, as they are equipped with plugs-in coils.

HUSH-HUSH II: A snappy little set built around S-M parts. Complete Dataprints, postpaid.....$1.00
(Radio Mechanics, Oct., 1926, for instructions, 25c)

BERT SMITH'S: Special amateur design, good for 10,000 miles. With Quality Amplifier makes beautiful broadcast receiver. Uses Aero coils. Complete Dataprints, postpaid.....$1.00
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PEANUT: A special receiver using Burke's new plate circuit control, built around General Radio parts. Complete Dataprints, postpaid.....$1.00
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ELIMINATORS AND POWER AMPLIFIERS

R–171: A Raytheon B supply and 171 a... using Thordarson and Muter parts. Has gl... to give constant voltage. Complete Datapri... paid.....
(Radio Mechanics, Jan., 1927, for instructions...

R–210: 216-B rectifier with glow-tube ... lator for B supply. Has 210 amplifier. ... darson parts. Complete Dataprints, pos...
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QUALITY AMPLIFIER: The most ... designs ever shown in Radio Mechan...

...RS

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SUBMARINE: Unquestionably the best radio set for the money ever designed. 4 tubes, PDX audio circuit, all latest features. Parts cost less than $25.00. Complete Dataprints, postpaid.....$1.00
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EQUAMATIC: The famous Karas 5-tube set which operates at peak efficiency at all wave-lengths. Complete Dataprints, postpaid.....$1.00
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Short-wave radio telephone transmitter and receiver, good for telephone communication up to 15 or 20 miles. Runs from B battery. Very low in cost.
5–N–1 receiver, Dataprints.....$1.00
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GLO-LIMINATOR: The perfect B battery eliminator, combined with a high quality UX-171 power amplifier. Complete Dataprints, postpaid.....$1.00
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2,000-MILE TRANSMITTER: A B battery operated transmitter built for the new Aero coils, in which the skill and experience of Bert Smith and F. J. Marco are combined. Complete Dataprints, postpaid.....$1.00
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N CIRCUIT: Official design for assembling the N circuit kit. Built around Precision Coil parts and the Emerson Multivalve. Complete Dataprints postpaid.....$1.00
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Radio Hill Poughkeepsie, N. Y.

Send me the following sets of Dataprints:

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Print name.....

Street ..... City ..... State .....

BETWEEN YOU AND ME

M. B.'s own page about radio, having fun, and other important things

IN another month or two, a new crop of young engineers will be ready to start their careers in the radio industry. To them, and to the others who are preparing to follow, I'd like to pass on a few observations which are the result of close association, over quite a period of years, with a great many men, young ones and old ones, in the industry.

Starting at this stage of radio development, and it is still a very early stage, there is a clear road ahead to success as measured in terms of money and in terms of useful achievement.

Excepting the limited number of graduates who have the knowledge and inclination to go in at the start for pure research, the young engineer must measure his ability and success by the salary he can command.

Summed up in a sentence, the thought I want to give you is this:

The money your employer can pay you depends upon the amount of money he can make from the work you do.

That's a simple statement, perfectly obvious when you stop to think of it, and such an absolutely incontrovertable fact that there's no way to argue around it.

I had a letter from a boy who graduated from M. I. T. last year. He wanted some advice, and needed it, though his experience is similar to hundreds of others. He started off with a very large concern, in their laboratory, but he quit because his salary was "all out of proportion to the investment he had made in his college training."

Figuring that there wasn't much chance in a big company anyway, he went with a small manufacturer, believing that in such an organization his ability would show up quickly.

Again he was disappointed, for, "they admit the importance of my work, but Mr. ———, the president, says they aren't making enough money to pay me what he admits I'm worth."

Just analyze this experience in the light of my axiom. The first company could afford to pay any salary. What they did pay was simply regular beginner's wages, for he wasn't making money for the company. He was just a laboratory assistant, a part of the overhead.

And he didn't have patience enough to stick to the job until he could climb out of that class into a place where he could do work from which the company could make money.

Did you suggest that, with another big concern, he might have started off in such a position?

You are wrong. He couldn't have done it. In the first place, the bigger the job, the bigger the background of experience and precedent required, particularly in regard to company policies of internal organization and external relations, upon which the entire structure of every business enterprise must be built.

More than that, such positions are only open to those who, over a considerable period of time, have demonstrated loyal cooperation and harmonious temperament, so that the men who are responsible for making money from the work of the employees can push ahead shoulder to shoulder as a group, and not as individuals, in unrelated efforts.

As for the company that couldn't pay him what he was worth—He had developed for them a truly remarkable machine for which there was a splendid market. However, the investment in tools and equipment necessary to manufacture it was so great that his employer could not afford to go into production.

Discouraged, he started to hunt a new job, but without results—which was very fortunate for him because, in the meantime, he worked out a small device, simple to manufacture, which in no time, as he wrote me a month ago, "is selling like a house a-fire! By fall, Mr. ——— expects that he can swing the other machine, and then I shall make some real money!"

And still this boy doesn't understand that he was, and will be, paid in direct proportion the money his employer can make from e work he's doing.

ou can apply this relation between your nd your wages to the job you under- will help you to recognize the oppor- t fitted to your individual circum- d keep you happy and patient while your ambition. Then, through which comes of a willingness to he door of the big future will be u.

M. B. SLEEPER, *Editor*

2,000 Mile Range

Consistent reception from broadcast stations. Up to 10,000 miles on short waves.

18 to 550 Meters

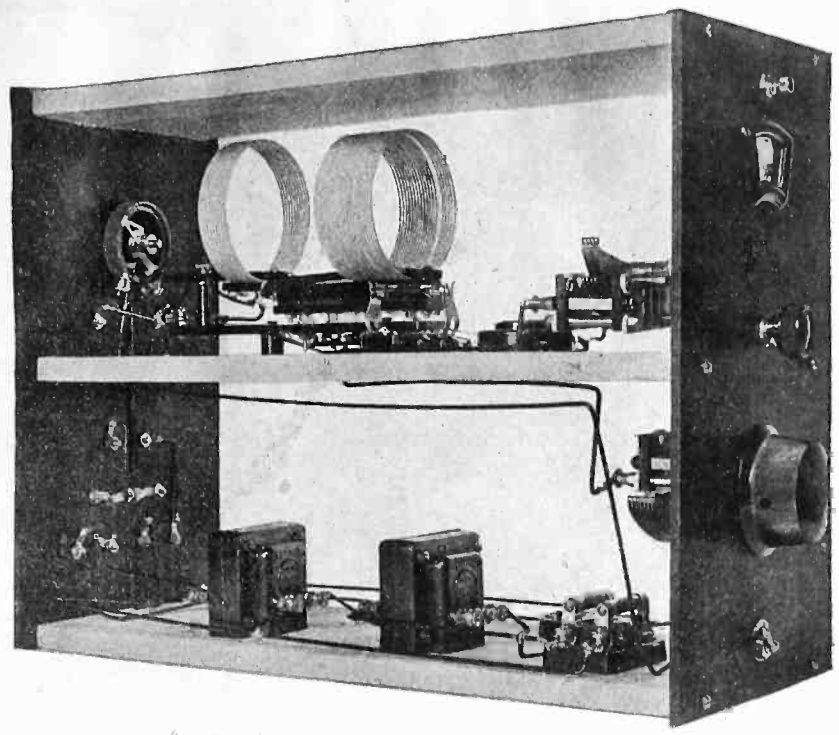
Four plug-in coils are supplied to cover short waves and broadcasting.

$24.10 Complete

Everything shown in the picture, including the other 3 coils, postpaid.

Guaranteed

If, upon inspection, you do not agree that every part is of the finest design, return the kit at once and your money will be refunded by return mail. You take no chances.



BUILD THE SUBMARINE!

LET'S get right down to brass tacks about the Submarine Kit.

First, about the price. Just run down the list of parts and see how much you would pay for first quality instruments at your radio store.—You make it about $50.00, don't you?

Well, that answers the question of saving money or spending it unnecessarily.

Second, the parts themselves. When you open up your Submarine Kit, if you feel in any way disappointed in them, or if you think you can buy better parts anywhere else, just ship 'em back. You don't need to offer any explanation. Just say they aren't as good as you expected, and your money will be sent to you by return mail.

Can you ask for a more liberal guarantee than that?

Third, as to performance. We have now had reports from all parts of the country, all unanimous in praising the accomplishments of the Submarine.

Well, you know that efficiency counts. Low-loss coils, Bakelite insulation, hard rubber panels. And as to quality — that's assured by the special circuit in which resistance and transformer coupling are combined.—You'll be well satisfied with the quality.

Here is the list of parts:

2—Panels, 7 x 10 x 3/16 in.
3—Wooden decks, cut to size
2—Low loss S.L.F. condensers
1—Illuminated vernier dial
4—UX sockets (take UV tubes also)
1—Low loss coil kit (4 coils)
1—Plug-in coil mounting
2—Bakelite case A.F. transformers
1—Resistance coupling unit
4—R
mounting
ach

1—Set of marked binding posts
1—Assortment of screws, lugs, wire, etc.
1—Set of blue prints

QUICK SERVICE

A. L. Farris recognizes the impatience of set builders when they get underway.

What's more, A. L. Farris is equipped to make shipment the day your order is received.

First, you will have an acknowledgment by first class mail. Then you will receive your Submarine Kit by American Railway Express.

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A. L. FARRIS, Arlington, N. Y.
Rush immediately, prepaid, complete SUBMARINE KIT. $24.10 enclosed.
Street.....
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State.....
C. O. D. orders cannot be accepted.

NO USE TO BE [illegible]IENT!

There are movies always [illegible] out a new set is just the minute [illegible] wh[illegible]he

RADIO MECHANICS

VOLUME I APRIL, 1927 NUMBER 7

THE N CIRCUIT COMES TO AMERICA

Combining Sir Oliver Lodge's N Circuit, So Popular in England, and the New Multivalve Tube

FREDERICK CHAMPION

WE might have headed this article, "This two tube set works a loud speaker," for that is exactly what we have here. When we add that the set is single control and, though regenerative, does not howl or disturb the neighbors, you will probably admit that it sounds interesting, if true!

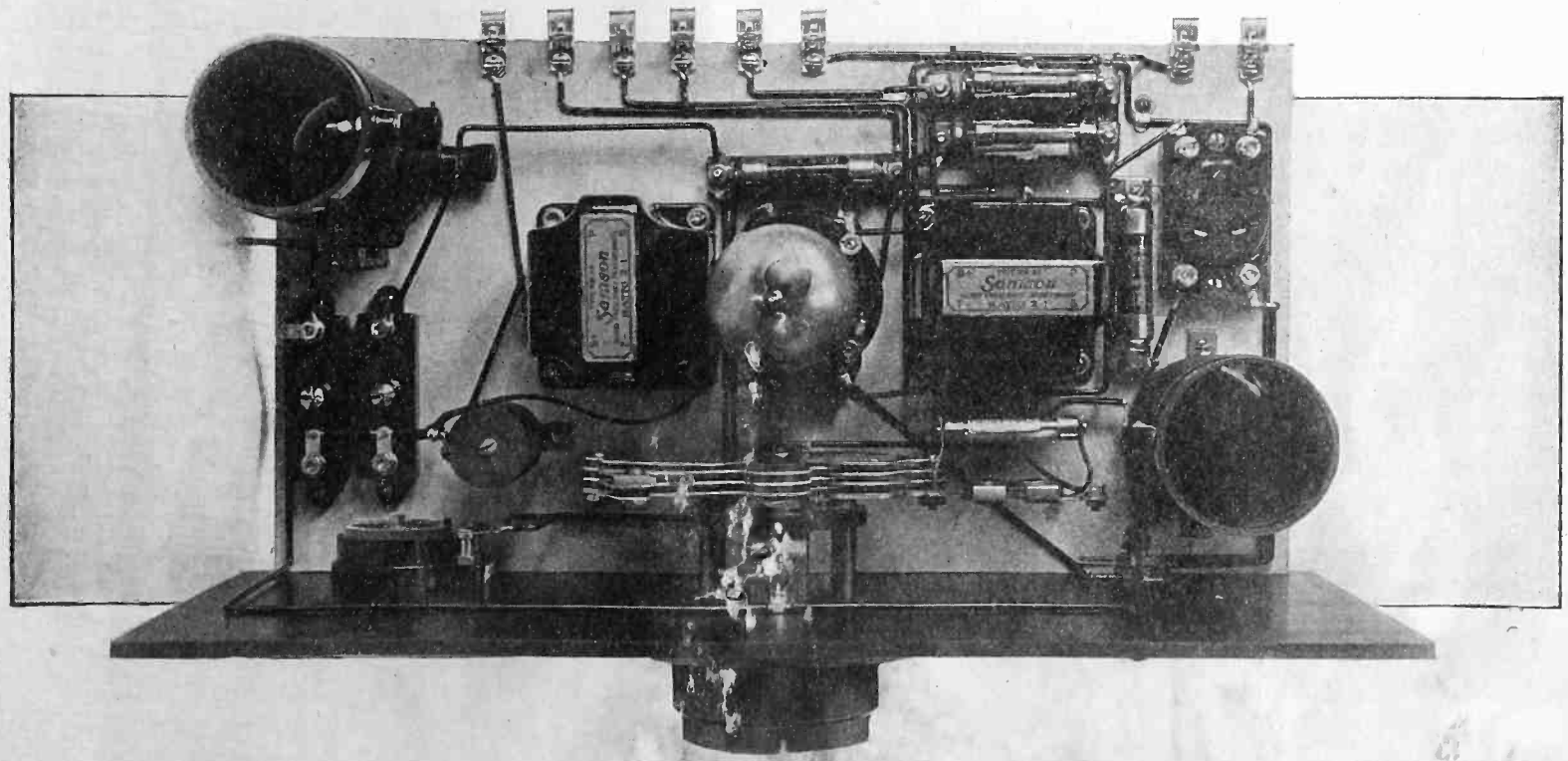
Well, it's true enough. That eminent British scientist, Sir Oliver Lodge, has developed the N circuit after a vast amount of research. By so doing, he has convinced us that he knows a thing or two about radio, as well as psychic phenomena. Let us see what he has to say about it.

"In designing the circuit which has become known as the N circuit," says Sir Oliver, "our object was first, to provide a set that would not oscillate or cause interference with other neighboring sets . . . and secondly, to provide a receiver which would be perfectly simple to operate."

There is no question but what Sir Oliver has accomplished just what he set out to do. As a matter of fact, actual tests of the N circuit lead us to believe that he has been quite modest about it. The set is really single control, with no auxiliary adjustments whatever, except the audio modulator which regulates the volume. The N circuit makes a receiver which is a real pleasure to tune for, as the one dial is turned, the stations snap in and out with regularity and precision, and with a complete absence of annoying howls and regenerative oscillations.

However, we want to state right now that this set is not intended for extreme long distance loud speaker reception. The circuit hounds, glancing at the schematic, will see that right away, for the N set consists of a regenerative detector and three stages of audio. It is true that many builders, residing in New Jersey, report consistent reception of Chicago stations, but if the set is used for a local receiver it will amply fulfill the necessary requirements for such a receiver.

You may ask, and naturally, too,



A dandy layout which can be put together quickly. It is supplied in complete kit form, or the parts can be obtained separately

"Is this four-tube circuit obtained from two tubes by reflexing?" No, it is not. The heart of the N circuit, as described here, is the new Emerson Multivalve, which is really three tubes in one. This tube has three grids and three plates, and the filaments are wired in series so that the current consumption is the same as that of a standard 201-A type. You can readily appreciate that the addition of a power tube then gives four-tube efficiency and results with two-tube compactness and economy.

Although the N circuit is new, it is not complicated. Its construction is neither tricky nor difficult. The balancing is but a few minutes work and, once done, it need not be changed again unless a different aerial is used. It is an excellent receiver for those who want music without the annoyance of twirling a multiplicity of dials and knobs. This feature will be appreciated particularly by the feminine fans.

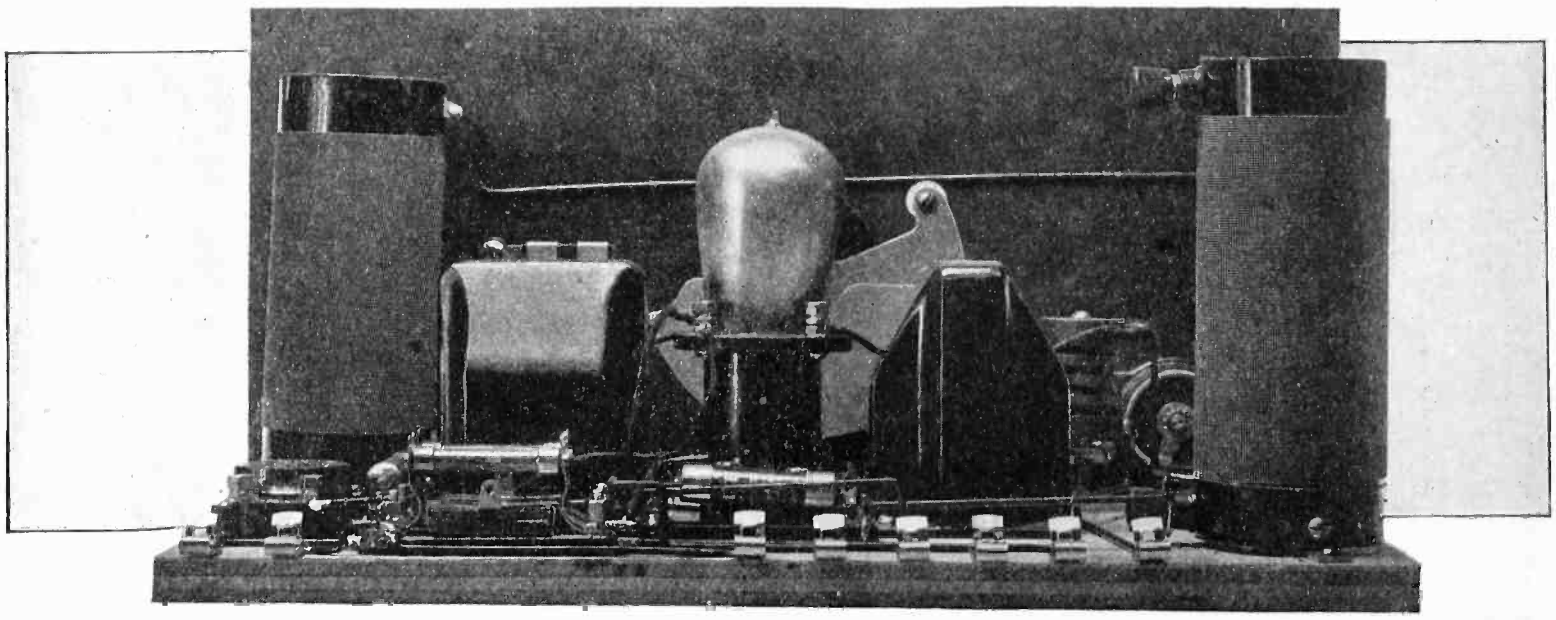
The audio amplifier is so designed that ample volume and good quality are obtained. High grade transformers are used, and the third audio stage, resistance coupled, introduces no distortion. When a good cone speaker is used the quality of reproduction is very pleasing.

Every attempt has been made to make the assembly as simple as possible and, at the same time, any sacrifice of efficiency has been avoided. The complete kit can be obtained including a drilled front panel and baseboard cut to size. The complete kit simplifies the construction of the set greatly.

Operating Instructions

You must have a good antenna for use with the N circuit, and this should be about eighty to one hundred feet long, well insulated, as free as possible from surrounding objects.

Be sure that all batteries are in good condition by testing them with a reliable voltmeter. You will need three 45-volt B batteries, a good 6-volt storage battery, and two 4½-volt C batteries.



Rear of the N circuit receiver. This shows the extra grid and plate terminals of the Multivalve

Hooking up the Batteries

Connect A + and B — together, and run this wire to clip No. 3. Connect A — and C + together, and run this wire to clip No. 2. Connect the two C batteries in series, and connect the C — 9 to clip No. 4. Hook the + 45-volt post of the first battery to clip No. 1, the + 45 on the second battery to clip No. 5, and the + 45 on the third to clip No. 6.

Connect a good loudspeaker to clips Nos. 7 and 8. The loudspeaker cord with the red tracer is connected to clip No. 7 and the other one is connected to clip No. 8.

LIST OF ACCESSORIES RECOMMENDED FOR THE N CIRCUIT SET

The accessories listed here have been given a thorough test in conjunction with the receiver described. It is, therefore, recommended that the builder follow this list in order to obtain the maximum results from the set.

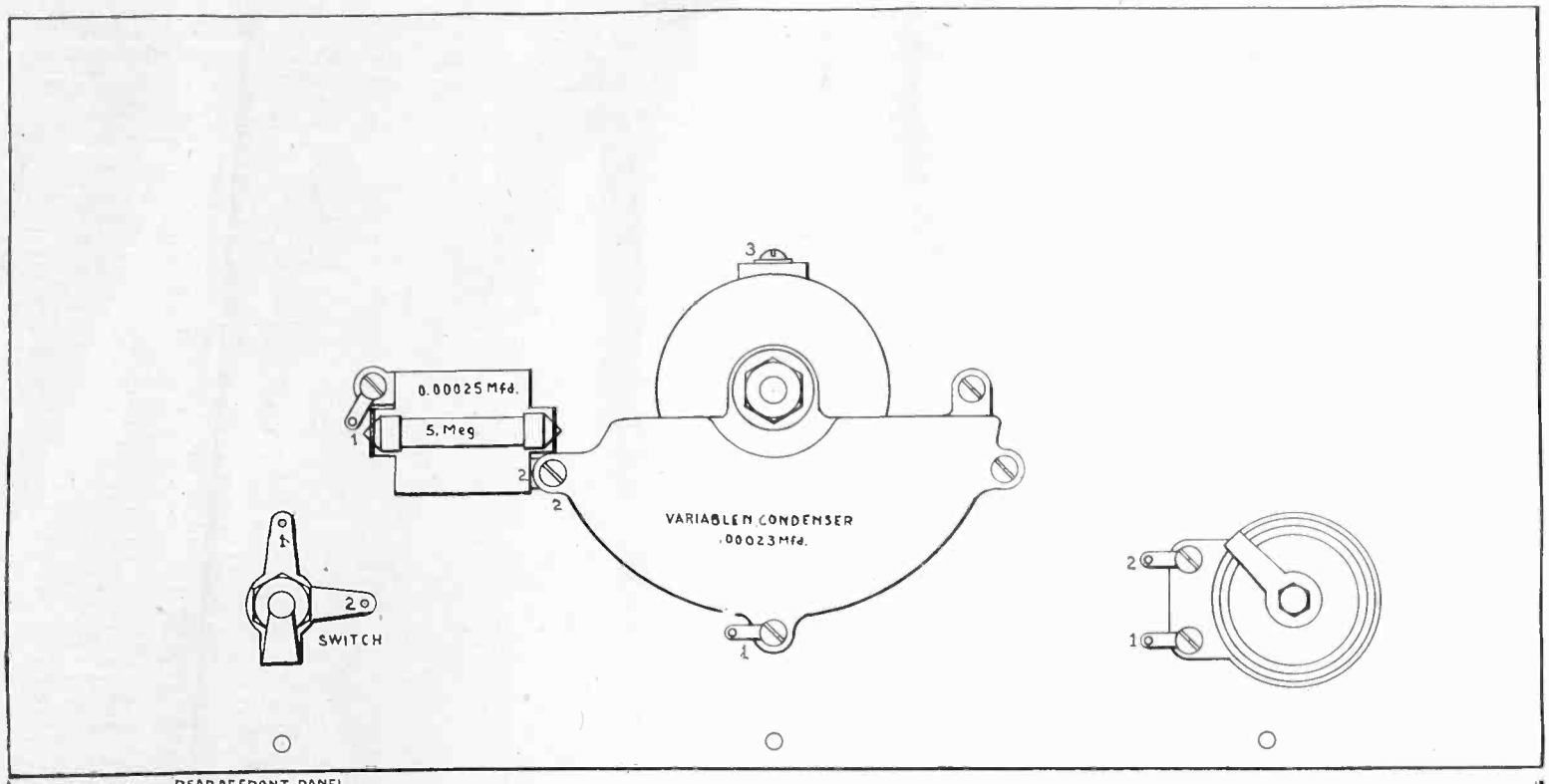
1 Cleartron Multivalve.
1 Cleartron CTX 11 power tube.
3 Eveready 45-volt B batteries.
1 Storage battery, 40-amperehour, any good make.
1 Radio Foundation Oval cone speaker.
1 Balkite trickle charger.
1 Acme battery cable.

Balancing the N Circuit

After the N Circuit is connected to batteries, antenna and ground there is one adjustment which must be made before the set will operate right. This consists of getting the proper capacity balance between the two variable fixed condensers, indicated as No. 1 and No. 2 in both the schematic circuit and in the wire-less wiring diagram of the parts. This is a matter of a very few minutes work, and once done need never be altered provided you don't change the aerial.

When the circuit is correctly balanced, you will have uniform sensitivity all over the wave band and absolute freedom from oscillation in the circuit. Further, the circuit will be absolutely non-reradiating. Stations will snap in sharply, each one occupying very little space on the vernier dial.

In adjusting the two balancing condensers which are designated as No. 1 and No. 2 in the diagrams, start by taking a long screw driver and adjusting the small screw on


0.00025 Mfd.
5. Meg
VARIABLE CONDENSER
.00023 Mfd.
SWITCH
REAR OF FRONT PANEL
N COIL
Top
Bottom
A.F. TRANS. N°2
SOCKET N°2
SOCKET N°1
A.F. TRANS. N°1
R.F. CHOKE
G-10 X-L N°1
G-10 X-L N°2
AMP N°2
AMP N°1
1-A
ANT
GND
ANT. COIL
L.S. N°8
L.S. N°7
+135 N°6
+90 N°5
C- N°4
A+B- N°3
A-C+ N°2
+45 N°1
0.00023 Mfd
5 Meg
0.00025 Mfd
N COIL
ANT. COIL
R.F. CHOKE
0.01 Mfd
0.1 Meg
0.5 Meg
300,000 Ohms
OUTPUT
AMP 1A
AMP 112
1-2-3 Elements in Multivalve
B+45V
A-C+
A+B-
B+90V
C-1½
B+135V

condenser No. 2 so that its capacity is at maximum. This is done by turning it to the right as far as it will go. Do not force it. Condenser No. 1 should be adjusted to minimum capacity by turning the screw to the left.

Set the vernier tuning dial on the front of the panel so that the condenser is nearly all the way in. In other words, adjust it for maximum wave length. Now when the set is turned on, the tube should oscillate. This condition can be recognized either by tapping the stator plates of the variable condenser with a finger, when the characteristic click-click of the oscillating circuit will be heard, or by moving the condenser, that is, tuning down the wave length range a bit until a whistle is heard, which will occur, of course, as soon as the tuning control reaches the wave length of any station within range.

Now turn down the adjustment screw on No. 1 balancing condenser until the circuit just stops oscillating. Then turn the tuning condenser so that it covers the wave length band and note whether the circuit come into oscillation again on the low waves. If it does, and it probably will, it means that the capacity of balancing condenser No. 2 is too great. Reduce this by turning the adjustment screw to the left a bit and repeat the former procedure. In other words, go back to the high wave lengths on the tuning condenser and re-adjust No. 1 so that the circuit is just below the oscillation point, and try covering the wave length band again. Repeat this procedure until the circuit is maintained just below the oscillation point over the entire wave length band.

It will be noted in making these adjustments that increasing balancing condenser No. 2 has a tendency to make the circuit oscillate more, and vice versa, while No. 1 balancing condenser has exactly the reverse action, that is, increasing its capacity stabilizes the circuit and stops it from oscillating. The whole secret of the adjustment is to strike a proper balance between these two. If the capacity in the balancing condenser No. 2 is too small, the circuit will have a tendency to oscillate on the high waves more than on the low waves, whereas if balancing condenser No. 2 is adjusted for too great capacity that is, if the adjustment screw is turned down too far, the reverse will occur and the set will oscillate on the short wave lengths more than on the long waves. After these two condensers have been adjusted so that a balance is struck and the set is uniformly sensitive over the entire band, make a final adjustment with condenser No. 1, screwing it down until the circuit is far enough below the point of oscillation so that no distortion occurs.

Once you are satisfied with the adjustment of the two balancing devices, you can forget them permanently, or at least until you change the location of your N circuit or vary the length of aerial on it.

The balancing of the N Circuit should be done after the tubes in the set have had a moment or two to warm up.

Mounting the Baseboard Parts

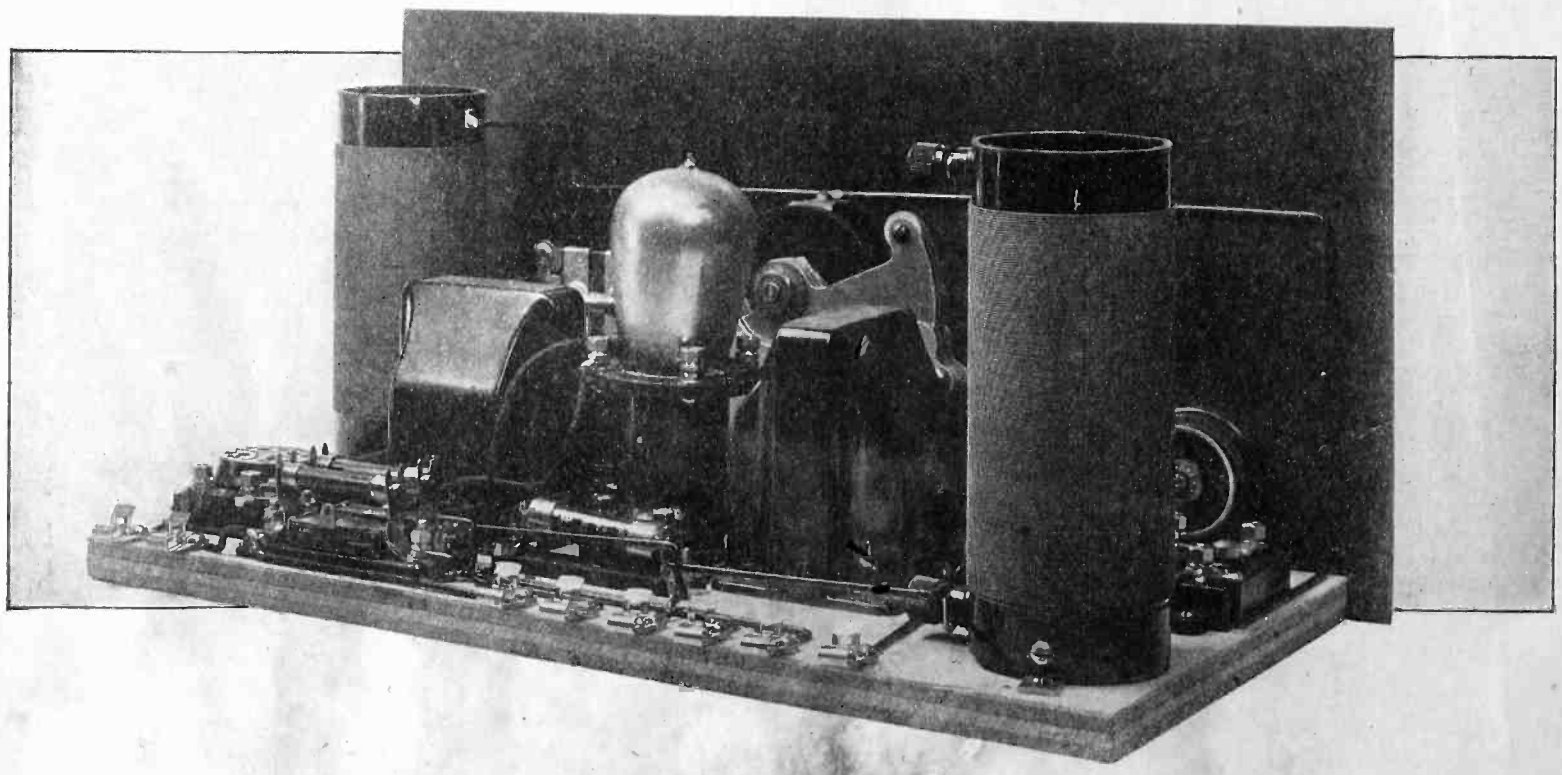
Mount the various parts on the baseboard exactly as indicated in the wireless [1] wiring diagram or, better, the baseboard layout shown on the Dataprints [2] can be fastened to the baseboard and used for a template. Facing the baseboard from the rear, notice that the antenna coil is placed at the right, and the two small balancing condensers between the antenna coil and the panel. The choke coil goes to the left of the balancing condensers, and slightly to the left of the center of the volume control. The first audio transformer comes next. Then the socket for the Multivalve which, by the way, is of conventional design.

The ¼-ampere Amperite is directly behind the first socket. The second audio transformer fits in at the left, with the double mounting for the resistance coupled stage in back of it. A .01 mfd. fixed condenser clips conveniently into the base of the resister mounting. The ½-ampere Amperite, for the 112 power tube, goes between the second stage audio transformer and the panel. The N coil fits in at the far left of the baseboard up close to the panel, with the socket for the 112 tube behind it.

Eight Fahnestock clips for battery and speaker connections are evenly spaced between the left end of the baseboard and the antenna coil at the far right. The .00025 mfd. grid condenser with leak mounting can best be placed by re-

[1] Patent applied for.
[2] These can be obtained from the Patterns Department, Radio Mechanics, Radio Hill, Poughkeepsie, N. Y.

You'll like the N circuit set, for its design introduces some novelties of arrangement and appearance



moving one of the small bolts securing the stator plates of the variable N condenser and fastening the fixed condenser to the N condenser by means of the bolt.

The parts layout as shown on the wire-less wiring diagram is very satisfactory, both from an efficiency standpoint as well as for the fact that it is very easy to wire. The separate circuits are effectively spaced and isolated to prevent possible interaction. Every connection point in the entire assembly is readily accessible and consequently very easy to wire.

Filament Wiring

It is advisable to wire the filament circuit first, and the directions will be given according to that procedure. For a neat wiring job use stiff Celatsite. This wire is covered with insulation, and serves as a safeguard against possible short circuits and consequent tube blowout.

On the rear of the baseboard, clip No. 2 is the A —, C + lead. Run a wire from this to 2 on resistor No. 2, to F — on transformer No. 1, and to 1 on the variable resistance.

Connect terminal 1 of Amperite No. 1 to F — on socket No. 1, to the ground post of the antenna coil and to 1 on X-L condenser No. 1.

On Amperite No. 2, connect terminal 1 to F — on socket No. 2. This completes the wiring of the minus A line.

Clip No. 2 is the A +, B — line. Starting from this clip, run a wire to 1 on the filament switch. From 2 on the switch run a wire to F + on socket No. 2, and to F + on socket No. 1. This completes the wiring of the A +, B — line, and also completes the filament wiring.

Before going further, connect the A battery to clips 2 and 3, and insert a 1-A Amperite for No. 1 and a 112 Amperite for No. 2. Put the Multivalve in socket No. 1 and a 112 power tube in socket No. 2. These tubes should light, and be turned on and off by the switch. If not, you have made a mistake, and the filament wiring must be rechecked.

PARTS FOR THE N CIRCUIT

This list gives the parts used in the standard N Circuit design illustrated in this article. Some substitutions can be made, but the essential parts should not be changed.

- 1 Precision N coil.
- 1 Precision antenna coil.
- 1 Precision type N R. F. choke.
- 1 Precision type N variable condenser.
- 2 Samson A. F. transformers.
- 2 X-L variodensers, type G-10.
- 1 Electrad Royalty resistance, 500,000 ohms, type L.
- 1 Electrad filament switch.
- 1 Electrad double mounting.
- 1 Electrad .01-mfd. fixed condenser.
- 1 Electrad .00025-mfd. grid condenser, with leak mounting.
- 1 Electrad 5-meg. grid leak.
- 1 Electrad .1-meg. resistor.
- 1 Electrad .5-meg. resistor.
- 2 Pacent cushion sockets.
- 1 Amperite, 6-volt, ¼ ampere.
- 1 Amperite, 6-volt, ½ ampere.
- 1 Silver-Marshall vernier dial.
- 1 7 x 14 x 3/16-in. bakelite panel.
- 1 7 x 13 x ½-in. wood baseboard.
- 8 Fahnestock clips for battery connections.
- 1 Multivalve.
- 1 112 power tube.

Plate Wiring

Connect P on transformer No. 1 to 2 on the R.F choke. Connect P on socket No. 1 to 2 on resistor No. 2. Connect P on socket No. 2 to clip No. 8.

Wiring the B Battery Lines

When the filaments have been found to function properly, disconnect the A battery and remove the tubes. You are now ready to wire the B battery circuit.

Clip No. 1 is the 45-volt connection. From here, run a wire to B + on audio transformer No. 1. This completes the wiring of the plus 45 lead.

Clip No. 5 is the plus 90-volt clip. From here, run a wire to B + on transformer No. 2, which completes the wiring of the plus 90 lead.

Clip No. 6 is the 135-volt connection, and this runs to 1 on resister No. 2 and to clip No. 7. This completes the wiring of the 135-volt line.

Clip No. 4 is the C — binding post, and this connects to F — of audio transformer No. 2.

Secondary Wiring

Run a wire from the ANT post on the antenna coil to 1 on X-L condenser No. 2, and to the top terminal of the N coil and to 3 on the variable condenser. Connect 2 of X-L condenser No. 2 to 2 on X-L condenser No. 1; and to 1 on the R.F. choke.

Connect G on transformer No. 1 to G on socket No. 1. Connect G on socket No. 2 to G on transformer No. 2.

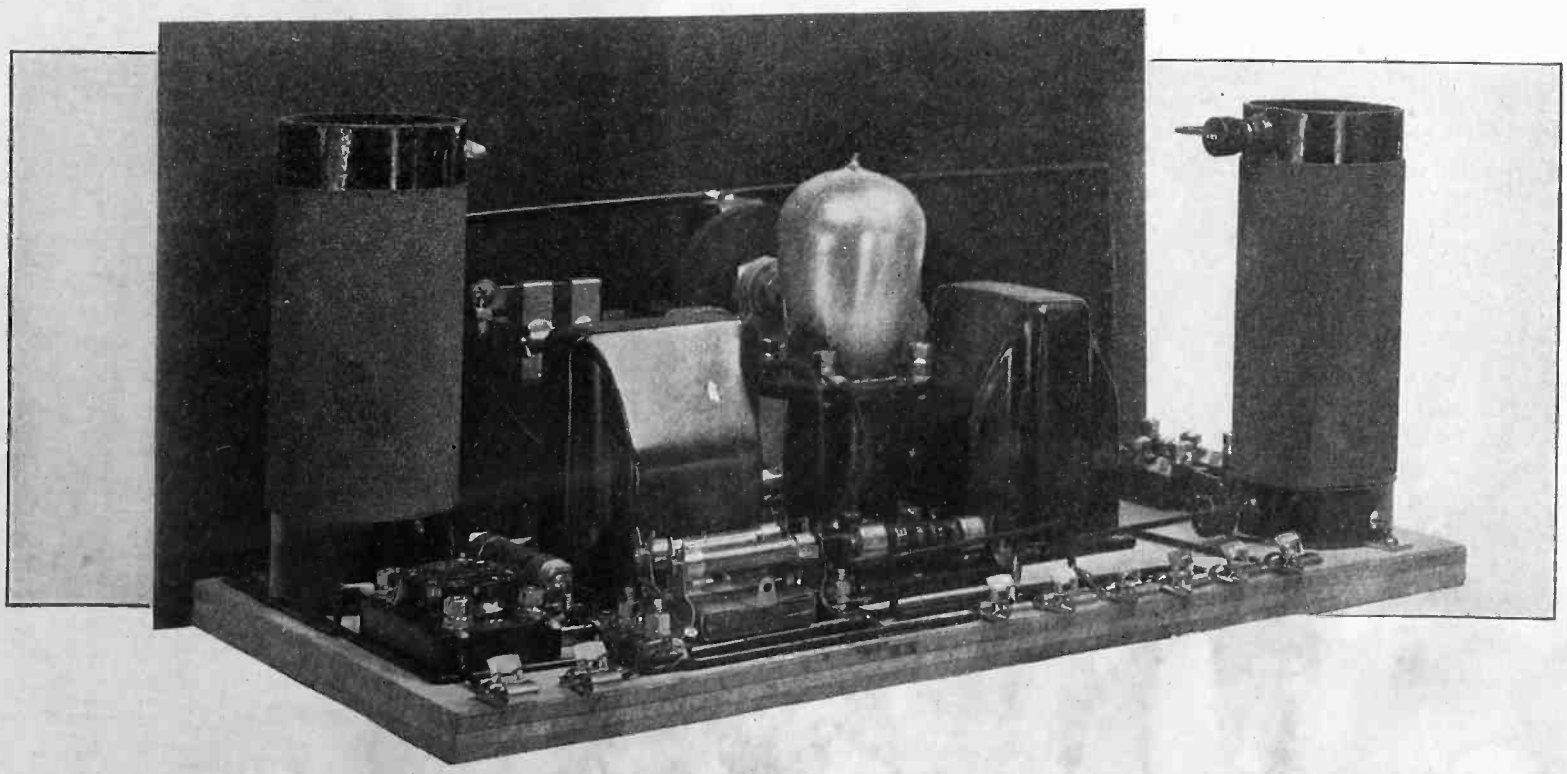
Wiring the Multivalve

Insert the Multivalve in socket No. 1. The ring on the base of the Multivalve has four terminals, marked P1 and P2, G1, and G2. These connections are wired as follows:

Connect P1 to 1 on the R.F. choke. Connect P2 to P on audio transformer No. 2. Connect G1 to 2 on the grid condenser, and connect G2 to 1 on resister No. 1.

The wiring of the receiver is now completed and, as soon as antenna, ground, batteries, and speaker are attached, it is ready for operation.

When you have studied this outfit and its circuit, you will have some new ideas for interesting experiments



MAKING LOW LOSSES LOWER

Are You Pursuing the Lowly Low Losses? If So, Try This Method of Reducing Dielectric Material in Your Coils

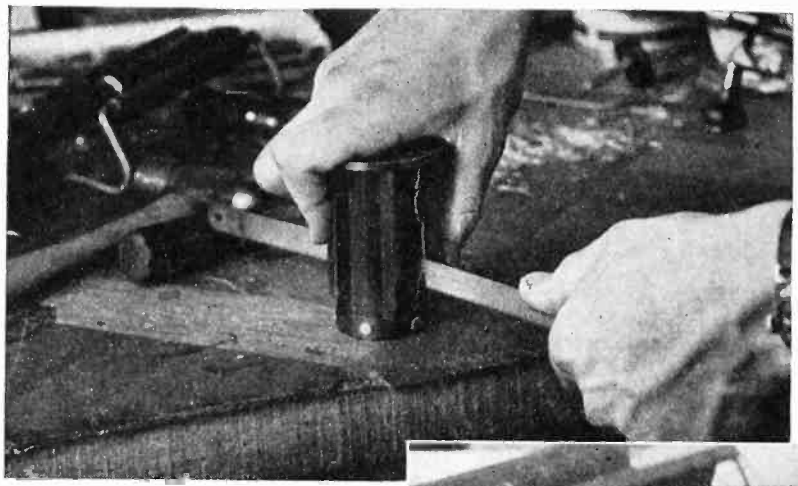
GERALD HEINZELMANN

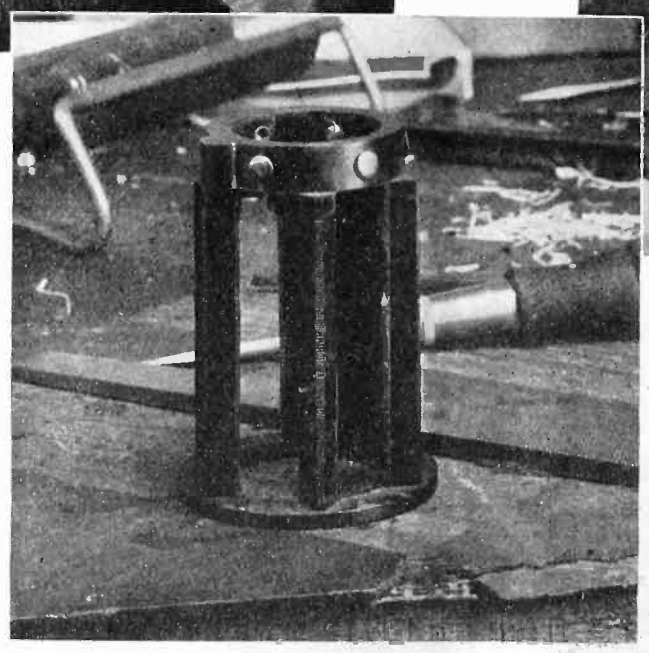
IF you, too, are a low loss bug, you may want to try a stunt which I use frequently for eliminating a little more of the small amount of dielectric that there is in the Silver-Marshall coil frames.

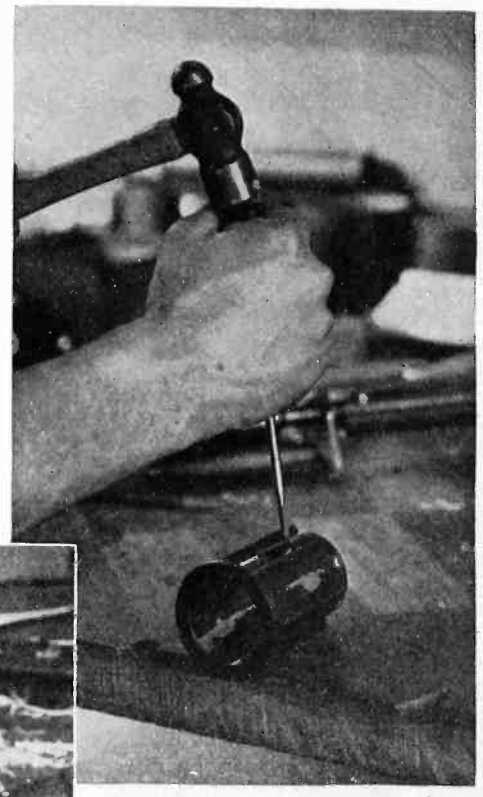
Mind you, I do not think that the elimination of losses at any one point in a radio circuit shows an appreciable effect in the loud speaker, but it is easy to demonstrate that the accumulative effect of eliminating loss at every possible point thru the entire system not only gives louder signals but sharpens the tuning as well.

The three photographs on this page show the method by which the Bakelite is cut out between the triangular strips.

First, I drill a number of small holes down the center of the thin wall. Then, with a hammer and screw driver, I open up just enough space to get a hack-saw blade started. This must be done on the opposite side, too, in order to get the blade thru, as is shown in the left-hand picture. After the wall has been cut out roughly, a little work with a coarse file smooths up the job.







At the right: Chipping out the thin wall, to start the hack-saw blade, after the holes have been drilled. Left: Cutting out the thin wall, close to the triangular strips. Center: A coil frame partly finished. A fairly fine file is best for this work, but it must be sharp, in order to cut the Bakelite. Be careful at all times not to split the end rings for much strain is put upon them while this work is in progress

On the frame illustrated, only the thin wall was removed. However, I have sometimes filed down the triangular strips into a rectangular cross section.

Moulded Bakelite is extremely strong, altho it must be handled a little gently or the end rings will crack on these forms. Filing down the strips to a rectangular cross section does not reduce their strength, for the pull of the wire as it is wound on is against the width.

Stunts of this sort are only justified when the set builder is consistent throughout, for it is very easy to work hard to cut down losses at a number of points and then slip up badly at another, with the result that the net effect will not be better than an average good job.

Another common cause of poor performance and noisy reception lies in poorly soldered joints. Many experimenters make the mistake of trying to solder directly to nickel-plated lugs or with a dirty soldering iron. Then, in order to overcome these handicaps, they smear the attempted joint with a profuse application of soldering paste. The result is a connection which is sure to corrode in time and cause leakage.

Never get pastes or acids for soldering flux. Rosin core solder is the best material for radio work. The iron must be hot, and the point should be cleaned frequently with a stiff wire brush.

RADIO PHYSICS COURSE

Chapter 4 — Describing the Action of the Vacuum Tube, and Clearing up Some of Its Mysteries

ALFRED H. GHIRARDI

POSSIBLY the greatest single invention in radio has been that of the vacuum tube—commonly called audion, valve, or, bulb. This versatile instrument, which is daily opening up new fields of application for itself in numerous branches of the industrial world, is the main backbone of the present radio art. It is used in transmitting stations for rectifying alternating current, and generating and modulating high frequency currents. In the modern receiver, vacuum tubes are employed for rectifying and amplifying the weak currents received by the antenna. They have also done a great deal toward solving the A and B battery elimination problem.

In appearance they resemble ordinary electric light bulbs somewhat, but in addition, contain a network of wires, known as the grid, surrounding the filament, and a strip of metal, called the plate, enclosing the grid. Connections to the various elements are made by prongs extending from the insulating base, Fig. 38. The operation of the three electrode vacuum tube as a detector and an amplifier can be understood better by first studying the various phenomena which control its action.

EDISON-EFFECT. In 1884 Thomas A. Edison, during the course of investigations on his incandescent lamp, discovered that when he took an ordinary incandescent lamp containing a filament, and introduced a second cold wire called a plate,

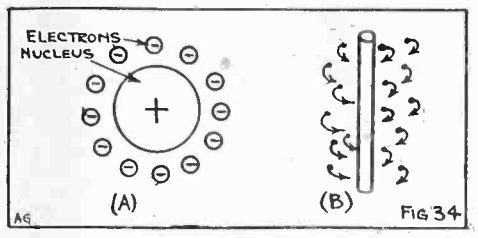
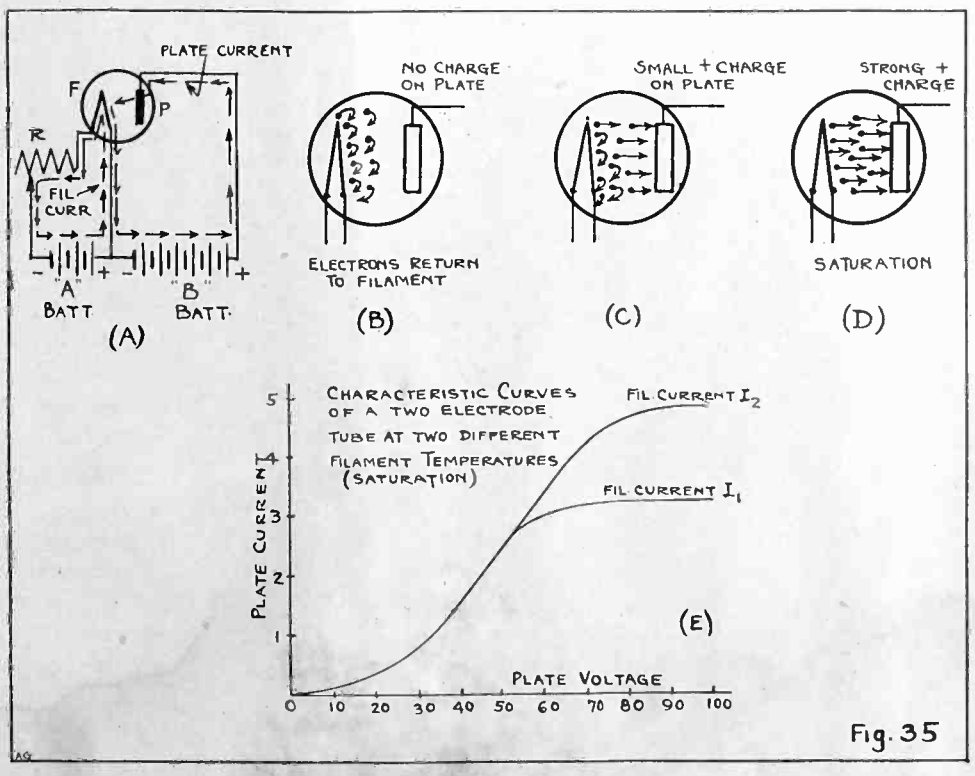


Fig. 34. A simple illustration of the distribution of electrons

insulated from the filament, and maintained at a potential positive with respect to the negative end of the filament, current flowed from this wire across the vacuum to the filament as long as the filament was incandescent. The current ceased as soon as the filament was allowed to become cold. If the wire was maintained at a negative potential with respect to the filament, no current flowed. This action has generally been known as the Edison Effect.

The effect was unusual but not deemed important at the time. It was taken up again years later by several other investigators.

Fig. 35. Illustrating some of the things which take place inside a vacuum tube



ELECTRON THEORY: The underlying principle governing the action is the electron theory of matter and electricity. All substances consist of myriads of atoms. Each atom in turn is made up of a center nucleus having a positive charge of electricity, around which revolves a number of small negative charges called electrons, shown in an elementary way in Fig. 34-A. Under normal conditions the positive charge of the nucleus is equal to the sum total of the negative charges around it, so that a state of balance exists and no external electrical manifestation is present. The chemical nature of the atom depends on the number and arrangement of its atoms, and the value of the positive charge of the nucleus of an element expressed in terms of the unit of electric charge is called the atomic number of the element.

At least one of these electrons is loose or free to circulate around among its neighbors, the number increasing with the conductivity of the substance.

ELECTRON EMISSION: As the temperature of the substance rises from absolute zero (-273 degrees Centigrade) the molecules begin to vibrate, their velocity increasing greatly as the temperature is raised. When the temperature is high it is relatively easier for the free, wandering electrons to become detached from their groups, and some of them, near the surface of the substance, are thrown off into

space. Thus there is an emission of free electrons from a heated body out into the surrounding space, forming a sort of cloud around it. Some substances give off electrons more freely than others as we shall see later.

When the electrons separate from the atom, the charge on the nucleus more than balances that of the remaining electrons, so that in an isolated body the free electrons are thrown off into space for a short distance and are attracted back by the unbalanced positive charge on the nucleus, somewhat as shown in Fig. 34-B.

As the temperature is raised, the agitation of the atoms increases, and electrons are boiled off into space at a faster rate. Since the electrons are negative charges of electricity, if a cold, positively charged body is placed near the hot substance emitting the electrons, they will be attracted to it and travel from the hot body to the positively charged body—since unlike charges attract. The space between the two bodies is then filled with a stream of free electrons moving from the hot body to the cold one. It was shown in Chapter 2 that free electrons in motion constitute an electric current, the direction of the current flow conventionally being considered as opposite to that of the electron flow. This means that an electric current is established in the intervening space.[1]

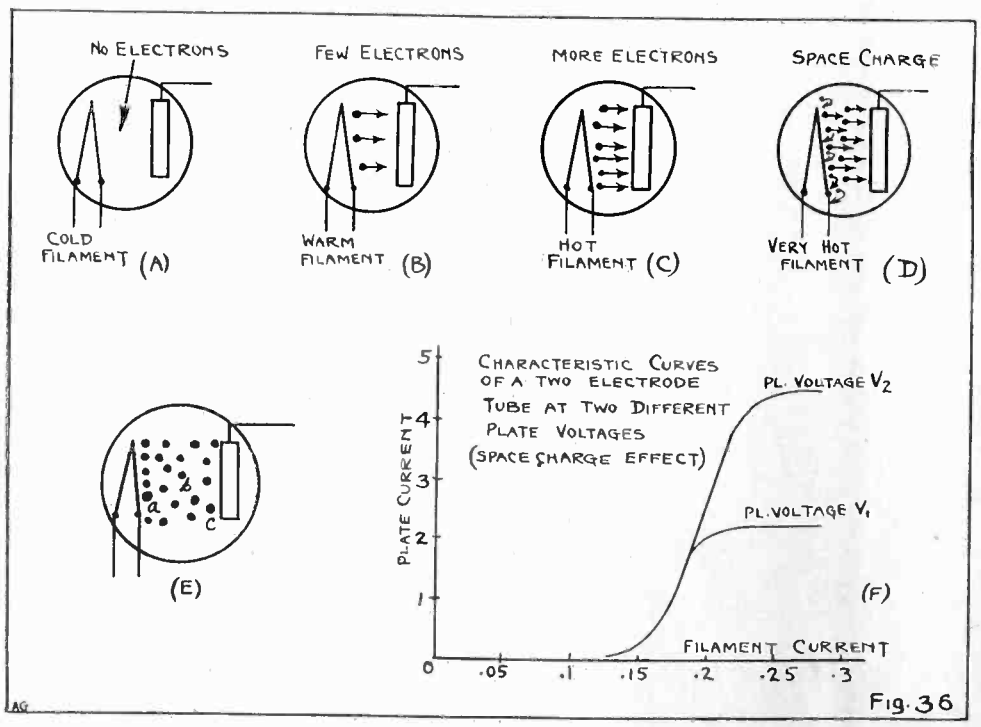


Fig. 36. The temperature of the filament controls the current flowing to the plate

Two Electrode Vacuum Tube: In 1890 Dr. J. A. Fleming made practical use of the Edison effect in his two electrode vacuum tube Fig. 35-A. F is a metal filament heated to incandescence by a source of current A, the current being controlled by a resistance R. B is a battery (source of potential) connected across the plate P and the filament. It serves to maintain the plate electrically positive with respect to the filament. Both the plate and filament are sealed in an evacuated glass bulb. As the filament is giving off free electrons and the plate has a positive potential, there is a flow of electrons from the filament to the plate, called the plate current.

[1] It is assumed in these discussions that the filament and plate are in a perfect vacuum. If a gas is present, ionization may take place, as explained later.

Saturation Current: If the filament temperature is kept constant, the number of electrons emitted by it per second will be constant. Some of these electrons are attracted to the plate by the positive plate charge and others go out into space for a short distance, only to be attracted back to the filament by the unbalanced electrical charge of the atoms. The proportion of the electrons attracted to the plate depends on the magnitude of the plate potential. When the filament temperature is kept at a constant value, and the plate potential is gradually increased, the number of electrons reaching the plate, and therefore the current in the plate circuit, will gradually increase. This will continue until a condition is reached where all of the emitted electrons are drawn over to the plate, so that a further increase of plate potential will not result in any increase of plate current. This maximum plate current, beyond which there is no increase for increased plate potential, is known as the saturation current of the tube for the corresponding filament temperature or plate voltage.

If the plate current is to be increased beyond this point, the filament temperature must be raised, thereby increasing the electron emission. For any given filament temperature then, there is a definite value of maximum plate current which can be obtained, occurring when the plate attracts the electrons at the same rate that they are emitted.

The action is shown by the graphs of Fig. 35-E, where the

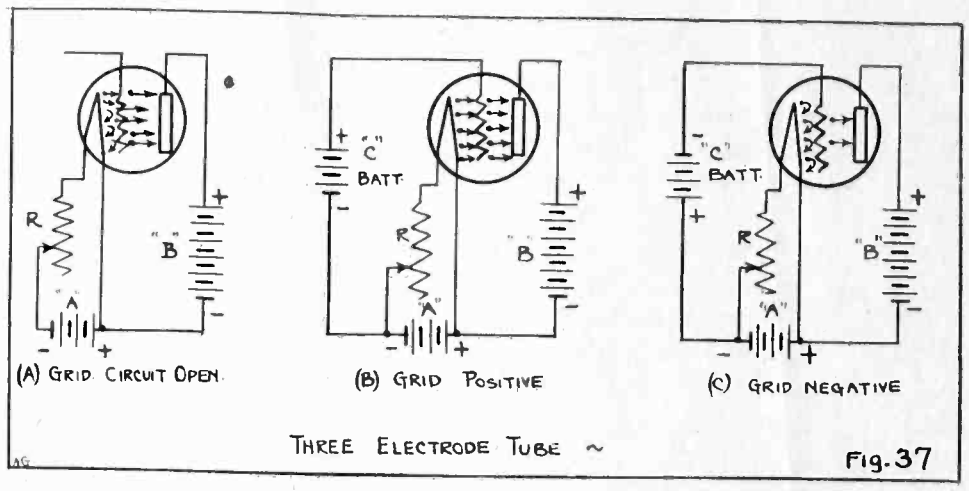


Fig. 37. What happens when a charge is put on the grid of a tube

plate potentials are laid out along the horizontal axis and the plate currents along the vertical axis. It will be seen that, for any fixed filament current or temperature, as the plate potential is increased the plate current rises up to the saturation point, where the curve bends over and becomes horizontal. It is evident that in order to obtain at the plate all of the emitted electrons, a certain minimum voltage must be impressed on the plate; increasing it beyond this does not result in any gain.

SPACE CHARGE: Now consider a tube with a fixed plate potential. When the filament is cold, since no electrons are being emitted, there is no current in the plate circuit, Fig. 36-A. If the filament is gradually heated, by increasing the current from the A battery, it begins to give off electrons when it has attained a dull red heat, Fig. 36-B. The number of electrons emitted by the filament increases approximately as the square of the excess filament temperature above red heat.

At any instant the space between the hot filament and plate contains those emitted electrons moving on toward the plate to be absorbed there. As the filament current is increased, Fig. 35-C, the rate of emission of these electrons increases so that at any instant the number of electrons present in the space between the filament and plate depends on the rate of emission by the filament and the rate of attraction by the plate. The steady increase of filament temperature increases the electron emission from the filament and also the number in the space. Since these electrons are negative charges of electricity, they act upon each other.

In Fig. 36-E let a, b, and c be three electrons occupying different positions in the space. Electron c is attracted by the plate, and is repelled toward the plate by all the electrons in back of it, since they have like

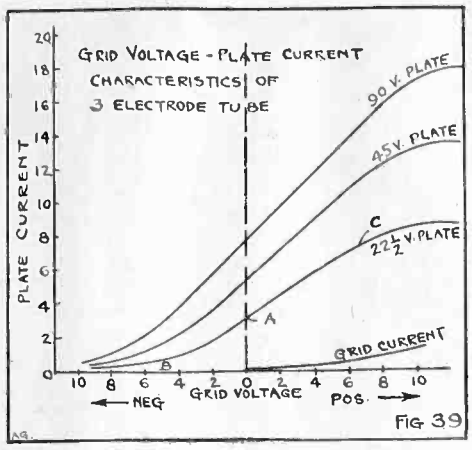
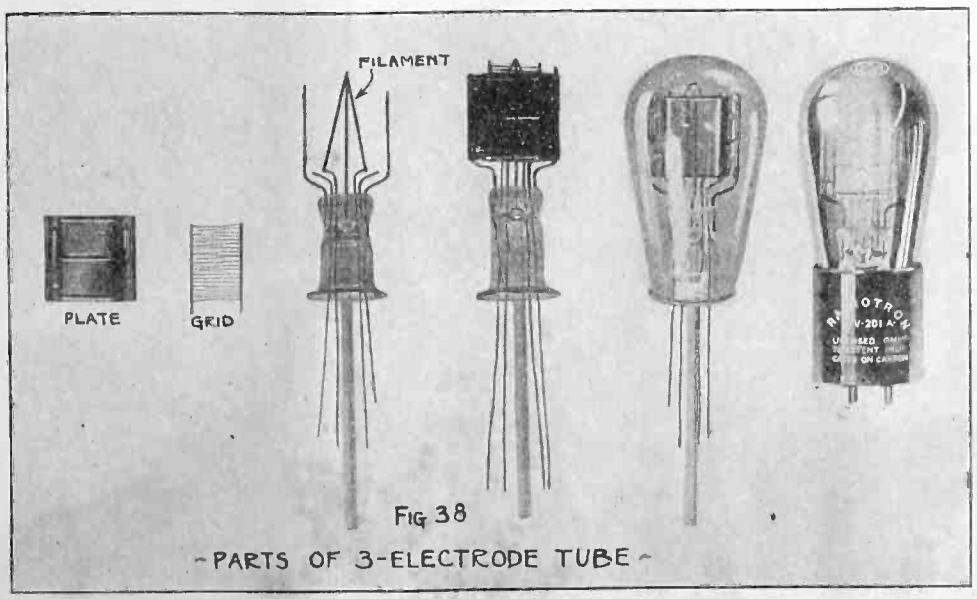


Fig. 39. With constant filament temperature, the filament-plate current depends upon the voltages on the grid and plate

charges, so it will undoubtedly go to it. Electron b is attracted by the plate, repelled back by the electrons in front of it and repelled toward the plate by the electrons behind it. Electron a is urged toward the plate by the hot filament, attracted by the plate, and repelled back by all the electrons between it and the plate. Whether it will move toward the plate or reenter the filament depends on which of these forces is the greatest. It is evident that when the electrons in the space become so dense that their combined negative charge—space charge—is equal to or greater than that of the plate, they neutralize the action of the plate and the electron flow to the plate cannot increase even though the temperature of the filament is raised. At this point any additional electrons in the space of the tube makes the space charge overbalance the plate charge and repell the excess emitted electrons back to the filament, as shown in Fig. 36-D. In order to increase the plate current at this point, the plate potential must be increased. Thus for every value of plate current, there is a certain value of filament temperature beyond which no increase in plate current can be obtained.

Fig. 38. Here are the separate elements of a tube, and the assembled device ready for use



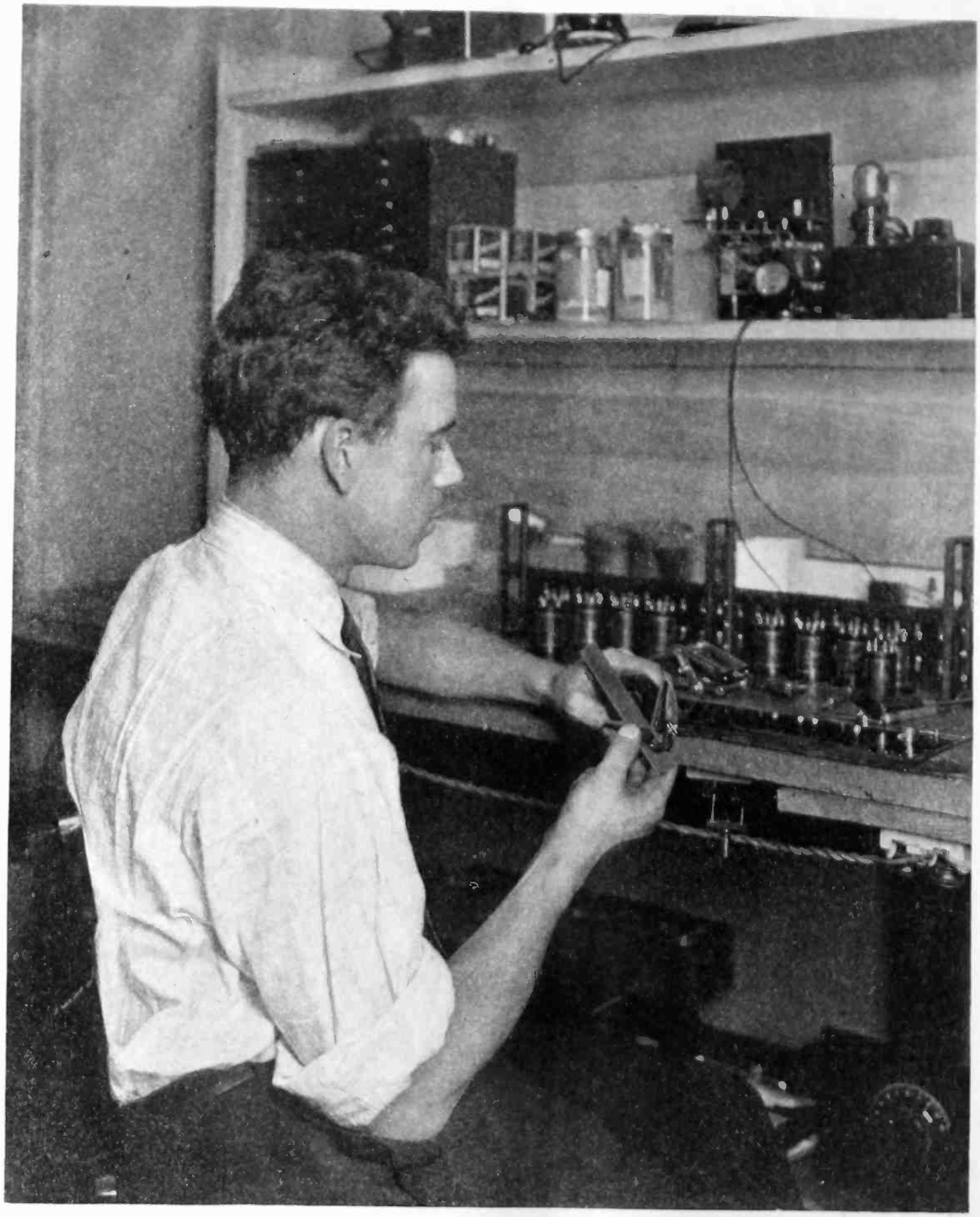
The phenomenon of space charge is illustrated in the graph of Fig. 36-F, where filament temperatures are plotted along the horizontal axis and plate currents along the vertical axis. For any given plate potential, the plate current increases as the filament temperature rises up to the point where the space charge becomes pre-dominant, where the curve bends over and becomes horizontal. If, now the plate voltage is increased to a new value, the plate current curve rises higher before bending over, because it takes a greater space charge to offset the effect of the plate at the higher potential.

The two-electrode tube described above was used in the early days of radio as a detector. When an alternating signal voltage is introduced in the plate circuit instead of the B battery, no current flows when the plate is made negative with respect to the filament, since the electrons do not leave the filament, on account of the repulsion from the plate; but current does flow when the plate is made positive.

THREE ELECTRODE TUBE: The two-electrode tube is hardly ever used in radio sets at present but, as will be shown later, it does find a very important application as a rectifier of alternating current.

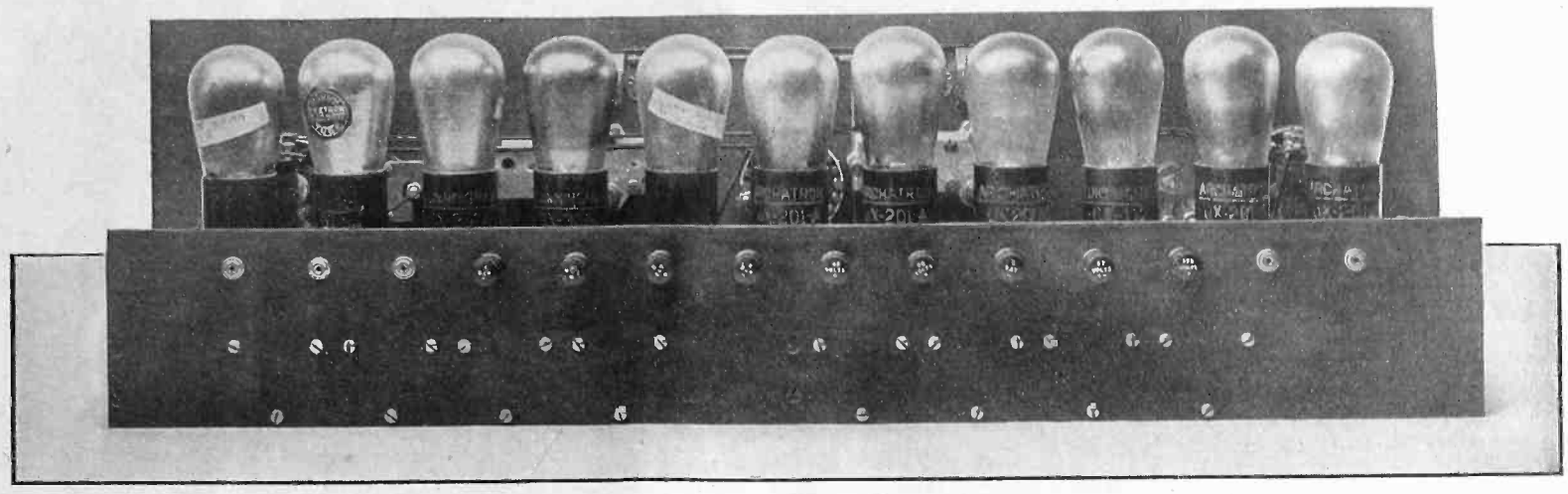
It has given way to the three-electrode tube developed by Dr. Lee DeForest in 1907. This tube is essentially the same as the former, but has in addition, a third electrode in the form of a metallic mesh, called the grid, which is interposed between the filament and

(*Concluded on p. 329*)



THE SUPER HOUND OF RADIO HILL

Any time Hollis de Neefe is missing from the office, it's a safe bet that he's up at the Laboratory, brewing a new super. Here he was discovered communing with the 'Leven.



HERE IS THE SUPER-LOOPER-'LEVEN!

Eleven Tubes Provide Uncanny Selectivity and Ability to Pierce Interference

HOLLIS DE NEEFE

BEFORE starting upon a description of the Super'-Loop-'Leven circuit, and the reasons for its design, you may be interested in the following tale of Mr. Whiffle, which really has a direct bearing upon our story. It is true that the incident recounted is a sad one, but it is also a fair portrayal of a common nightly occurrence in many of our American homes. It is entirely possible that, in each case, the tragic ending does not culminate in a destruction of furniture, but it is also probable that strained marital relations and even separations have resulted from unfortunate experiences such as we recount here.

THE SAD STORY OF MR. WHIFFLE

Mr. Whiffle drew his chair back from the table, and breathed a noisy sigh of satisfaction. It had been a hard day at the office, but the excellent evening repast set before him had considerably revived his drooping spirits. Leisurely he filled his pipe, and then shuffled over to the elaborate console which housed his beloved Profanadyne.

Between puffs at his pipe, Mr. Whiffle hummed gay snatches of the latest popular song hit. He made no bones about the fact that he was an ardent devotee of jazz, and he often spent whole evenings in trailing elusive night club orchestras up and down the dials. This particular night promised to be more entertaining, for him, than usual, for was not Paul Tightman and his orchestra broadcasting through WOE, scarce three hundred miles away?

After several adjustments of the various gadgets littering the front panel of his Profanadyne, Mr. Whiffle was rewarded with a raucous wail, which finally resolved itself into the closing strains of the popular dance number, "The Dog Disliked the Baby, So They Gave the Child Away." Then a familiar voice, saying "this is Lionel Larynx, announcing from station WOE."

"The next number on this evening's program will be 'Lard,' rendered by Oscar Philittoo, saxophone soloist of Paul Tightman's orchestra. Station WOE, Lionel Larynx announcing."

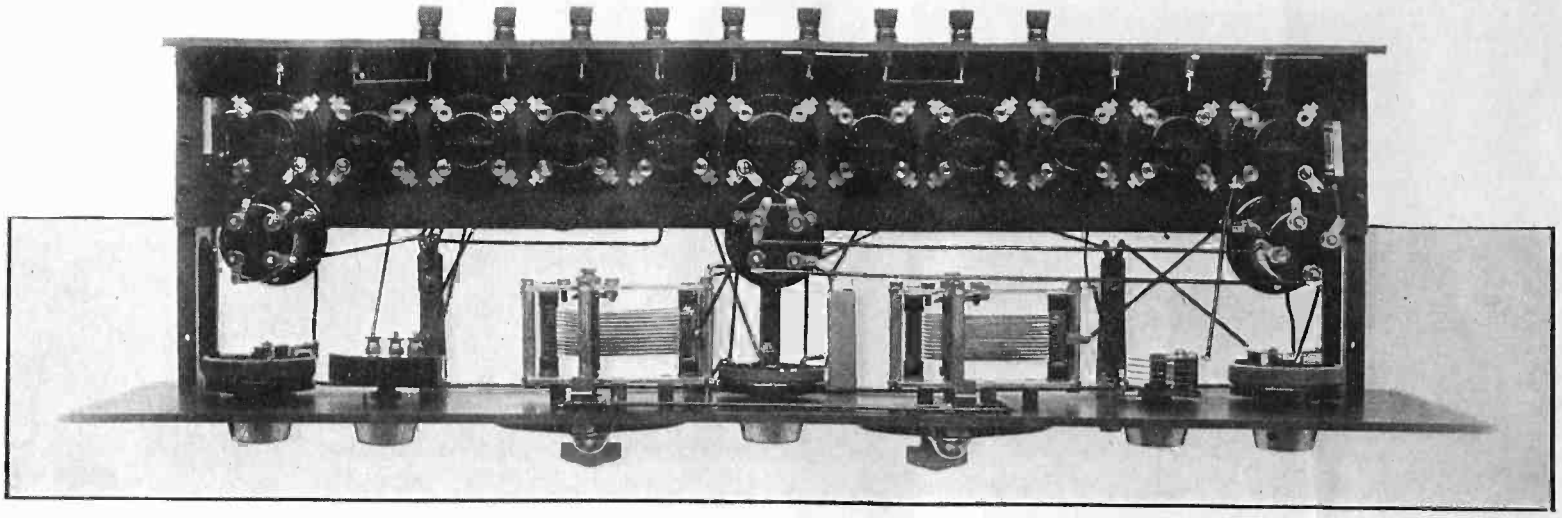
With a grunt of satisfaction, Mr. Whiffle sank into his easy chair, picked up the evening paper, and prepared to spend his idea of a perfect evening. But alas, his enjoyment was not for long. Scarce had the slick sound of "Lard" begun to soothe his ears, when the music was rudely drowned out by, "This is station WUSS, Ima Gaygirl speaking. The first part of our eight hour program this evening will be devoted to a two hour review of Parisian fashions. Please stand by."

Mr. Whiffle uttered a fearful curse, and sprang from his chair as if stung. So aroused was he that

LIST OF PARTS IN 11-TUBE SUPER

The following parts were used in the original model. Substitutions are not recommended, for they are liable to upset the circuit design:

- 1 Melocoupler, type 160 R. F.
- 1 Melocoupler, type 120 R. F.
- 6 Melocouplers, type 135 R. F.
- 3 Meloformers.
- 11 General Radio UX sockets.
- 1 Tinytobe .01-mfd. fixed condenser.
- 1 Tinytobe .00025-mfd. fixed condenser.
- 1 Tinytobe .002-mfd. fixed condenser.
- 2 Tobe 1.-mfd. bypass condensers.
- 1 2 megohm Tobe vacuum Tipon leak.
- 5 Yaxley pup jacks.
- 9 Eby binding posts, marked as follows: A—, A+, B—, B+45, B+90, B+180, C+, C—, C—40.
- 2 Amsco .0005-mfd. S. F. L. Allocating condensers.
- 1 Amsco orthophone.
- 1 Aalco loop.
- 2 Yaxley 2-ohm rheostats.
- 1 Yaxley 400-ohm potentiometer.
- 1 Centralab 500,000-ohm modulator.
- 1 Silver-Marshall type 276 long-wave choke.
- 1 Silver-Marshall type 340 midget condenser.
- 1 Carter Hold-Tite jack switch, 2 springs.
- 1 Carter Hold-Tite jack, type 104, double circuit.
- 3 Garfield Radion brackets.
- 2 National Velvet Vernier dials, type C.
- 1 Bakelite or hard rubber front panel, 7 x 26 x 3/16-in.
- 2 Bakelite or hard rubber subpanls, 3½ x 24 x 3/16-in.
- 50 Ft. Acme Celatsite wire.



he spluttered and almost strangled before he could utter a word.

"That blankety danged local again," he bellowed. "That brainless bunch of nincompoops and mugwumps will ruin my reception of anything besides their dadburned, five-watt, bottle blowing, o v e r-m o d u l a t e d fraudcaster! Where's that axe?"

And so it was that the passers-by, in the vicinity of the ordinarily peaceful Whiffle bungalow, were struck dumb with amazement by the sounds of splintering wood and glass, and by the sight of the enraged Mr. Whiffle pitching the remnants of his once beloved Profanadyne through the shattered window.

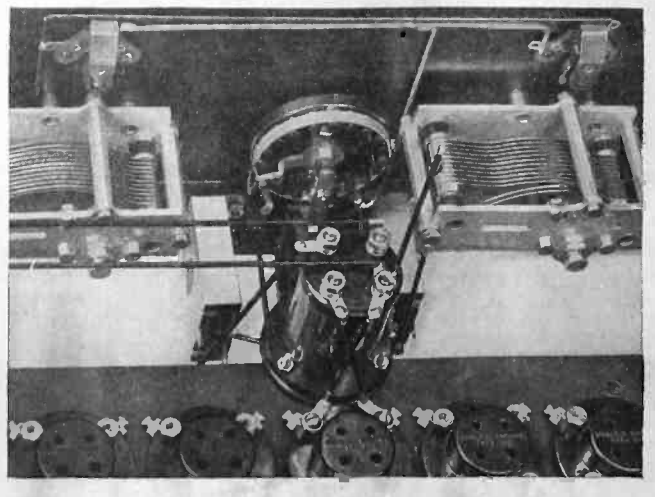
Perhaps, even as Mr. Whiffle, you have been troubled with interference, and your reception of a quality program from a distant broadcaster has been rudely interrupted by some mediocre local. If so, the Super-Looper-'Leven described here will be a godsend to you.

In the Super-Looper-'Leven, knifelike selectivity is combined with tremendous power. Not only are the locals separated with ease, but distant stations are brought in between them. Naturally, you would expect such performance from an eleven tube receiver, and this one will not disappoint you. There are various circuit features that may interest you, so we will call your attention to some of them.

The tubes in the 'Leven are used as follows: First, comes the first detector, which receives the signal impressed upon it by the loop, which is tuned by the first variable condenser. In order to make this tube very sensitive, regeneration is used, and is controlled by the midget condenser. As the capacity of the midget condenser is increased more radio frequency is fed back, through the loop, from the plate to the grid of the tube, and the signals are greatly amplified thereby. The use of regeneration also sharpens the tuning of the loop circuit, and is an essential aid to greater selectivity in congested districts.

You will notice on the schematic diagram that a coil is also connected between one side of the loop and the grid of the first detector. This is the pickup coil of the oscillator and, by means of it, a frequency generated by the oscillator is fed into the grid of the detector tube, mixed with the frequency to which the loop is tuned, and a difference, or beat frequency is produced which is the difference between the two original ones. This operation is called heterodyning, and is the action from which the super-heterodyne derives its name.

Above: Top of the Super-Looper-'Leven. Below: Center section detail, showing transformer mounting



You see that we now have a signal of lower frequency, or higher wavelength, which can be amplified more efficiently by the intermediate tubes. These are five in number, and the amplifying action takes place through the transfer of energy from one tube to the next by the intermediate transformers.

After the beat frequency has been highly amplified by the intermediate tubes, it is rectified by the second detector tube. You will notice that no grid leak or condenser is used here, however, because a grid leak condenser combination has a tendency to overload or block under strong signals. Therefore, the detecting action in this tube is obtained by means of a negative bias placed upon its grid by a C battery. This method of detection possesses considerably more handling capacity, as well.

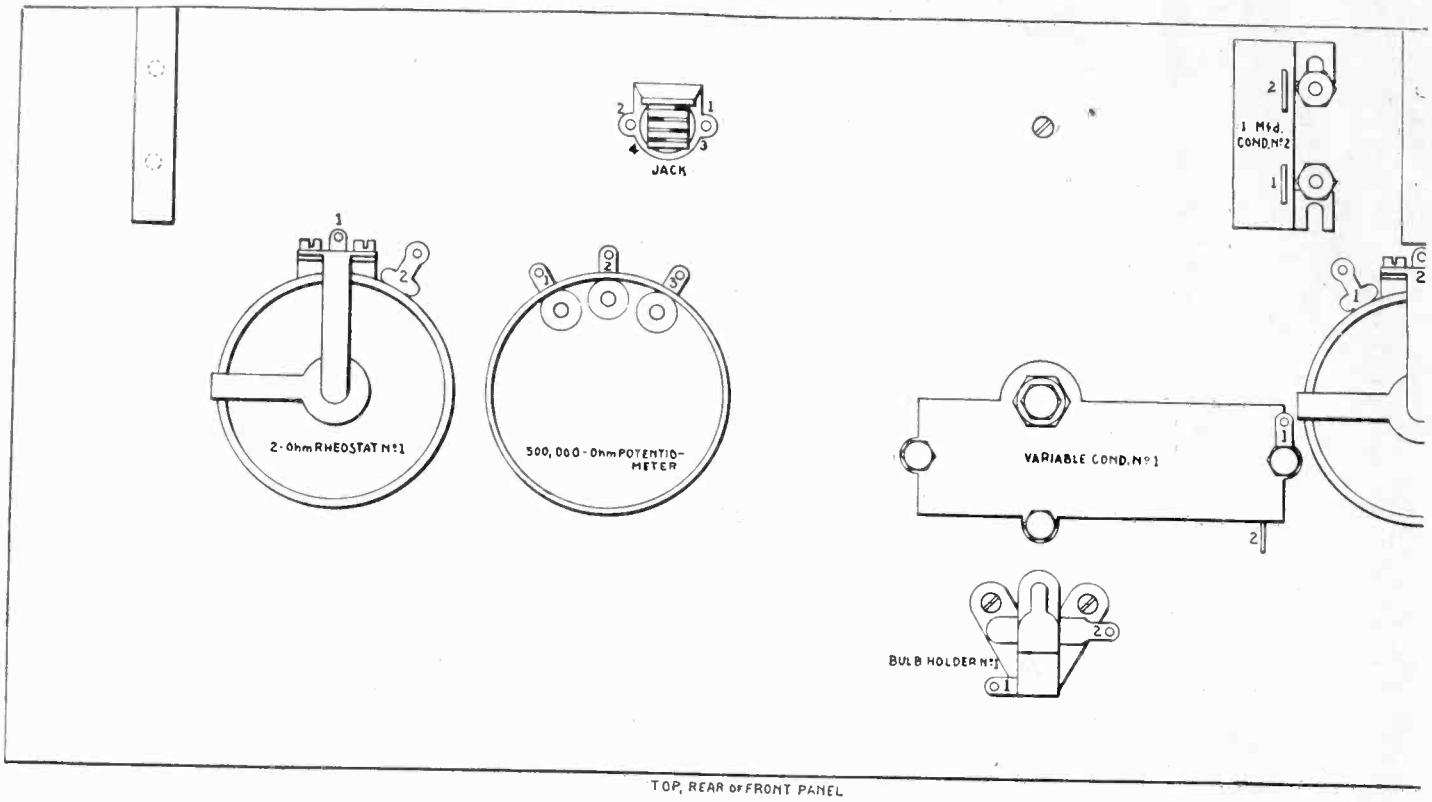
After passing through the second detector the signals would be audible if headphones were inserted in the plate circuit of this tube, but they would not be strong enough for satisfactory loud speaker reception. Therefore, they are further intensified by three stages of t r a n s f o r m e r coupled a u d i o frequency amplication, so that anything which it is possible to hear at all in the detector circuit will be amplified to full loud speaker volume.

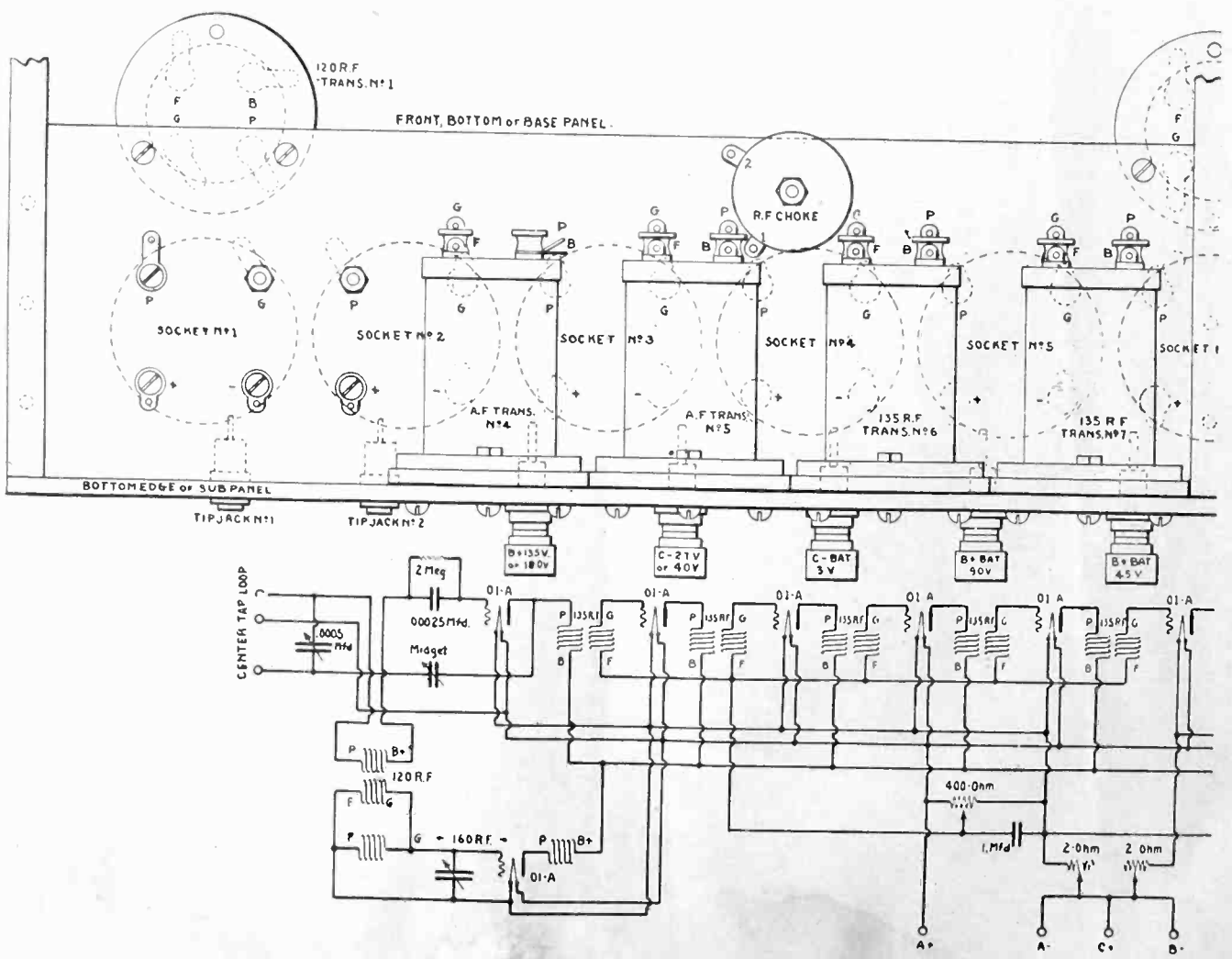
Battery Requirements

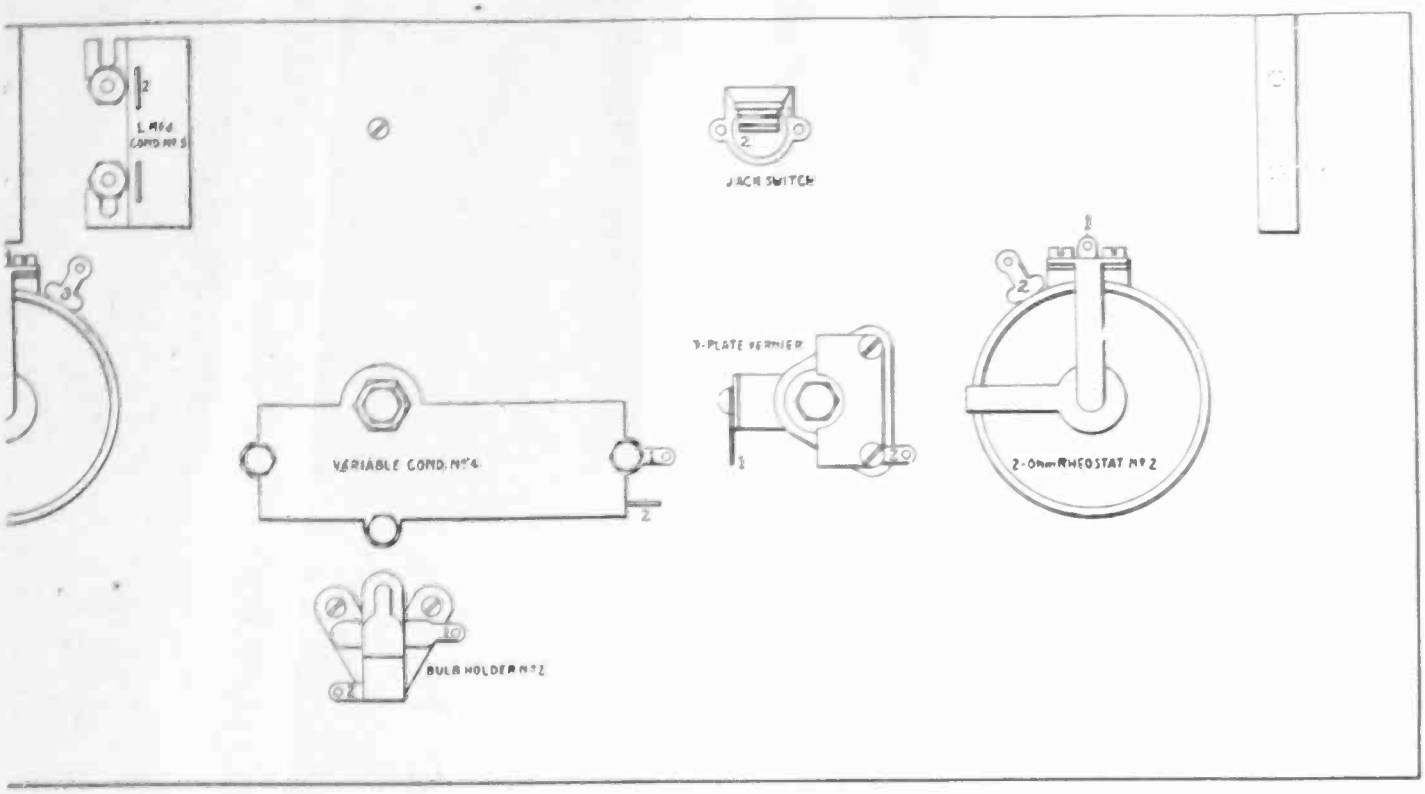
The circuit, then, is a superheterodyne, consisting of an oscillator, first and second detectors, five stages

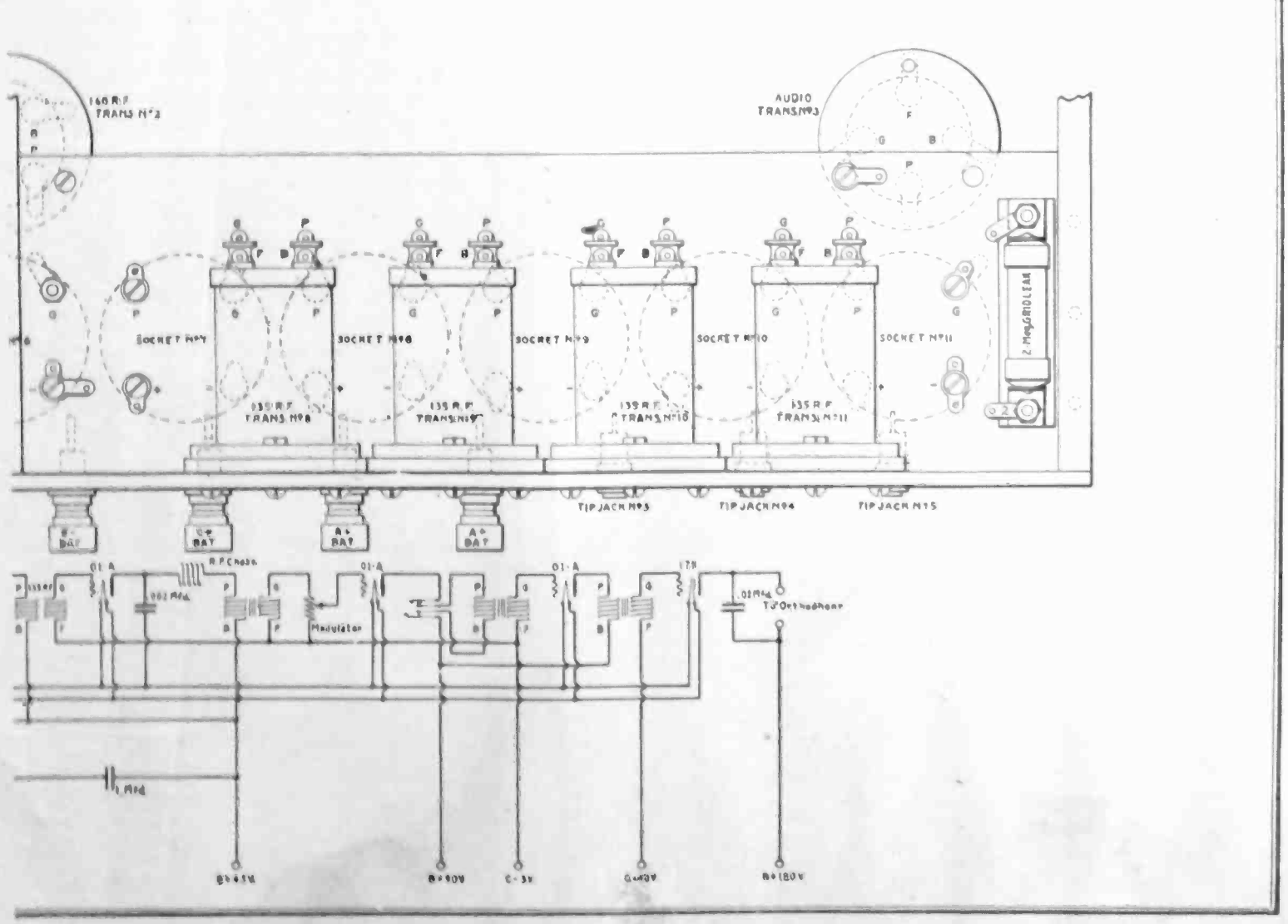
SET IT AND LEAVE IT

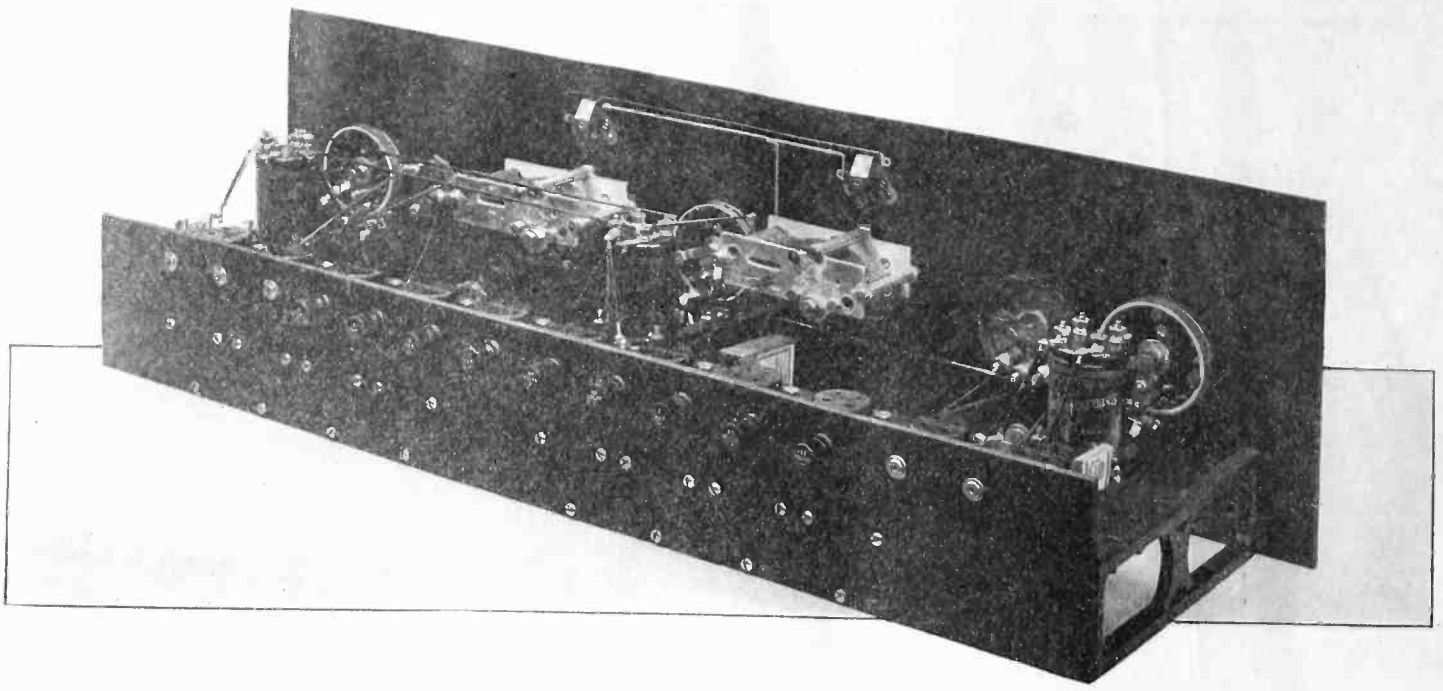
Even Dad stops to wonder when we surprise him by putting real DX on the speaker down stairs. Here is an Amplion, connected thru an Amsco Orthophone output device


JACK
1 Mfd. COND. N°2
2-Ohm RHEOSTAT N°1
500,000-Ohm POTENTIO-METER
VARIABLE COND. N°1
BULB HOLDER N°1
TOP, REAR OF FRONT PANEL


120 R.F. TRANS. N°1
FRONT, BOTTOM or BASE PANEL
R.F CHOKE
SOCKET N°1
SOCKET N°2
SOCKET N°3
SOCKET N°4
SOCKET N°5
A.F TRANS. N°4
A.F TRANS. N°5
135 R.F. TRANS. N°6
135 R.F TRANS. N°7
BOTTOM EDGE OF SUB PANEL
TIP JACK N°1
TIP JACK N°2
B+135V. or 180V
C-27V or 40V
C-BAT 3V
B+ BAT 90V
B+ BAT 45V
CENTER TAP LOOP
2 Meg
.00025 Mfd.
Midget
.0005 Mfd
120 R.F
160 R.F.
01-A
400-Ohm
1 Mfd
2-Ohm
2 Ohm
A+
A-
C+
B-


JACK SWITCH
VARIABLE COND. N°4
3-PLATE VERNIER
2-OhmRHEOSTAT N°2
BULB HOLDER N°2


160 R.F TRANS N°2
AUDIO TRANS N°3
SOCKET N°7
SOCKET N°8
SOCKET N°9
SOCKET N°10
SOCKET N°11
135 R.F TRANS N°8
135 R.F TRANS N°9
135 R.F TRANS N°10
135 R.F TRANS N°11
2 MegaRIOLEAK
TIP JACK N°3
TIP JACK N°4
TIP JACK N°5
B- BAT
G+ BAT
A+ BAT
A+ BAT
01-A
R.F Choke
.002 Mfd
Modulator
.01 Mfd
T.2 Orthophone
1 Mfd
B+45V
B+90V
C-3V
G+4V
B+180V



Right hand rear end of the set, and a detail of the transformer and controls

of intermediate frequency amplification, and three stages of transformer coupled audio frequency amplification. You can appreciate that, since eleven tubes are used, it is important to employ a large storage battery. Do not attempt to use the small trickle charger variety of battery, for the heavy current drain will run it down so quickly that reception will be uncertain and noisy, and the battery may be seriously damaged.

On the other hand, the B battery current drain is not excessive. For all local and moderately distant reception 25 volts will be sufficient on the 45-volt binding post, and the drain will be reduced accordingly. However, when it is desired to obtain the maximum results from the receiver it is advisable to increase this voltage to 45 or 50 volts. If dry batteries are used, you should get the heavy duty type, especially if a 171 tube is used in the output.

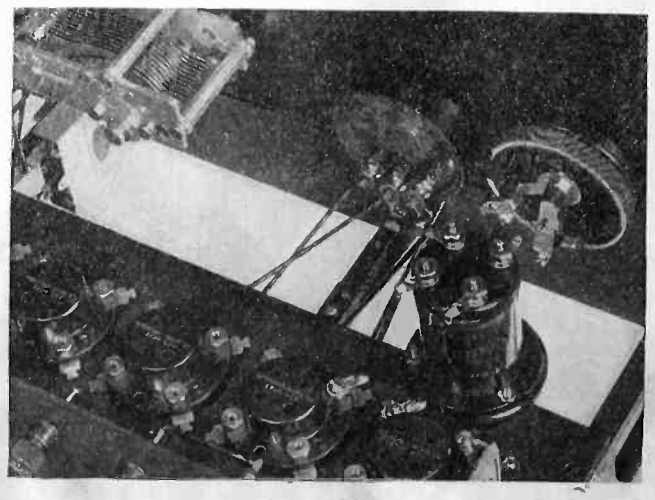
Any good B eliminator will operate this set satisfactorily. In fact, all of our laboratory tests were made with a B eliminator attached to the 'Leven. Storage B batteries also work excellently, so that you have a wide variety of power sources available from which to choose.

Tube Combinations

For everything up to the second stage of audio, the 201-A type is satisfactory. It is suggested that a 112 be used in the second audio stage, and a 171 in the output. However, you will notice that no output coupling device is used between the power tube and speaker. Therefore, if 180 volts are applied to the 171, it is vitally important to attach a coupling device, such as the Amsco Orthophone, to the loud speaker tip jacks and to plug the loud speaker into the Orthophone. This will protect the loud speaker windings against damage by the heavy plate current of the power tube. Battery binding posts are provided for the necessary B and C voltages for a power tube, so that any kind of a tube can be used in the output without circuit changes.

Mechanical Details

I worked for many weeks on a suitable design for the Super'-Loop-'Leven. You will admit that it is no small feat to build an eleven tube set on a 7x26 front panel and a 3½ by 24 sub base without crowding the parts or encountering circuit complications. I finally solved the problem by mounting eight of the transformers under the sub base, and in such a position that extremely short grid and plate leads were possible. This system is not only efficient, but it possesses the further advantage that most of the wiring is concealed, and the finished job presents a very neat appearance.

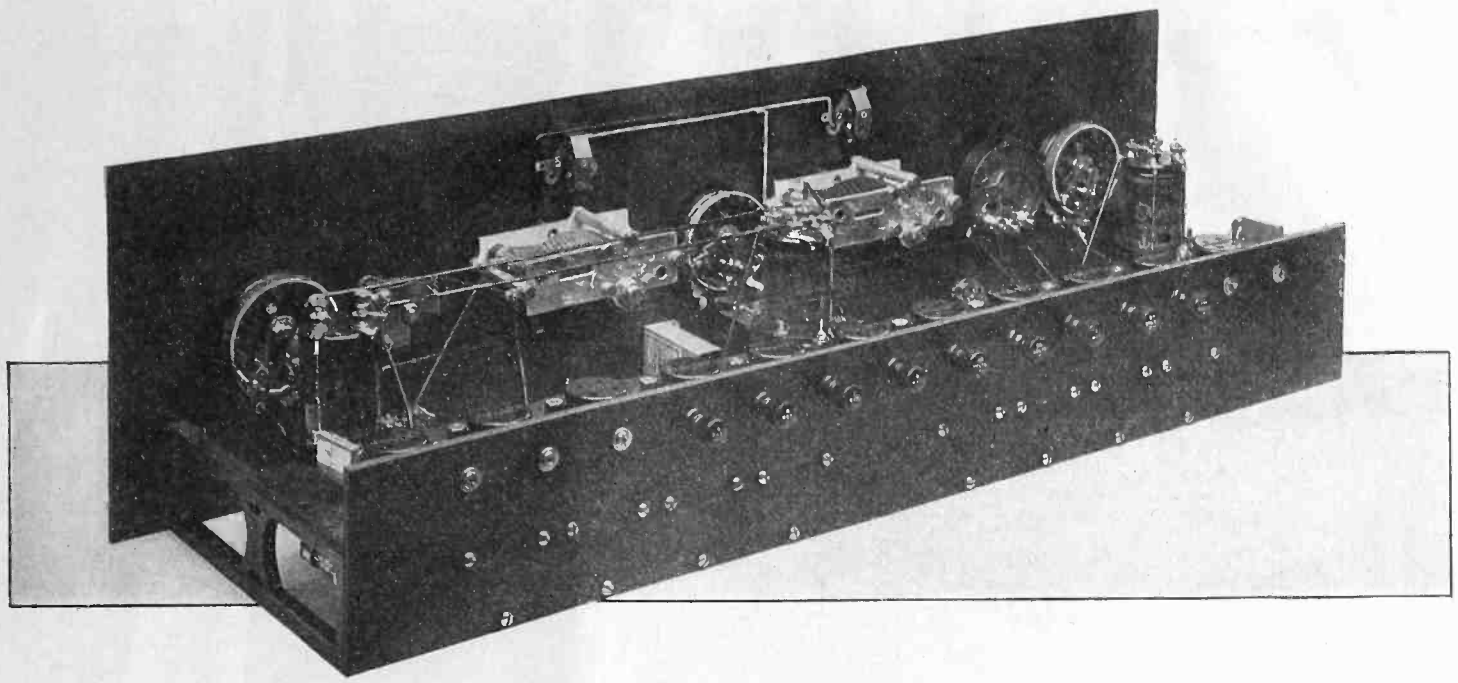


A jack is provided after the first audio stage, so that a power amplifier can be plugged in, if desired. In this connection, you can use the Quality Amplifier[1] described in the November issue, the 171 Compact Eliminator[1] which appeared in January, the 210 Compact[1] described in March, or the Glo-liminator[1] which appears in this issue. The modulator used across the first audio transformer secondary controls the volume whether the regular audio channel or a power amplifier is used.

Operating Instructions

For one thing, you will not be bothered with the antenna annoyance on the Super'-Loop-'Leven. A loop is the only pickup device necessary for the powerful and sensitive receiver. However, it is essential that a good loop be used in order to realize the maximum results of which the receiver is capable. An Aalco loop is recommended, for it provides excellent pickup, is

[1] Dataprints available.



Left hand rear end. Note the lug connection at the base of the transformer, and the condenser mounting

provided with the necessary center tap, and folds conveniently into almost any shape desired so that the proper value of inductance can be obtained. The two outside connections on this loop are connected to the two outside tip jacks, and the center tap is connected to the center tip jack.

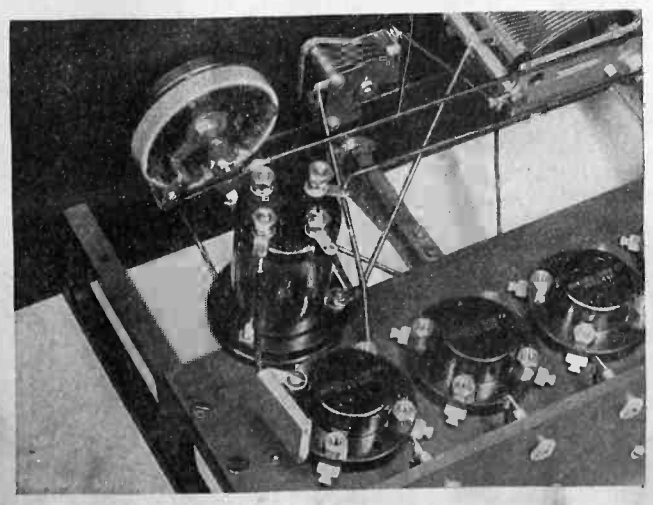
Binding posts are provided for all the battery connections, so that it is not necessary to cross connect the batteries or the eliminator. When hooking up the batteries, it is advisable to use 180 volts on the 135-volt binding post, and 40 volts of C battery on the C-27 post. This assumes the use of a 171 tube in the last stage, and this tube is necessary to handle the heavy output of the 'Leven. In this case, however, you must protect the loudspeaker windings against damage by the heavy plate current of the 171. An easy solution of this difficulty is to plug an Amsco Orthophone into the loudspeaker tip jacks, and then plug the speaker into the Orthophone. The speaker is then protected, and its handling capacity will be increased and the quality of reproduction will be considerably improved.

When the batteries, loop, and loudspeaker have been connected, you are ready to operate the 'Leven. Switch on the filaments, and turn both rheostats about three quarters on. Now, if the potentiometer is advanced to the negative side, the intermediates should go into oscillation, and squeals should be heard if the oscillator dial is rotated. Back the potentiometer slightly away from this point.

If the capacity of the midget variable condenser is increased too far, the first detector will oscillate. The midget condenser should be set just below the point of oscillation, in which position the circuit will be in its most sensitive condition.

With these preliminary adjustments made, set the loop tuning dial at about 50, and very slowly rotate the oscillator dial from about 30 to 70. If nothing is heard, set the loop dial at 52, and again slowly swing the oscillator. Continue this operation until a station is picked up—which will not be very long if one is on the air—and then retune both dials for maximum signal strength. Now adjust the rheostats to the best operating point.

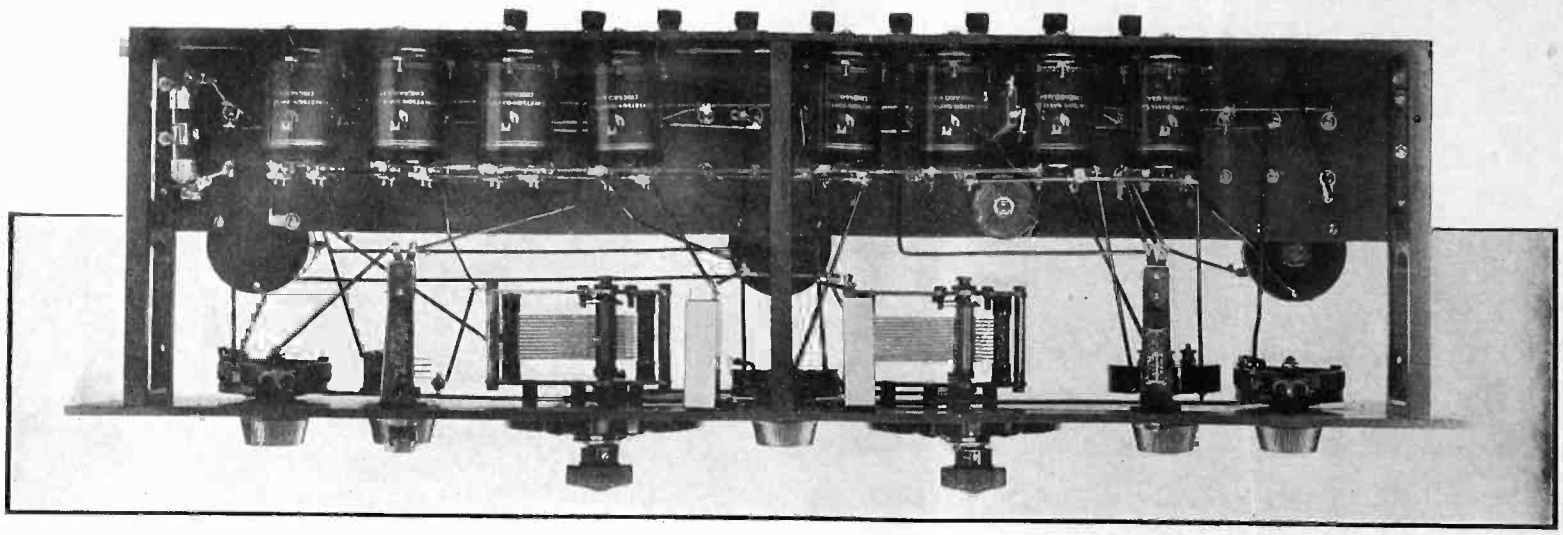
Remember that the sensitivity of the set is controlled by the midget condenser and the potentiometer, while the volume is regulated by the potentiometer and the modulator. Do not play with the rheostats after you have found the best setting for them, for it is bad practice to regulate the output of this receiver by varying the filament current.



The loop should be rotated until a point is found at which the signal strength is at maximum. This is important, for the loop is very directional on account of the regeneration in the first detector circuit. Never forget to swing the loop particularly when tuning for distant stations, for it is possible to completely eliminate even a comparatively nearby station by turning the loop at right angles to it.

The jack can be used for headphones if desired, although it is primarily intended for a power amplifier. It should never be necessary to use headphones on this receiver if it is carefully tuned, for anything picked up on the loop will be amplified to full loud-speaker volume.

Do not expect phenomenal results the first time you set up the 'Leven, for you must learn its operating characteristics and master the method of tuning. When you have become thoroughly familiar with its operation, you will be delighted with the results. All stations received can be logged, and it is a simple matter to reset the two tuning dials to the correct numbers for any given broadcaster.



It's just as good looking underneath. It has to be, for otherwise trouble would develop on such a set as this

Front Panel Assembly and Wiring

Mount the following parts on the front panel: Two 6-ohm rheostats, 500,000-ohm potentiometer, two 0.0005 mfd. condensers, 400-ohm potentiometer, two dial-lighting brackets, two 1-mfd. by-pass condensers, double circuit jack, jack switch, and 7-plate vernier condenser.

Starting at the left hand end of the panel, when it is in the position shown in the wire-less wiring diagram, connect 1 on rheostat No. 1 to 1 on rheostat No. 2.

Connect 1 on condenser No. 1 to 1 on condenser No. 2. Connect 1 on condenser No. 2 to 1 on condenser No. 3, and connect this lead also to 3 on the potentiometer.

Connect 1 on bulb No. 1 to 1 on bulb No. 2; connect 2 on bulb No. 1 to 2 on bulb No. 2; and run a wire from this last lead to 1 on the potentiometer. Also, run a wire from 1 on bulb No. 2 to the lead from 1 on rheostat No. 1 to 1 on rheostat No. 2.

Connect 1 on condenser No. 4 to 1 on the vernier condenser, and connect 1 on the switch to 1 on rheostat No. 2.

Base Panel Assembly and Wiring

Mount the center bracket under the base panel. Note that special holes must be drilled in the bracket. You may find it easiest to drill No. 31 holes in the brackets and put 6-32 screws right in them without threading the holes.

Mount the eleven sockets, all with the G and P posts toward the front edge. Note that the sockets are fastened by screws put in from under the base panel and up into the terminals.

Mount the grid leak clip, R. F. choke, 120 R. F., 160 R. F., and A. F. transformer.

Starting at the left again, connect all F + terminals of the sockets together, and connect together the F — terminals of sockets Nos. 1, 2, 3, 4, and 5. Then connect together the F — terminals on sockets 6, 7, 8, 9, 10 and 11.

Connect a .01-mfd. Tinytobe across the P and F + terminals of socket No. 1. Connect G on socket No. 1 to G on transformer No. 1.

On socket No. 2, connect P to P on transformer No. 1.

On socket No. 4, solder P to terminal 1 of the R. F. choke, and between P and F + connect a .002-mfd. Tinytobe.

On socket No. 6, connect P to P on transformer No. 2, and G to G on transformer No. 2.

On transformer No. 2, connect G to G on transformer No. 3, and connect F to F on transformer No. 3.

On socket No. 11, connect G to 1 on the resister mounting, F — to 2 on the resister mounting, and between G and B + on transformer No. 3 connect a .00025-mfd. Tinytobe. At terminal 1 on transformer No. 3, put a lug on the mounting screw on the flange of the case, and another under the base panel. Connect P on the transformer to the upper lug 1.

Sub Panel Assembly and Wiring

On the sub panel mount the five tip jacks, nine binding posts, and eight transformers. The locations of these parts are given in the wire-less wiring diagram. Note that Lastites are used on the binding posts to simplify connections.

Connect tip jack No. 2 to + 135V, and C + BAT to A — BAT.

LIST OF ACCESSORIES RECOMMENDED FOR THE 11-TUBE SUPER-HETERODYNE

The accessories listed here have been given thorough test in conjunction with the receiver described. Therefore, it is recommended that the builder follow this list in order to obtain the maximum results from the set.

1 Amplion cabinet cone speaker.
10 Archatron 201-A tubes.
1 Archatron 112 power tube.
1 Amsco Orthophone.
1 Aalco folding loop.
1 Accurate B eliminator.
1 6-volt storage battery, 120-amperehour, any good make.
1 Acme battery cable.
1 Balkite battery charger.

Connect together the F — posts on transformers Nos. 4, 5, and 6. Connect F — on transformer No. 5 to C — BAT, thru a hole in the sub panel.

Connect together the B + posts of transformers Nos. 5, 6, 7, 8, 9, 10, and 11. Make the connections on transformers Nos. 5, 6, and 7 temporary, as they must be removed when the center bracket is fastened to the sub panel. Connect B + on transformer No. 7 to + 45V.

First Inter-Panel Assembly

Fasten the sub panel to the base panel. Now the fun begins. Get your iron well tinned, for there is some difficult soldering ahead.

Connect tip jack No. 1 to P on socket No. 1. Connect F — on transformer No. 1 to C — 40V.

On transformer No. 4, connect G to G on socket No. 2, and P to P on socket No. 3.

On transformer No. 5, connect F to C — 3V, and P to 2 on the R.F. choke.

On transformer No. 6, connect G to G on socket No. 4, and P to P on socket No. 5.

On transformer No. 7, connect G to G on socket No. 4; connect P to P on socket No. 7; and connect B to B + 45V.

Connect B BAT — to — on socket No. 6. Connect A BAT + to + on socket No. 7.

On transformer No. 8, connect G to G on socket No. 7; connect P to P on socket No. 8; and connect B to B on transformer No. 2.

On transformer No. 9, connect G to G on socket No. 8 and connect P to P on socket No. 9.

On transformer No. 10, connect G. to G on socket No. 9, and P to P on socket No. 10.

On transformer No. 11, connect G. to G on socket No. 10, and P to P on socket No. 11.

Connect tip jack No. 4 to — on socket No. 11, and tip jack No. 5 to the underneath lug at 1 on the base of transformer No. 3.

Second Inter-Panel Assembly

Fasten the base and sub panels to the front panel.

Connect 2 or rheostat No. 1 to — on socket No. 1.

(*Continued on page* 328)

BILL AND BUD ARE BUSY

Working Overtime, Bill Sent Us Only a Short Note This Month

DEAR EDITOR: Bud and I have been pretty much tied up lately with the result that we have not been able to get off our monthly letters. This is just a note to go along with a picture of a very nice installation we made recently.

I am sending this picture to show you that our spare time business of installing radio sets is past the stage where we can get our customers most any kind of an outfit and install it in the easiest way.

Folks are getting mighty fussy now.

We have made up a clipping book from manufacturers' catalogues so as to show the appearance of the outfits. Then we explain what the different sets can do. In that way, we make sure of giving them the kind of performance and the sort of installation that they want, in a form which will satisfy them as to its appearance.

This Bosch outfit, with a wall type speaker, was picked out from our clipping book that way, and it certainly has made a hit since we got it in operation.

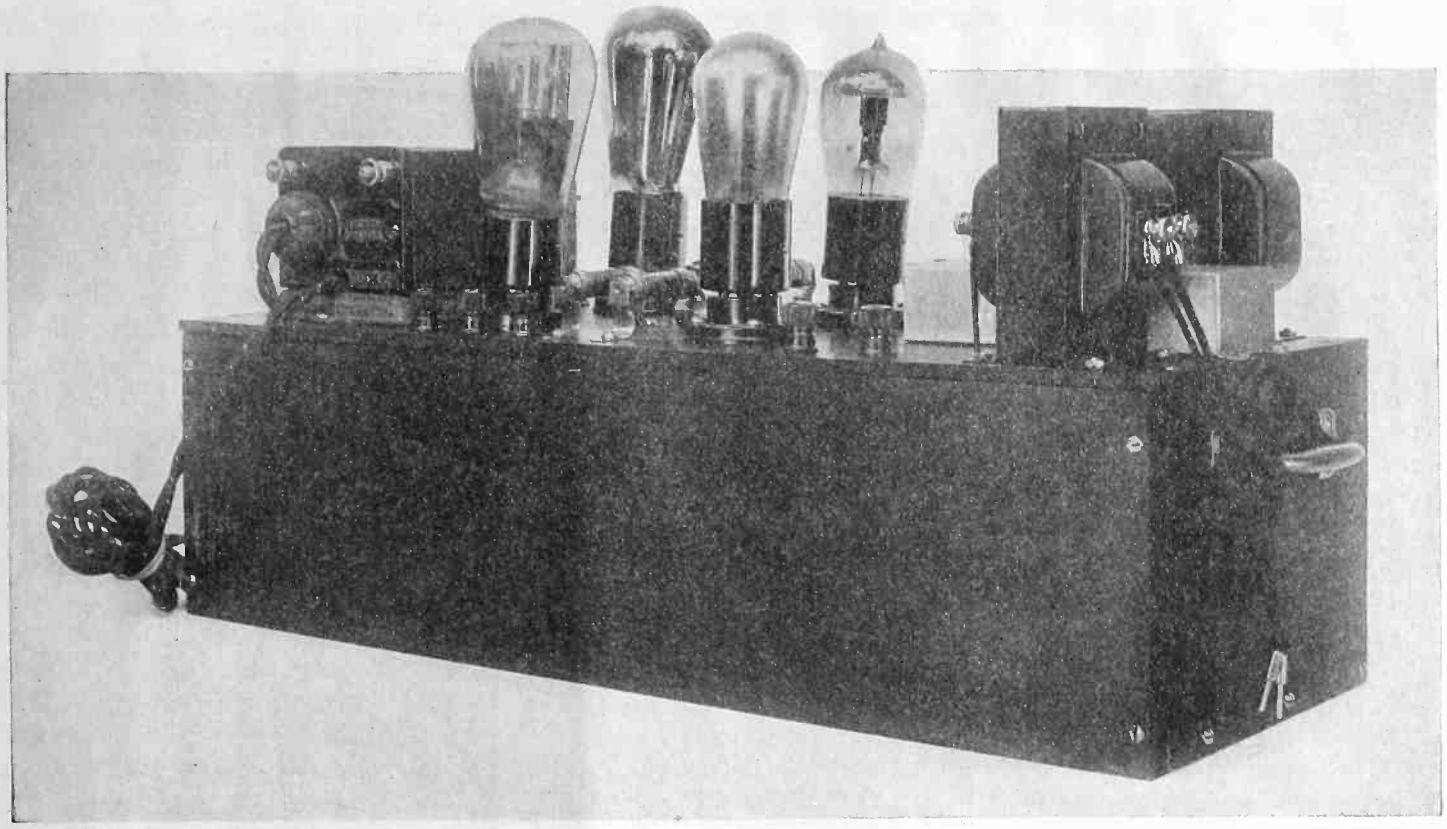
Now that we have such good equipment to instal, and since folks are learning how well it pays to want good stuff, if the new Commission will just do some things to straighten out the broadcasting stations, we'll have real radio reception.

Yours for better air conditions,

Bill

QUALITY BEGINS AT THE POWER SUPPLY

The finer the loud speaker, the more perfect the set, the more important is the power supply. The Glo-liminator is almost perfect



GLO-LIMINATOR—FINEST POWER PACK

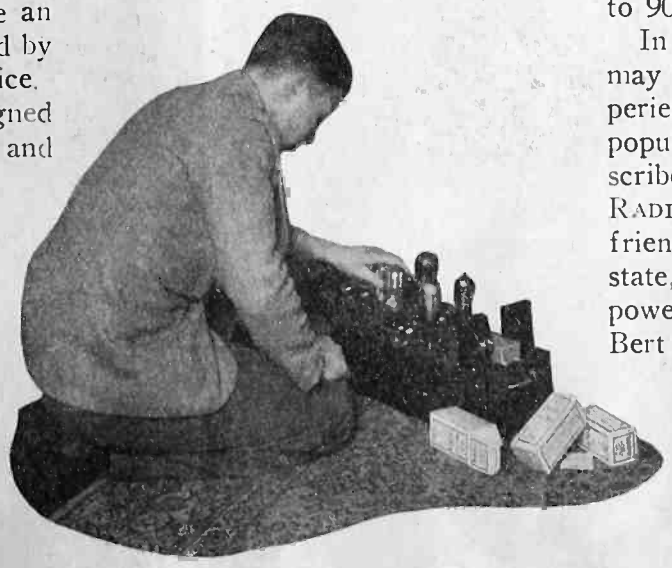
For Highest Quality Results from the Radio Set and the 171 Power Amplifier Tube

HAROLD ODELL

THE heading of this article carries a pretty strong statement, does it not? In order to fulfill this claim, it is evident that we must have something pretty good in the way of a combined B eliminator and power amplifier. True enough, we have. The Glo-liminator possesses all of those features that every owner of a B eliminator has wished for, and by following these simple instructions, you can easily assemble it in your home workshop. When completed, you will have an outfit which cannot be duplicated by any factory-built job at any price.

The Glo-liminator was designed to furnish quality amplification and unvarying B supply to any set, whether it be a three-tube regenerative receiver or a high-powered eleven-tube super-heterodyne. There is no guesswork connected with its operation. You merely attach it to your storage battery, trickle charger, and receiver, plug the cord into a convenient light socket, and forget it.

Let the line voltage vary if it will, and draw more or less B current by varying your potentiometer or filament rheostats if you wish, but the voltages of the Glo-liminattor will remain as steady as the voltage of fresh B batteries. Beside, the Glo-liminator effects a considerable saving in filament current, for it supplies the half-ampere filament of the power tube direct from the A. C. line, and also supplies the necessary 40-volt C bias to this tube as well as the B potential.



If you are familiar with the action and characteristics of the ordinary B eliminator, you know that its output varies a great deal, depending upon the amount of current drawn from it and the variation in the A. C. supply. The last named is often a serious consideration in outlying districts and rural communities, where 105 volts A. C. may vary, within a few hours, down to 90 volts or up to 125.

In connection with the above, you may be interested to hear of the experience of Bert Smith, whose popular New Day Set was described in the November issue of RADIO MECHANICS. One of Bert's friends, living in a small town up state, wanted a B eliminator and power amplifier, and called upon Bert to build it for him.

Now, when it comes to radio Bert knows his onions. You can readily imagine his surprise then, when the 171 power tube "went West" shortly after he hooked up

the unit in his friend's home.

"Well," said Bert, "that dealer sold me a bum bottle, I guess, so we'll try another one."

The second tube gave up the ghost in even shorter time than its unfortunate predecessor. By this time, Bert was getting pretty mad, and was ready to call down the wrath of the gods upon everything radio in general and power units in particular. Realizing, however, that he was up against a most unusual condition, he decided to trace the whole layout from the source.

The trouble was located immediately. When Bert put an A. C. meter on the line, he found that the line voltage registered 137, a 28 per cent increase over its rated value! In order to prevent further occurence of the same mishap, he found it necessary to put a heavy duty resistance in series with one leg of the A. C. input, so as to decrease the impressed primary voltage to a reasonable figure.

Nothing on this order can occur with the Glo-liminator, however. Two glow tubes, wired in series, are shunted across the output. Since each of these tubes holds its respective output constant at 90 volts, two of them deliver exactly 180 volts, which is the correct maximum B voltage for the 171 power tube.

Since the two glow tubes are in series, we can use their junction for a constant 90 volt tap. Now, 90 volts is somewhat too high for our detector, but still we do not want to put in a series resistance, for there is too much chance for fluctuation and unstable operation.

In order to obviate this trouble, a fixed resistance of 50,000 ohms is connected from the 180-volt to the 45-volt post, and a 25,000 ohm resistance is connected from this point to B —. You can see these connections clearly illustrated in the schematic diagram. These resistances, connected in shunt to the output as they are, furnished a very steady 45-volt potential, and the glow tubes assist in maintaining this voltage constant.

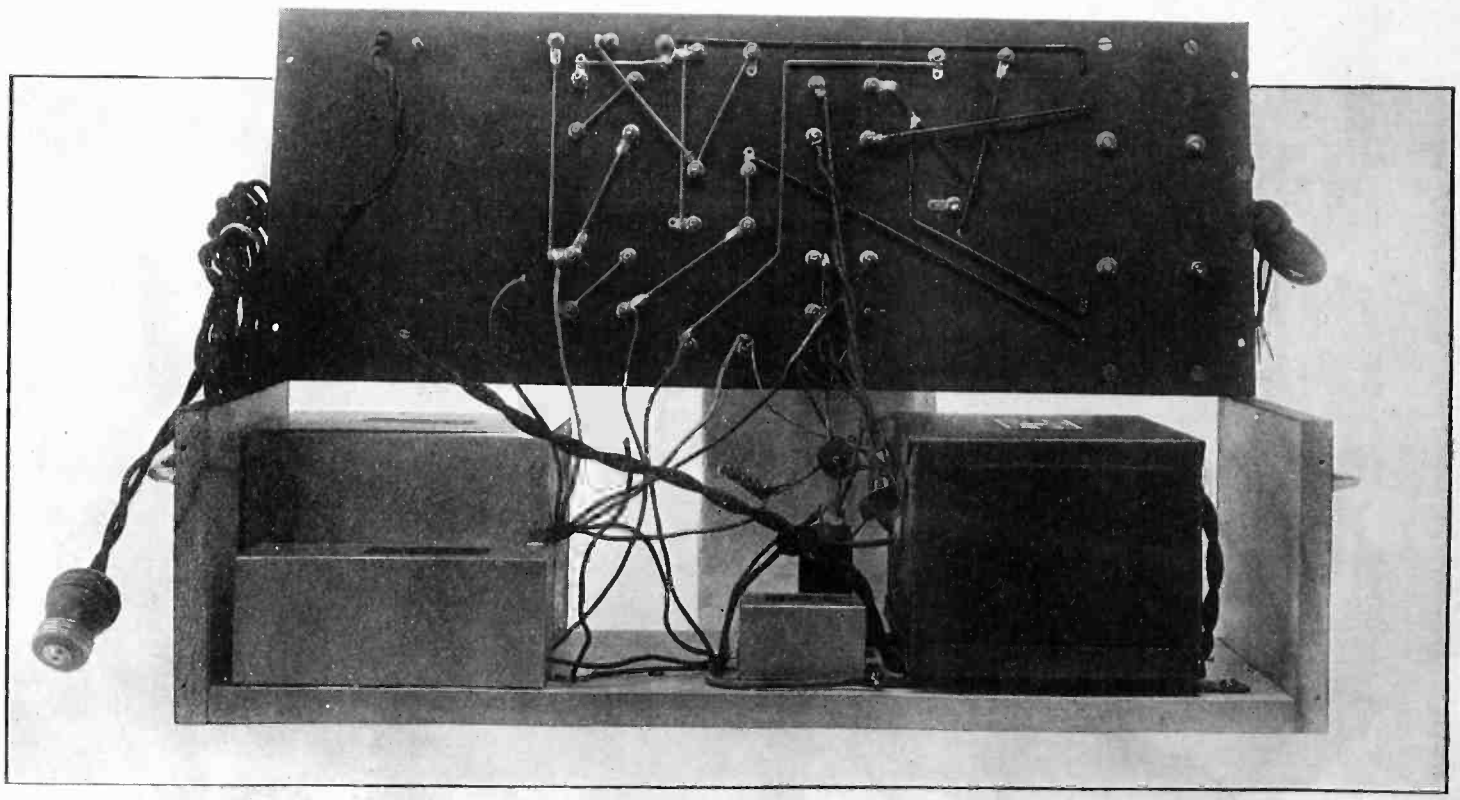
In some cases, however, the value of the 50,000 ohm resistance may have to be changed. Many multi-tube receivers, particularly super-heterodynes, draw B current for a number of tubes from the 45-volt tap. If such a set is to be used with the Glo-liminator, the 50,000 ohm resistance should be replaced with various lower values until the best operating conditions are found, after which this resistance need not be changed again.

To those who do not care to experiment with various values, it is recommended that a Clarostat be substituted for the 50,000 resistance. This variable resistor will not alter the characteristics of the circuit in any way, and it will permit the user to instantly adapt the

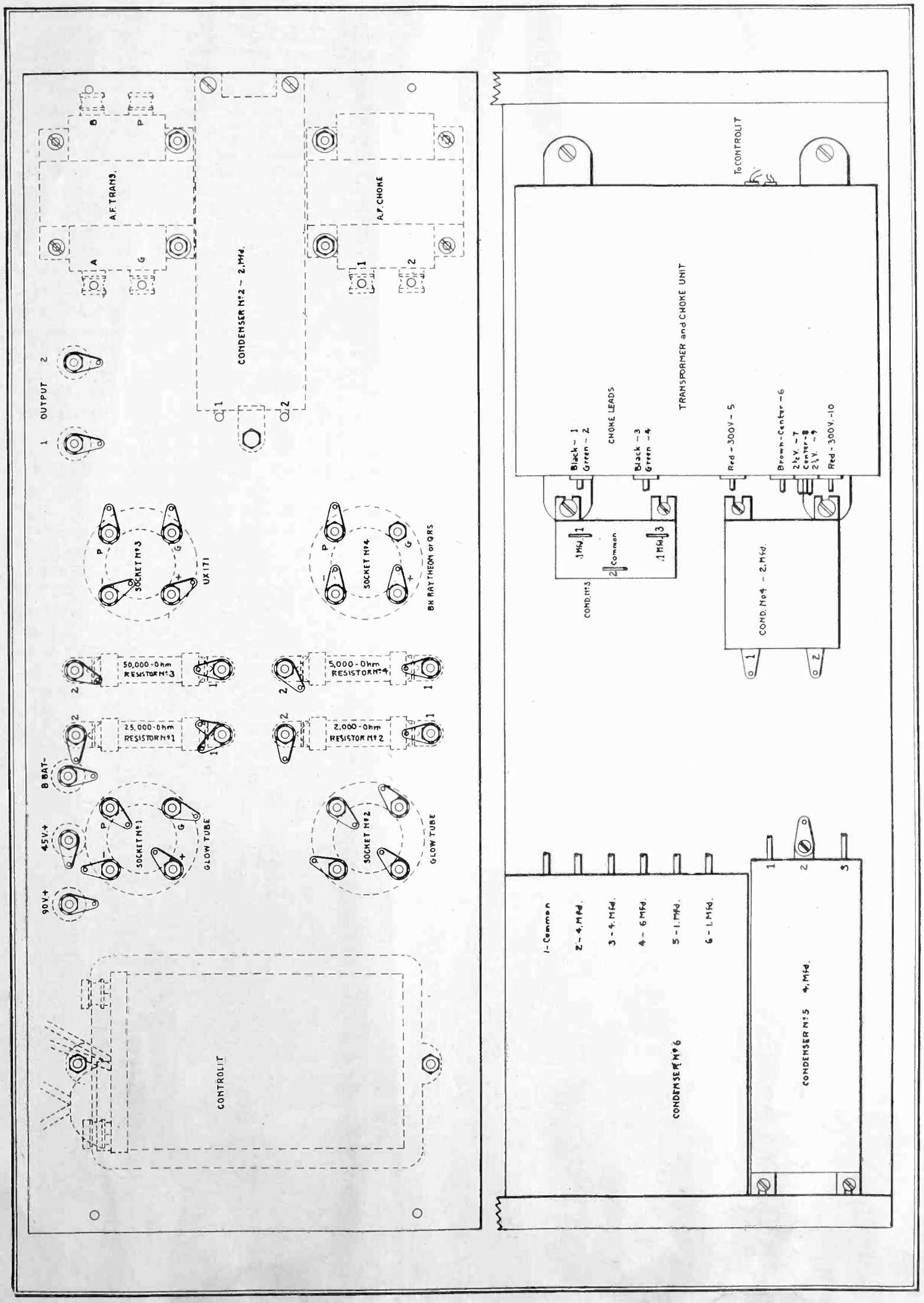
PARTS LIST FOR GLO-LIMINATOR

This list of parts, as used in the original laboratory model of the Glo-liminator, is as follows.

1 Dongan Power Unit, type No. 3516.
1 Dongan Diatonik or type H audio transformer.
1 Dongan Diatonik or type H audio impedance.
1 Aerovox type B H Raytheon condenser block.
1 Aerovox 4.-mfd. filter condenser, 300 D.C. working voltage.
1 Aerovox 2.-mfd. filter condenser, 300 D.C. working voltage.
1 Aerovox 2.-mfd. bypass condenser.
2 Aerovox 1.-mfd. bypass condensers.
1 Aerovox buffer block, two .1-mfd. capacities.
1 Brach Controlit.
4 Na-ald UX Sockets.
1 Aerovox Lavite resistance, 50,000 ohms.
1 Aerovox Lavite resistance, 25,000 ohms.
1 Aerovox Lavite resistance, 2,000 ohms.
1 Aerovox Lavite resistance, 1,000–5,000 ohms (optional).
5 Eby binding posts.
4 pair Daven grid leak mounting clips.
1 7 x 18 x 3/16-in. Bakelite or hard rubber panel.
1 Raytheon B H rectifier.
1 CX-371 power tube.
2 CX-glow tubes.



The front of the unit, with the front and back removed, and the panel tipped back


A.F. TRANS.
A.F. CHOKE
CONDENSER N°2 - 2 Mfd.
OUTPUT
B BAT-
45V.+
90V.+
SOCKET N°3
SOCKET N°4
SOCKET N°1
SOCKET N°2
UX 171
BH RAYTHEON or QRS
GLOW TUBE
50,000-Ohm RESISTOR N°3
5,000-Ohm RESISTOR N°4
25,000-Ohm RESISTOR N°1
2,000-Ohm RESISTOR N°2
CONTROLIT
TRANSFORMER and CHOKE UNIT
To CONTROLIT
CHOKE LEADS
Black - 1
Green - 2
Black - 3
Green - 4
Red - 300V - 5
Brown - Center - 6
2½ V. - 7
Center - 8
2½ V. - 9
Red - 300V. - 10
.1 Mfd
Common
.1 Mfd
COND. N°3
COND. N°4 - 2 Mfd.
1 - Common
2 - 4 Mfd.
3 - 4 Mfd.
4 - 6 Mfd.
5 - 1 Mfd.
6 - 1 Mfd.
CONDENSER N°6
CONDENSER N°5 4 Mfd.

Glo-liminator to any receiver, regardless of the circuit or the number of tubes.

The construction of the Glo-liminator is greatly simplified by the use of a foundation unit which contains the power transformer and two chokes in the case. Flexible leads to the various terminals are brought out to convenient points through insulated holes in the case, and these leads can be soldered directly to their respective points in the circuit.

The mechanical design has been worked out so that the assembly and actual construction are reduced to the simplest possible form. All of the dangerous high voltage leads are completely enclosed within the case, and the finished outfit presents the neat and attractive appearance of a factory built job. The tube sockets and resistors are mounted on the top, for these are the only items which need be accessible for possible changing.

Operating Instructions

In order to make it clear as to the correct insertion of the tubes, it is important that you get the right location of the various parts firmly fixed in mind. Looking at the Glo-liminator from one side, turn it so that the Controlit is at your left. The glow tubes then go into the two sockets next to the Controlit, the Raytheon rectifier is inserted in the right hand rear socket, and the 371 power tube is inserted in the remaining socket, which is the one nearest the audio transformer.

Still looking at the Glo-liminator from the rear, that is, with the binding posts nearest to you, insert a 2,000-ohm Lavite resistance in the pair of clips that are to the rear and next to the Controlit. Insert a 25,000-ohm Lavite resistance in the pair of clips immediately in front of the 2,000-ohm resistance. Put a 6-volt, 199 Amperite in the right hand rear pair of clips. A 5,000-ohm resistor is specified at this point, and should be used if the voltage exceeds 110. When the line voltage is apt to be low the Amperite acts as a fuse to protect the glow tubes in case the eliminator should be turned on before the tubes in the set are lit. Now put a 50,000-ohm Lavite resistance in the right hand pair of clips nearest to the binding posts.

At this point, it is well to make a suggestion. If you are going to use the Glo-liminator with a set which draws current for a number of tubes from the 45-volt tap, or which is critical as to the detector voltage, do not use the fixed 50,000-ohm resistance, but substitute a Clarostat in its place. There is room here to mount the Clarostat on the panel, and the resistance clips for the 50,000-ohm Lavite can be omitted. The Clarostat will permit you to make any adjustment necessary on the 45-volt tap and, after you have found the correct operating point, you need not touch it again. This substitution is recommended to those who to obtain the maximum results from their receiver and Glo-liminator combination.

Connect the B — post on the Glo-liminator to the B — post on your receiver. Connect the 45-volt post on the Glo-liminator to the B + Det. or 45-volt post on your receiver, and cross connect the two 90-volt posts. Remove the A + wire from your set, and connect it to one post on the Controlit. Connect the other post on the Controlit to the A battery.

Plug the cord plug from the power transformer into the Controlit receptable marked B Battery Substitute. Plug the A. C. connection on your trickle charger into

(*Concluded on page* 328)

Here it is—an honest-to-goodness power plant that will even operate most resistance amplifiers without motor-boating

VICTOREEN SOCKET-POWER SUPER

Helpful Suggestions for Getting Best Results from the A. C. Operated Super Using 201-A's and Power Tube

THE Victoreen Socket-Power Super first described in Radio Mechanics last month is undoubtedly one of the most satisfactory sets ever offered to the home constructor. Here at Radio Hill we have it in operation almost continuously, for we do not have to bother with a lot of batteries and chargers in order to keep its performance right up to snuff.

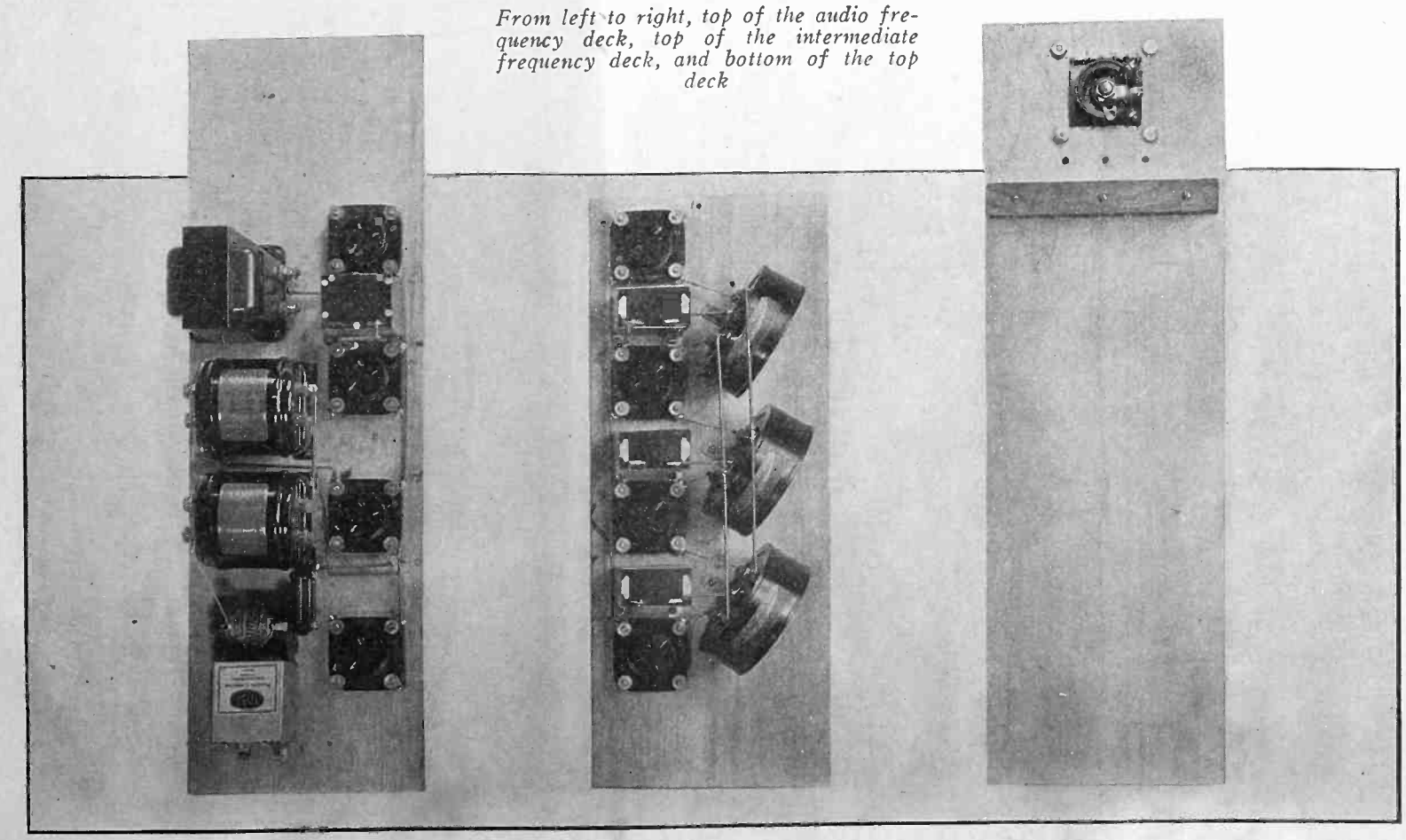
A number of inquiries have been received as to whether or not the set could be operated from batteries. Of course, this is perfectly feasible, but it is naturally necessary to change the filament wiring to the usual parallel arrangement and to insert suitable rheostats or ballast resistances for controlling the filament current. However, this change is only recommended to those who have no A.C. current available, for one of the big features of the set is its complete light socket operation.

In order to obtain the best results from the set, it is important to strike a proper balance between the resistance controlling the 45-volt tap on the 01–ABC eliminator, and the variable high resistance used for volume control on the set. The resistance on the eliminator should be screwed in until it is possible to cause the set to squeal when the volume control is turned clear to the right, but it should not be screwed down so far that the volume control will fail to bring the intermediates out of oscillation at any point in the broadcast band.

While making these adjustments, it is important to change the setting of the midget condenser at the same time. The reason for this is that the first detector may plop into oscillation as the 45-volt controlling resistance is decreased if the midget condenser is set too far in, and you may mistake the resulting squeal for oscillation in the intermediate stages.

The audio amplifier, properly constructed of the parts recommended, will give tremendous volume and a very realistic quality of reproduction. However, this is an A.C. operated set and a superheterodyne besides, and this combination is very sensitive to proper adjustment of the audio amplifier. It is advisable to scrape the paint from one of the mounting feet on each transformer and put a soldering lug under the head of the screw which goes through this mounting foot. This soldering lug should then be connected directly to the A— binding post.

This procedure stabilizes the audio end, and prevents any inductive pick-up directly on the transformer coils. If, after doing this, the audio stages should still show a tendency to sing or whistle, a grid-leak of about .2 megohm can be shunted directly across the secondary of the first audio transformer. A still better arrangement is to use a variable high resistance of about 500,000 ohms maximum in this position. This can be adjusted once for best results, and need not be touched again. Or if desired, this high resistance can be mounted on the rear panel and used for an audio frequency modulator.



From left to right, top of the audio frequency deck, top of the intermediate frequency deck, and bottom of the top deck

WHO GETS THE GOOD RADIO JOBS?

Few Other Industries Offer the Wide Field for Trained Men That Is Opened by Radio Developments

J. E. SMITH

THE scene is the employment office of a large radio manufacturing plant. The man at the desk, the director of employment, looks up from a card in his hand and surveys the applicant before him.

"Why," he asks, "do you feel you are qualified for such a position as this?" The question is purely perfunctory, for the employment director knows by heart the answer he will hear.

Sure enough: "Ive read every issue of four radio magazines for three years past," says the applicant, "I've been a radio bug since the early days of broadcasting, and built thirty-two sets. I tinkered with my aerial and cut out some of the static—maybe I could work out something like that for you. I built such-and-such a circuit, and changed it around in such-and-such a way, and now I get coast-to-coast on the loudspeaker."

And so on. The employment director listens to it reasonably for a minute. Then tactfully, because his company wants the good will of those it must refuse to give the good positions they desire, he offers the applicant some information. This particular man has asked for a position in the company's experimental laboratory, where only the best engineering brains available are employed.

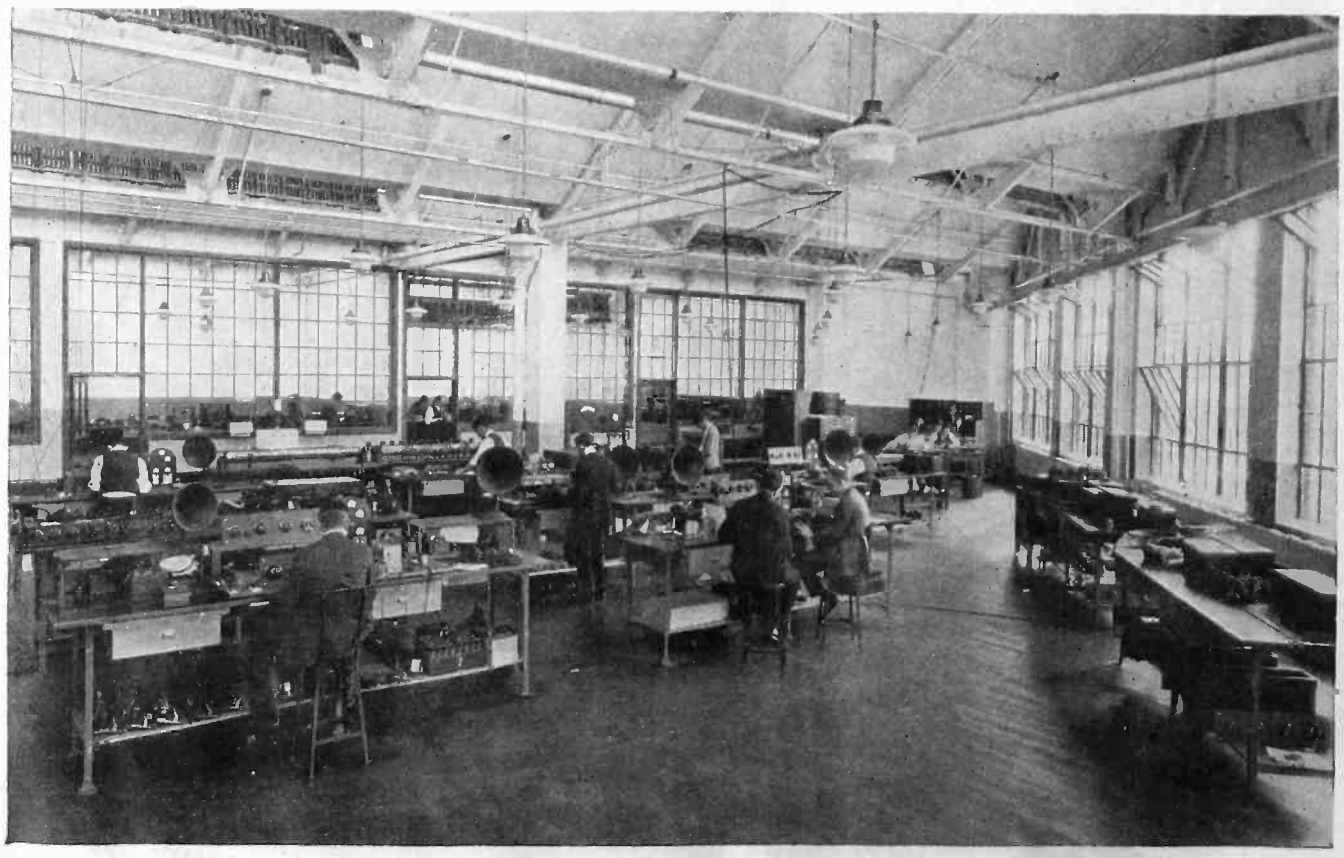
"For a position such as the one you want," the applicant is told kindly, "the most thorough and exhaustive college training is not too much. In fact, such training counts as only the necessary foundation."

"Look at Edison," objects the applicant. "He never went to college."

"Yes," the employment director quickly agrees, "and there are some like him in the radio profession, too. One of our own engineering staff, as a matter of fact, is a man who got his training in another way, outside of a college. But he's trained, make no mistake about that. Just because I like your interest in radio, and because I think you'll make a good man when you learn to do things our way, I'll put you to work in our inspection department. Want to try it?"

But the applicant is hardly convinced that he's not the thoroughly polished radio expert his admiring neighbors have told him he is.

"Every professional radio man reads those radio magazines you've been reading," explains the employment director. "But he reads them to keep up with what's going on. Magazines can't take the place of systematic, fundamental training; if they did, they would not be magazines, but correspondence schools. And, while you've built a lot of sets successfully, you'll admit you know only the 'how'—not much of the 'why'. In any line you have to be prepared by previous training for good posi-



A typical inspection and testing department in a modern radio factory

tions, and that goes doubly for radio."

"If I take this position in the inspection department," asks the applicant, "what can I look forward to?"

"You needn't look out of your own department," is the reply. "There are plenty of splendid positions there if you work conscientiously, learn all you can, and earn promotion."

"'Could I get into the experimental laboratory later?"

"You certainly can. We could use another qualified engineer there now. In every intelligently managed concern the way to the top is kept open. I suggest you do just what Edison did. Improve yourself by study. Get books, and study radio in your spare time. Better than that, take a regular course of training—an opportunity Edison didn't have. Such a course would be your foundation, and you could build up from it."

When the applicant shortly left the employment director's office, he carried in his pocket a card to the head of the inspection department directing that he be put to work. Also in his pocket was another card, with the address of a radio school which the employment director had recommended. In his mind there presisted a ruefulness over his disillusionment as to his radio attainments. But at least he might be glad that he was on the right track at last.

What Is a Radio Expert?

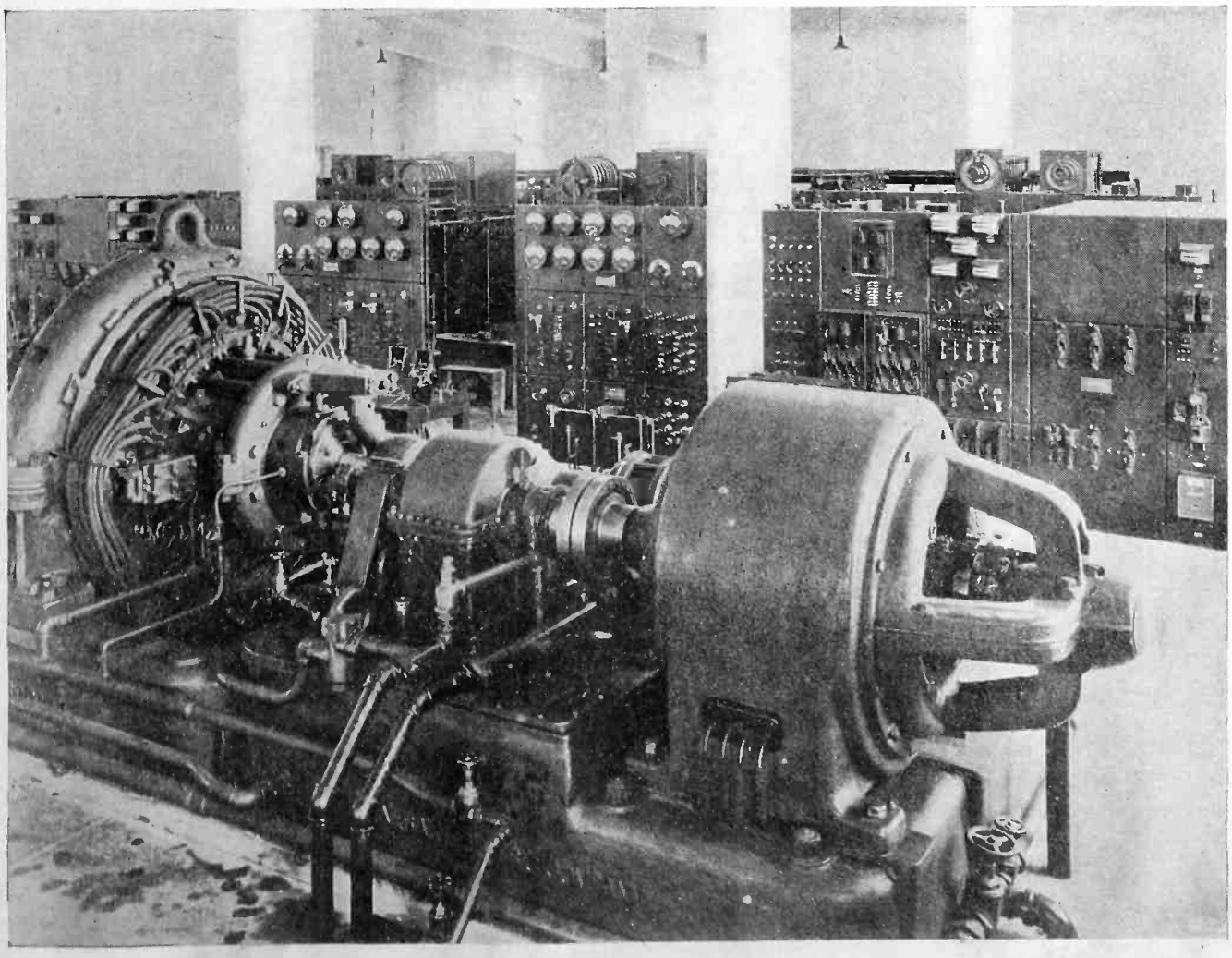
The proof that this episode is not drawn from the imagination is the fact that almost every employer of radio men will recognize it as blood brother to like experiences he himself has encountered, time after time. What is a radio expert? Thats a question many an employer has asked himself, after listening to the qualifications of some self-styled expert like the applicant just described. Many lay claim to the title. How many really deserve it?

There are a few pretty well defined paths to radio proficiency—the sort of proficiency that is adaptable to the economic uses of the radio industry, and for which the radio industry will, consequently, pay in good, hard cash. It is not the man who follows these methods of preparation, but the lack of them that causes an important radio employment problem of today. The problem is, "Where can we find a radio expert who *is* an expert, and how shall we know him when we find him?"

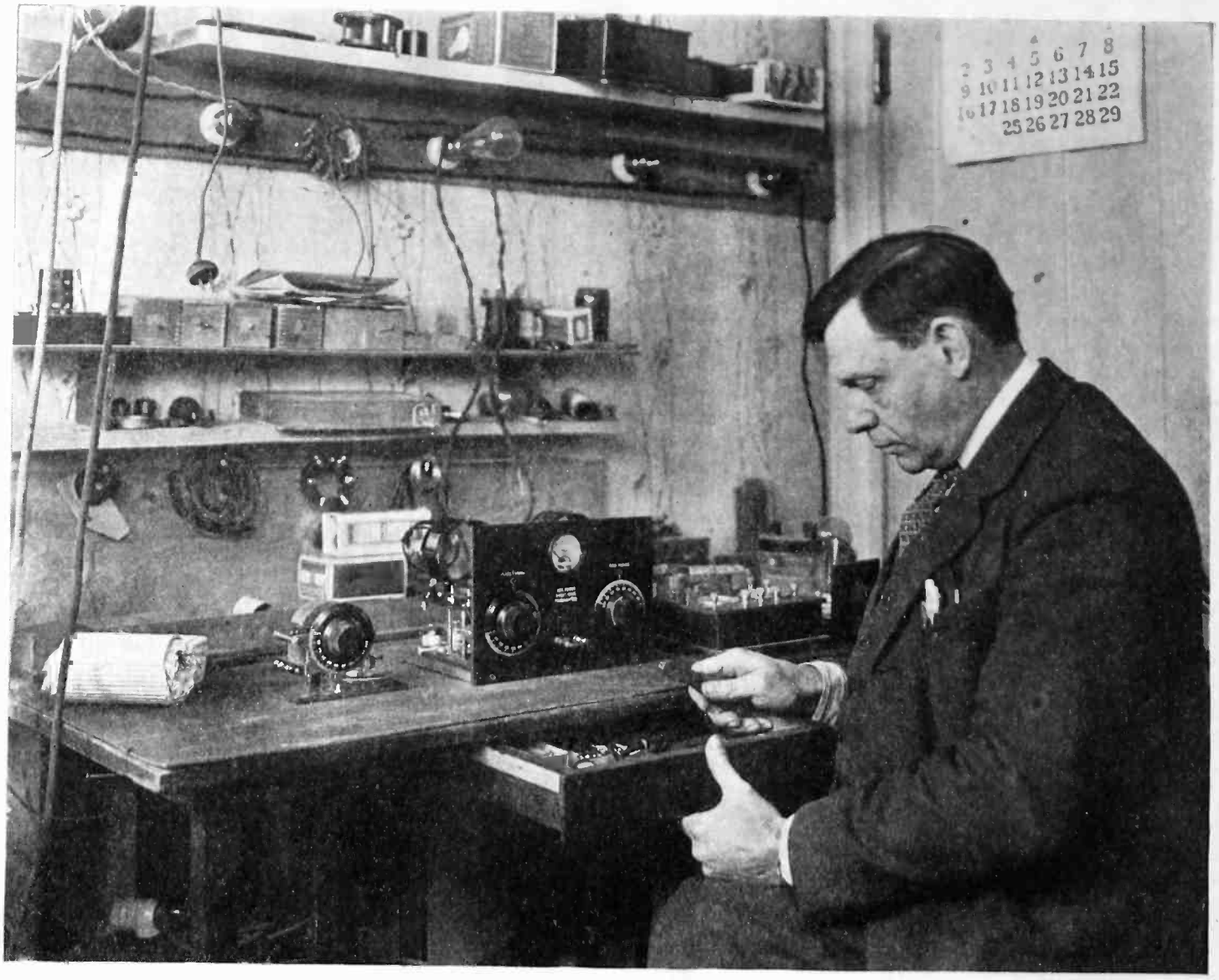
It's not particularly the problem of big manufacturers, this one, because the larger firms now have well-organized employment departments, fully capable of sifting the wheat from the chaff. And when trained men are needed in any branch of the business, the employment department knows what aggressive means it must employ to find them.

But the seriousness of this personnel problem to many smaller firms can hardly be overestimated; first, because such firms often unwittingly employ incompetent men; thinking they are capable of doing the work required; and second, because the growth of some concerns is stopped by the pure and simple impossibility of finding competent men

(*Continued on page* 331)



Radio transmission equipment, representing investments of thousands of dollars, is only entrusted to trained men



2,000-MILE RADIO TRANSMITTER

This Little Transmitter Can Handle Regular Radio Transmission Clear Across the Continent.

WINTHROP MORTON

IMAGINE a little radio transmitter, costing under thirty dollars, that can handle regular transmission at short waves over longer distances than a powerful broadcasting station can cover dependably!

And then consider that the amateur operators who comprise the American Radio Relay League,[1] operating home-made sets, have friends in practically every foreign country with whom they communicate by radio! To them, reception which is real DX to the B. C. L. is only local stuff. There is even a WAC Club in the A. R. R. L. comprised of American amateurs who have communicated with every continent in the world.

The LP-SW For Beginners

Mind you, such transmission is not as simple as dial-twisting on a broadcast receiver. It takes experience and lot of it. A knowledge of the telegraph code is necessary, too, for telephone transmitters cannot send as far as telegraph transmitters.

The LP-SW set described here, used in conjunction with any of the short wave receivers previously shown in Radio Mechanics,[2] makes a splendid set to start with, for it is exceedingly easy to build, and cost very little. The transmitting tube is just a 201-A or 210, run from a 6-volt storage battery, with about 135 volts of B battery.

What The LP-SW Set Can Do

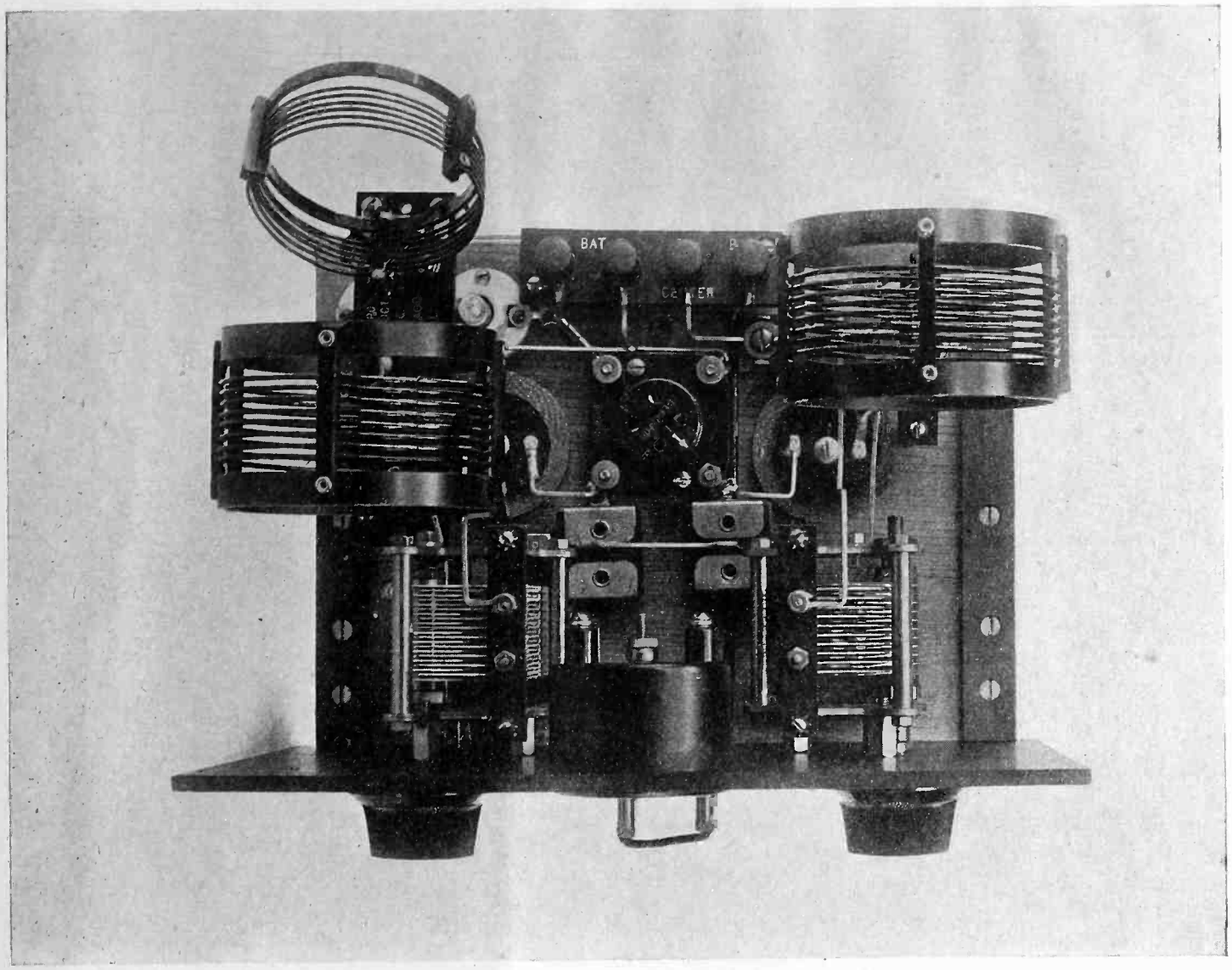
Bert Smith, designer of the famous New Day receiver,[3] built the original LP-SW transmitter. With a 201-A tube working on 135 volts, he has communicated from New York with every district in the United States, except the third and eighth. Probably his failure to include those two districts are due to skip distance effects.[4]

[1] For further information, write to the American Radio Relay League, Hartford, Conn.

[2] Hush-Hush II, Oct. 1926; Bert Smith's Nov. 1926; 5NI, December, 1926; Submarine, Feb. 1927.

[3] See Radio Mechanics, Nov. 1927. Complete Dataprints are available for this set.

[4] See report for tests made by General Electric Co., published in Radio Engineering, Jan. 1927.



This design represents the combined skill of Bert Smith and Fred Marco, both well-known S. W. experts

That is not the full transmitting range of the LP-SW set, however, for similar sets get down to South America, Europe and Australia without difficulty.

Fred Marco, short wave expert of Chicago, who designed the Aero coils used in the LP-SW set, operating a similar transmitter, but with a 210 tube on 400 volts plate supply, taken from B batteries, has worked all the U. S. and Canadian districts at 40 and 80 meters.

At 19.72 meters, all U. S. districts were worked with daylight at both ends, in a period of two and one-half hours. Stations which Fred Marco worked reported a signal strength of R9[5] as far away as Texas.

Notes About The LP-SW

The ideal amateur transmitter is one which can almost instantaneously shift its wave to the most favorable one, taking into account the skip distance, time of day, season of year, and other special factors. We have found that in winter afternoons, 20 meters is by far the best band. Later, at 6.00 P. M., we shift to 40, and possibly up to 80 for traffic handling or middle distance DX work during the dull hours when the 40-meter U. S. A. stations are riding over our heads and it is still too early for the super DX.

In order to make adjustment simple and speedy, both for the experienced amateur and the novice or converted broadcast listener, a circuit entirely adjusted by panel-controlled variable condensers is to be preferred to one which requires the juggling of many clips and taps.

A schematic diagram of the transmitter is given with the wire-less wiring diagram.[6] The grid and plate circuits of the tube are tuned by the plug-in inductances and 0.00035-mfd. variable condensers. The condenser readings for any particular wavelengths are almost identical.

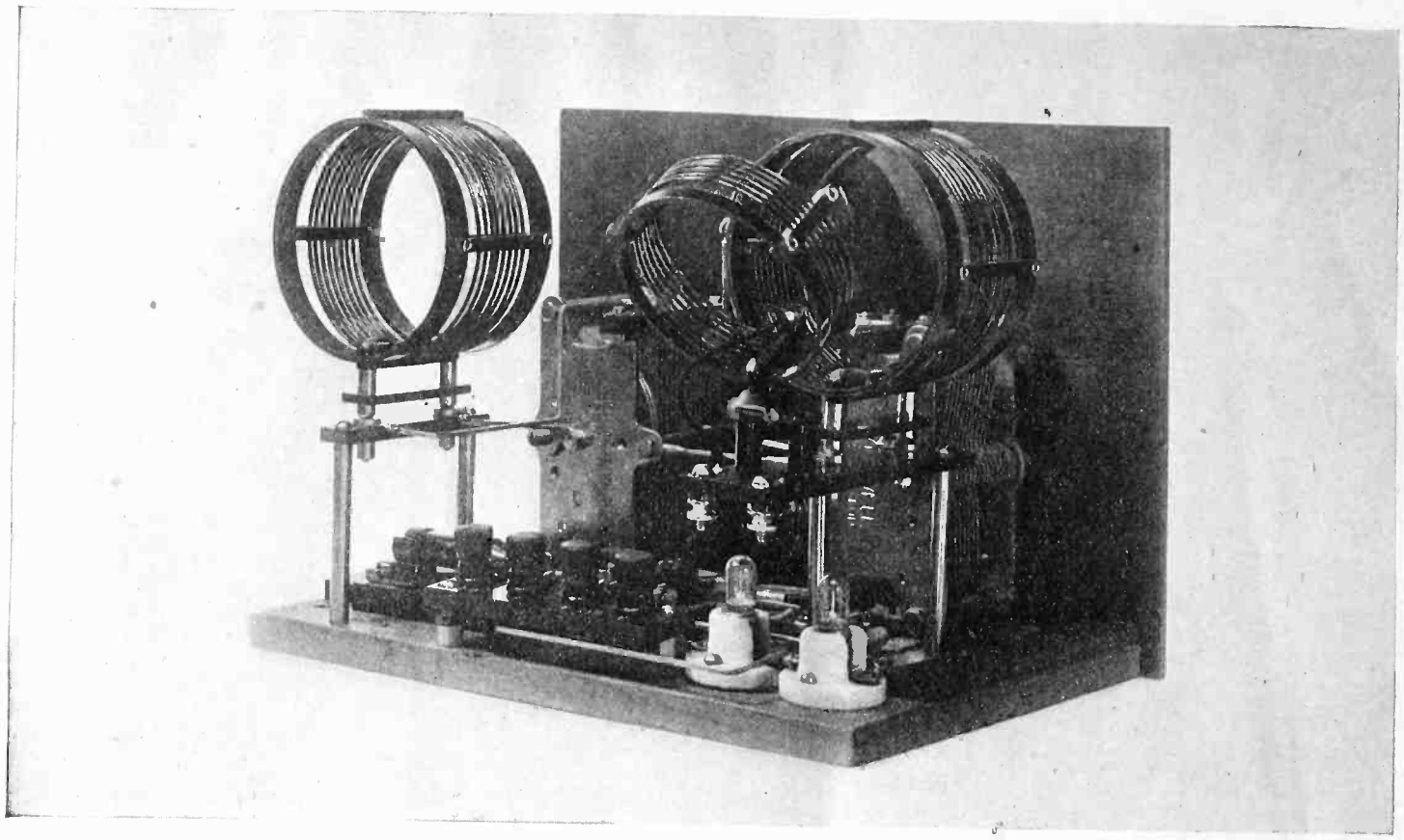
The shunt-feed circuit was chosen primarily because of the greater safety afforded the operator. The grid and plate blocking condensers may be anything from 0.0001 to 0.00025 mfd., as they are not critical. The smaller capacity is to be preferred on the shorter waves, as tube heating does not cause such bad creeping of the wave. Too small a capacity cannot be used, however, as it may interfere with the feedback thru the tube and cause trouble in starting oscillations. The leak is shown shunted from grid to filament altho it can be connected directly across the grid condenser.

Both grid and plate circuits are isolated at radio frequencies by Cardwell RF chokes, type 198-C. They can be seen at each side of the socket in the top view.

Bert Smith favors the use of two miniature-base lights, connected across the tube filament, to divide

[5] "Extremely strong signals." See page 148, Radio Amateur's Handbook. This can be obtained from Radio Mechanics, Inc., Albany, N. Y.

[6] Patent applied for.



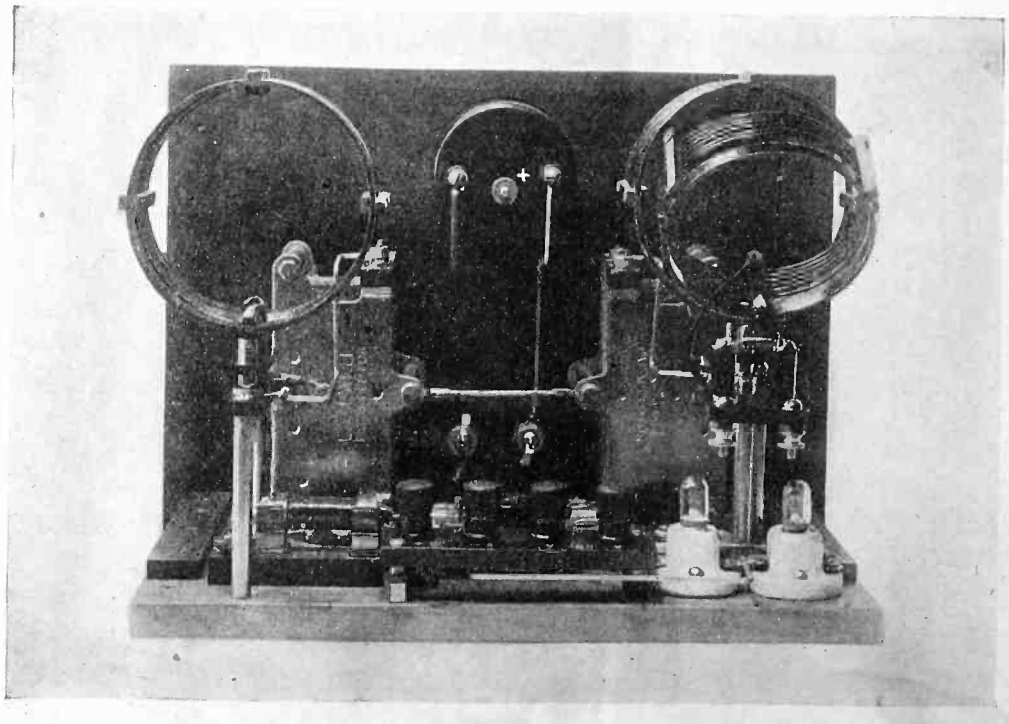
Close-ups of the LP-SW transmitter. Combined with Bert Smith's S. W. receiver, it's the real thing for experimental communication

the plate current between the two halves of the filament. If B— is run directly to one side of the filament, that side will disintegrate faster than the other. This is particularly true of the 199, frequently used for local transmission.

The plate coil is coupled to a variable primary of six turns, in order to control antenna input. This can be tilted back and forth at the filament end of the plate coil. There is also a 0.00035 mfd. variable condenser in the ground lead, to tune the antenna to its fundamental wavelength or a desirable harmonic.

Details of the Coils

The plug-in coils are the main item of interest of the set. They are constructed similar to the Aero receiving coils, built up on a skeleton framework of Bakelite rings and strips. Thus they are mechanically sturdy and electrically efficient. The windings are of No. 14 enameled wire, heavy enough to carry anything up to about 100 watts input. Two pairs of coils are necessary to cover the entire band from 16.5 to 90 meters, inclusive, without gaps. The larger pair, shown in the accompanying illustrations, with two 0.00035 mfd. tuning condensers, cover 35 to 90 meters. They have eight turns each, spaced by the wire diameter, and are fitted with two positive-action plugs. The primary, also of No. 14 wire, is hinged to allow varying the coupling from very tight to nearly zero. The leads are pig-tailed and brought to two binding posts on the base of the unit.

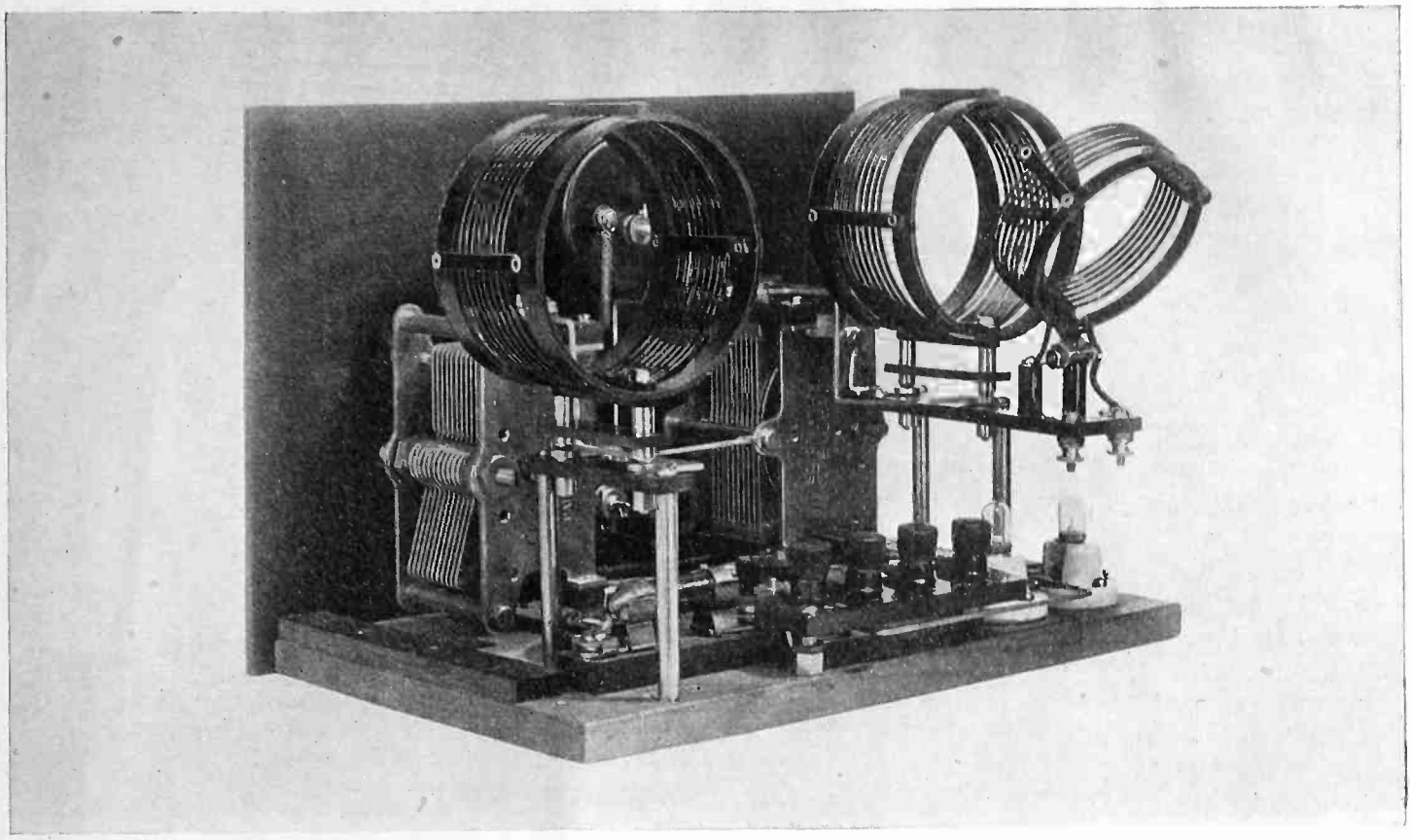


The second pair of coils is identical to the larger size, except that there are only 3 turns of wire on each coil. With the same variable condensers, they tune from 16.5 to 52 meters.

The units are primarily intended for low-powered transmitters using less than 100 watts input, altho they can be used on somewhat higher powers. An overloaded fifty-watter—this means at least 400 watts input to the U.S. ham—will heat the wire somewhat, altho no other effects occur and the electrical loss is small. The insulation is of such character, and so placed with respect to the field, that no measurable losses occur due to its presence.

Suggestions

The range of the milliammeter

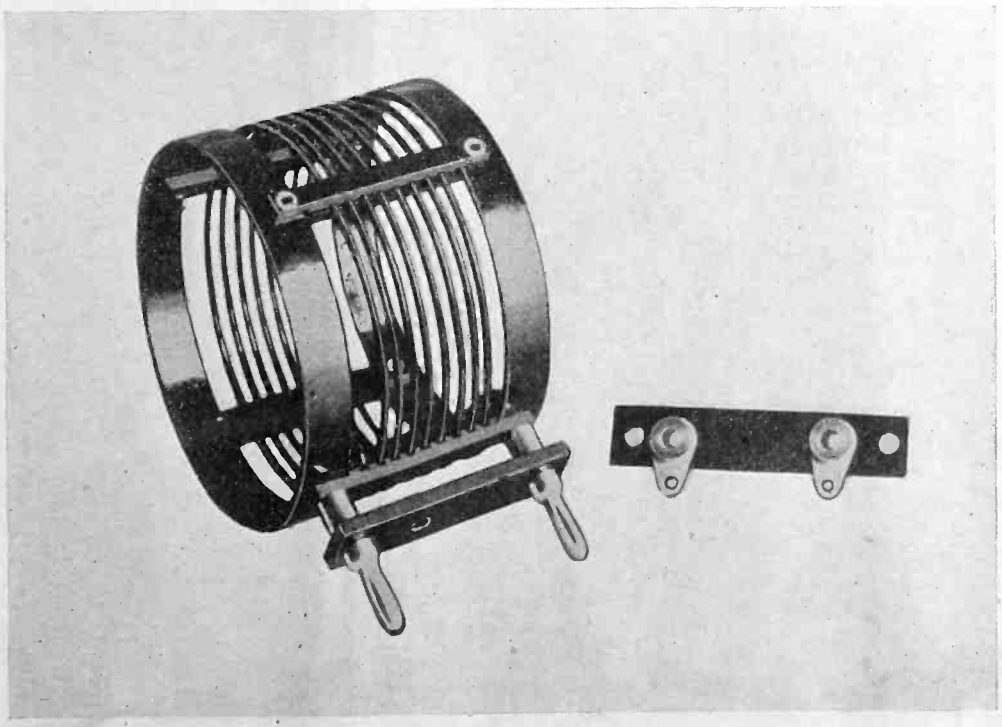


Details of the coil mountings and the plug-in coils. Special spring friction plugs assure perfect contact to the jacks

will depend upon the tube in use. For one 210 tube the meter should be 100 or 150 mils full scale; for a 201-A or 199, perhaps 20 mils.

The grid leak will vary with the tube. This particular set uses a 4,000-ohm Lavite resistor altho it is suggested that a 10,000-ohm size with taps be tried; 5,000 ohms is about right for a 210, a 210-A or a VT2 altho for a 171 or 112 a much higher resistance, around 15,000 to 20,000 ohms, is better. In any case the grid leak should be of the wire wound variety rather than the carbon or metalized glass products, as these latter seldom have enough heat dissipation to render them safe.

The antenna or counterpoise is more or less optional with the operator. It is recommended that the new A. R. R. L. Amateur Handbook be rigorously followed as to to these questions, as well as those of with power supply and keying troubles.



Tuning the LP-SW

If you have a short-wave receiver, but no wavemeter, you can tune the transmitter in this way:

Tune the receiver to the desired wavelength. You probably know more or less about the calibration of your receiver by determining the points at which commercial and government stations such as NKF and WIZ are received.

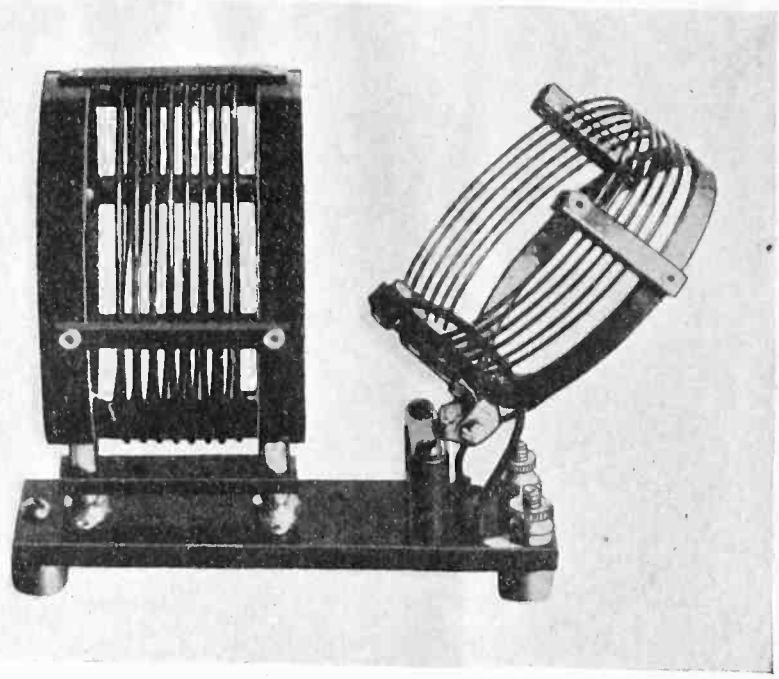
Then connect the antenna coupling coil of the transmitter in the antenna lead of your receiver. Now vary the plate condenser—the left-hand dial of the transmitter—until the receiver stops oscillating. At that point, the plate coil of the transmitter is tuned to the same wavelength as the receiver.

Now remove the receiver and, turning on the transmitter, press the key, varying the grid condenser—right-hand dial—until the set oscillates. Probably the easiest method of determining this point is to go to the nearest electrical store and get a Mazda 1/40-watt glow lamp or a spark plug tester of the glow type Spark-C. Hold this against the stator of the plate condenser, grasping it by the glass, and when the set oscillates it will glow. Tune to the maximum brilliancy.

Now hook on the antenna and counterpoise, or ground. Put a 2½-volt flashlight bulb in the socket on the base of the antenna condenser, and remove the clip provided to short on the

bulb. This puts the lamp directly in series with the antenna lead. Then vary the antenna condenser carefully until the flashlight lamp begins to glow. Be careful not to burn it out. Put the clip on the end of the wire loop and tune carefully until maximum brilliancy of the lamp is reached. Vary the grid condenser just a little to reach absolute maximum, and you are ready to go.

The wave emitted by this outfit is very sharp, and similar to that of a crystal controlled job.



The antenna coupling unit. Several improvements have been made by the Aero company in the design of these coils

General Assembly Instructions

The front panel of the LP-SW set is of 3/16-in. hard rubber or Bakelite, 7 by 10 ins. while the base board, of ½-in. white wood, measures 6¾ by 9½ ins. Two Bakelite strips were used to brace the base board, but that should not be necessary if the wood is well seasoned.

All the dimensions and hole sizes are shown on the full-size panel patterns which are furnished with the Dataprints.[7] Be sure to drill all the holes before you start the assembly, for it will save much time.

The only special parts required for this set are the coil mounting pillars, which raise the coil mountings from the base board. Four are required, cut from ¼-in. brass rod, 2⅜ ins. long, and threaded at each end to take 6-32 screws.

Front Panel Assembly

Mount the meter, variable condensers, and tip jacks on the front panel. Referring to the wire-less wiring diagram, on variable condenser No. 1, lugs 1 and 3 are on screws which hold the fixed plates to the hard rubber strips; lugs 2 and 4 make contact with the rear end plate. On variable condenser No. 2, lugs 1 and 4 connect with the fixed plates, and 2 and 3 with the rear end plate.

Front Panel Wiring

Connect 1 on fixed condenser No. 1 to 3 on variable condenser No. 1, and connect 1 on fixed condenser No. 2 to 4 on variable condenser No. 2. This cannot be done later when the front panel is fastened to the base board.

Connect 2 on the D. C. milliameter to tip jack No. 1, and connect 2 on variable condenser No. 1 to 3 on variable condenser No. 2.

[7]These can be obtained from the Patterns Dept., Radio Mechanics, Inc., Poughkeepsie, N. Y.

Base Board Assembly

Fasten the coil mountings, R.F. chokes, socket, grid leak mounting, binding post strip, and porcelain-base miniature sockets on the base board, according to the layout in the panel patterns. Use brass wood screws, except for the coil mounting pillars, which take ¾-in. 6-32 F.H. screws.

PARTS LIST FOR THE 2,000-MILE TRANSMITTER

These parts were used in the original model of the LP-SW transmitter.

- 1 Kit of Aero 17 to 50-meter coils and mountings, key 2040.
- 1 Pair Aero transmitting coils, 36 to 90 meters.
- 3 Cardwell taper plate condensers, 0.00035 mfd.
- 2 Kurz-Kasch dials, 3-in. diam.
- 2 Dubilier Micadons, 0.00025 mfd.
- 1 Benjamin socket.
- 2 Cardwell R.F. chokes.
- 3 Miniature lamp sockets.
- 1 2½-volt lamp.
- 2 110-volt miniature lamps.
- 1 4,000-ohm Lavite resistor and base.
- 4 Eby binding posts.
- 1 Panel, 7 x 10 x 3/16 in.
- 1 Baseboard, 6¾ x 9½ x ½ in.
- 3 Lengths stiff Acme Celatsite wire.

Base Board Wiring

Connect 1 on R. F. Choke No. 1 to G on the socket, and connect 2 on R. F. choke No. 2 to P on the socket.

Connect 2 on R. F. Choke No. 1 to 1 on the Lavite resistor, and connect 2 on the resistor to B BAT—.

Connect the 1 terminals on the lamp sockets together, and connect this junction to B BAT—.

Connect the outer A BAT binding post to + on the socket and also to 2 on lamp socket No. 1.

Connect the inner A BAT post to — on the socket and also to 2 on lamp socket No. 2.

Inter Panel Wiring

Fasten the front panel to the base-board, using three 1-in. No. 6 F. H. wood screws.

Run a well-insulated lead from tip jack No. 2, under fixed condenser No. 1, and up to B BAT+. Connect 1 on the milliameter to 1 on R. F. choke No. 2.

Solder the 2 lugs on fixed condensers Nos. 1 and 2 to G and P respectively on the socket.

Connect 1 on the grid coil mounting to 4 on variable condenser No. 1, and 2 on the mounting to 1 on variable condenser No. 1.

On the plate coil mounting, connect 1 to 2 on variable condenser No. 2, and 2 to 1 on variable condenser No. 2.

Plug a pair of coils in the mountings, put the lamps in the sockets, and the set is ready for testing.

Antenna Tuning Unit

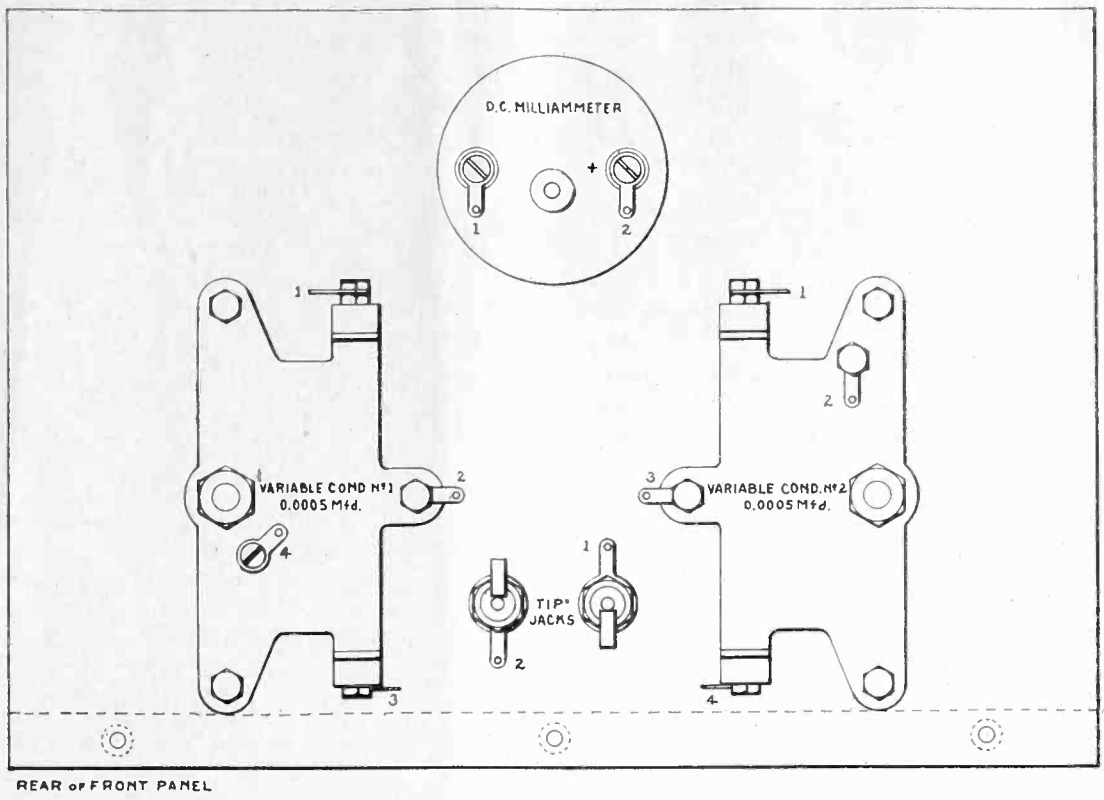
The antenna tuning unit consists of a 0.00035 mfd. condenser mounted with angle brackets on a hard rubber base 4 by 5½ by 3/16 in. In the rear right hand corner is a miniature lamp socket, mounted so that the terminals are on a line parallel with the front of the base.

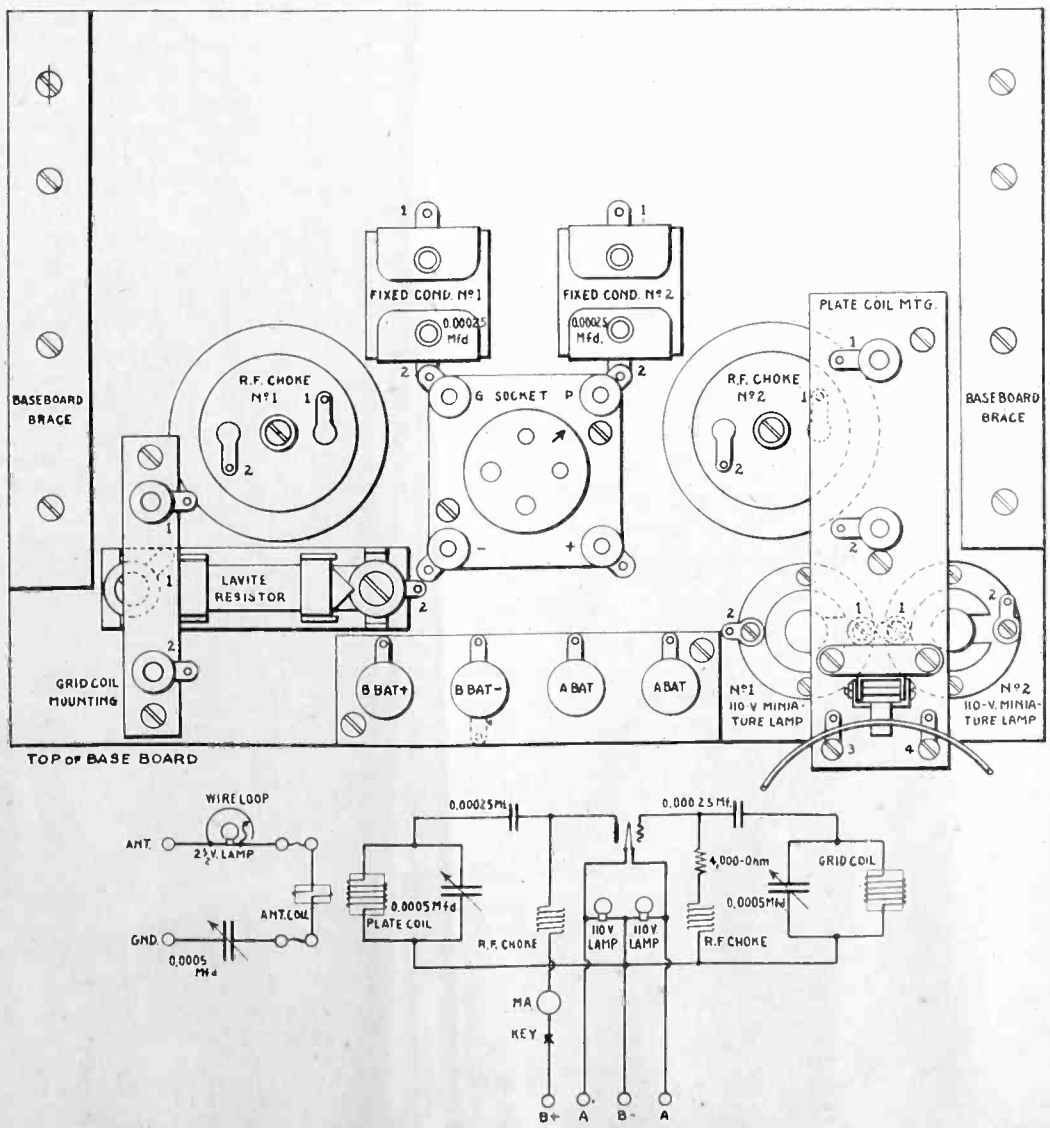
The wire loop, shown in the schematic diagram, is a piece of bus bar, fastened to the fixed plates at the right hand side of the condenser. This wire drops down to within ⅜ in. of the base, then straight back to the left hand contact on the lamp socket, where it is soldered. Next, it is bent to the left, swinging around under the condenser in an arc of 270 degrees, 3 ins. in diameter, ending finally at the front screw which holds the socket to the base. The right hand contact of the socket has a Fahnestock clip from the terminal going to the set, and also a piece of flexible wire with a clip to put on the bus bar loop. The ground lead goes to the frame of the variable condenser.

When the clip is at the open end of the wire loop, the light will glow highest, dimming down as more of the loop is cut out.

Important Note

When you solder the connections, use only rosin core solder. This is more important on short wave transmitters than receivers. If paste flux is used, even tho all excess is apparently wiped off, the trace of grease remaining will hold dust particles thru which the high frequency currents will flow almost as easily as through a solid wire connection. Perfect insulation is absolutely necessary at every point on a transmitter.





WIRE-LESS WIRING DIAGRAM — Pat. Applied for

SUPER-LOOPER-'LEVEN

(*Continued from page* 312)

On the 500,000-ohm potentiometer, connect 1 to F on transformer No. 4; connect 2 to G on socket No. 3; and connect 3 to G on transformer No. 5.

Connect 2, a lug on the fixed plates and condenser No. 1, to G on transformer No. 2.

Connect 2 on condenser No. 2 to B on transformer No. 7; connect the lead running from 1 on condenser No. 2 to 1 on condenser No. 3 to — on socket No. 6; and connect 2 on condenser No. 3 to F on transformer No. 8.

On the 400-ohm potentiometer, connect 1 to + on socket No. 6 and connect 2 to F on transformer No. 7.

On condenser No. 4, connect 1 to tip jack No. 3, and connect 2, a lug on the fixed plates, to the upper lug at 1 on the base of transformer No. 3.

Connect 2 on the vernier condenser to P on socket No. 11.

On rheostat No. 2, connect 2 to — on socket No. 11, and also to F on transformer No. 3.

On the jack, connect 1 to P on socket No. 3; connect 2 to P on transformer No. 4; connect 3 to B on transformer No. 4 and also to B on transformer No. 1; and connect 4 to B + 90V.

Connect 2 on the jack to A — BAT.

Put a 2-megohm grid lead in the resister mounting, and the set will be ready for testing.

GLO-LIMINATOR

(*Continued from page* 318)

the receptacle marked A Battery Charger. Attach a good cone speaker, such as the Western Electric model 540-A W, to the two speaker binding posts. The P and B + posts on the audio transformer are connected to a loudspeaker cord, which is then plugged into the first audio stage on the receiver. Do not attempt to use the Glo-liminator after two stages of audio, for you will surely have trouble.

You are now ready to put the Glo-liminator in operation. Turn on the filament switch of your set, and the Controlit should immediately turn on the Glo-liminator. The glow should appear at once. That is, the glow tubes will have a bright reddish color. Tune your set to a station that you know is broadcasting, and adjust the Clarostat, if used, to the point of best reception.

The Glo-liminator is easily moved, for two handles are provided for carrying. However, it is designed to be stowed away in the bottom of a console, or it can be located down cellar with the storage battery and charger equipment. While it is the sort of a power plant that you will be proud of, both in appearance and performance, you can put it away in any handy location and forget it.

When using the Glo-liminator, you will no longer find it necessary to grope under the table or in a dark cabinet in order to adjust the controls every time the power line varies in voltage. The owner of a Glo-liminator can laugh at his less fortunate friends who must devote nearly as much attention to adjusting their power plants as they do to tuning their receivers.

General Instructions

First, obtain the panel and the wooden baseboard and side pieces, as given in the parts list. These must be accurately and squarely cut to size, for otherwise the assembly will not fit well together and the completed job will present an unfinished appearance.

The power unit, filter condenser block, buffer condenser block and the 2 and 4 mfd. condensers should be fastened to the baseboard in their respective position as shown on the wire-less wiring diagram.[1]

If you want to be sure of getting the apparatus spaced correctly, it is advisable to follow the Dataprints,[2] which are drawn full-size, and can be used as templates for locating the various holes.

Mounting the Tube Sockets

The wire-less wiring diagram shows the under side of the top panel, for practically all of the wiring, with the exception of a few short leads to the audio transformer, output condenser and choke, is done on this side. The bolts which come with the sockets are removed, and ¾-in, 6-32, round head machine screws are substituted, with the heads on top of the sockets, instead of underneath, as they come from the factory. Holes are drilled through the panel to accomodate these machine screws and, on the under side, soldering lugs are slipped over the bolts. Then lock washers are put on and, finally, the nuts are tightened down. In this way, the builder is assured of good, tight connections and a neat job.

[1] Patent applied for.

[2] These can be obtained from the Pattern Dept. Radio Mechanices, Radio Hill, Poughkeepsie, N. Y.

Panel Assembly and Wiring

On the top panel, mount the parts shown in the wire-less wiring diagram. Note that this diagram shows the under side of the panel, and a top view of the parts in the case. All lugs on the terminal screws and binding posts are under the panel.

Connect 90V. + to — of socket No. 2; connect 45V. + to 1 on resistor No. 1; connect B BAT — to — on socket No. 1, to 2 on resister No. 1, to A on the input transformer, and to 2 on resistor No. 2; connect output No. 1 to 1 on resistor No. 2; and connect output No. 2 to 2 on condenser No. 2.

On socket No. 1, connect + to P, and connect G to — on socket No. 2.

On socket No. 2, connect + to P, and connect G to 2 on resistor No. 4.

Connect 2 on resistor No. 3 to 1 on resistor No. 1; connect 1 on resistor No. 3 to 2 on resistor No. 4 and to 2 on the A. F. choke.

On socket No. 3, connect P to 1 on condenser No. 2, and to 1 on the A. F. choke.

Put a phone cord on the B and P terminals of the A. F. transformer, to go to the plate circuit of the detector on the first A. F. amplifier tube in the set.

Case Assembly and Wiring

The case is made as a separate unit, from which the front can be removed to facilitate wiring. Fasten the transformer and choke unit firmly in place, then condensers Nos. 3 and 4, put condenser No. 6 tightly in the corner, and fasten down condenser No. 5. As an added security, solder together the cases of condensers Nos. 5 and 6 at one point.

On condenser No. 6, connect 1 to 1 on condenser No. 4 and connect 3 to 1 and 4 of the transformer unit.

Connect 3 of condenser No. 5 to 1 on condenser No. 4, and connect 2, a lug making contact with the case, to 1 on condenser No. 4.

On condenser No. 4, connect 1 to 2 on condenser No. 3, and to the screw which fastens down the forward mounting lug on the condenser and on the transformer unit. This is to ground the cases. Connect 2 to 8 on the transformer unit.

Inter-Panel Wiring

On condenser No. 6, connect 2 to P on socket No. 4; connect 4 to 1 on resistor No. 4; connect 5 to — on socket No. 2; and connect 6 to 45V. +; connect 1 on condenser No. 5 to G socket No. 2, and connect 2 to B BAT —.

Connect 2 on condenser No. 4 to 1 on resistor No. 2.

On condenser No. 3, connect 1 to + on socket No. 4; connect 3 to — on socket No. 4.

On the transformer unit, connect 2 to 1 on resistor No. 4; connect 3 to P on socket No. 4; connect 5 to + on socket No. 4; connect 7 to — on socket No. 3; connect 9 to + on socket No. 3; and connect 10 to — on socket No. 4.

Fasten down the top panel, run the cord from the transformer unit up thru the panel to the Controlit, put the resisters and tubes in place, and the unit will be ready for testing.

RADIO PHYSICS COURSE

(*Continued from page* 303)

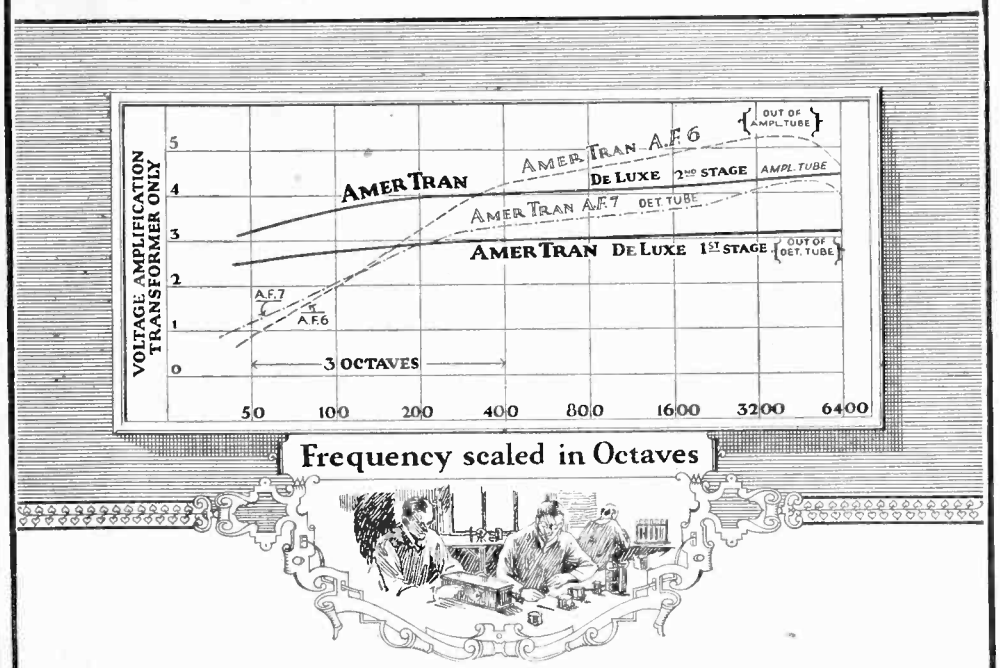
the plate. Since in the two-electrode tube with a given filament temperature, the flow of electrons depends on the potential of the plate, if a third electrode, or grid, is inserted between the filament and plate so that the electrons must go through the open spaces in it on their way to the plate, then, by varying the potential of this third electrode, the electron flow can be controlled. When it is made positive with respect to the negative end of the filament, Fig. 37-B, it tends to neutralize the effect of the space charge thus permitting more of the electrons to get to the plate, and so increasing the plate current.

When it is made negative, Fig. 37-C, it assists the space charge in repelling some of the electrons back to the filament, so less electrons get to the plate, and the plate current is decreased. When the grid is made positive, it collects a few electrons itself, acting like a second plate, giving rise to a current in the grid circuit from grid to filament. This should be remembered as it becomes important in the practical use of the three-electrode tube in modern receiving sets.

The grid of the tube, being much closer to the filament than the plate, can, when a potential is applied to it, control the electron emission far more effectively than the same potential applied to the plate. In other words, two volts applied to the grid of the tube can cause anywhere up to five times the change in emission caused by two volts change of voltage on the plate. We thus have a sort of trigger action here; a small voltage on the grid controlling the plate current just as effectively as a much larger voltage change on the plate.

This means that, in the radio set, instead of applying the signal voltage to the plate circuit of a two-electrode vacuum tube to produce a variation in the plate current, if we apply it to the grid of a three-electrode tube, the same signal voltage will produce a much larger change in plate current and hence a greater movement of the earphone diaphram and consequently more

AN EXPLANATION OF AMERTRAN DELUXE EFFICIENCY



The above curves are plotted from measurements made in accordance with the latest tentative rules of the N. E. M. A. These curves have been proven conservative, and accurately represent the AmerTran DeLuxe Audio transformer.

For one and one-half years the AmerTran DeLuxe has been used with great success by all those seeking improved audio amplification. The secret of its excellence centers chiefly in the special alloy core material which provides the high inductance needed for the normal amplification of the fundamental base tones. This makes possible an improved coil structure for maintaining the higher frequencies with no appreciable "peak" or "droop" until beyond the useful range.

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The AmerTran DeLuxe is well made and designed to give long, dependable service. Metal cased and embedded in a solid compound, it is not affected by climatic changes.

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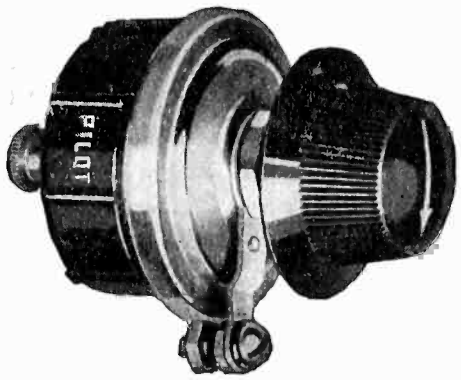

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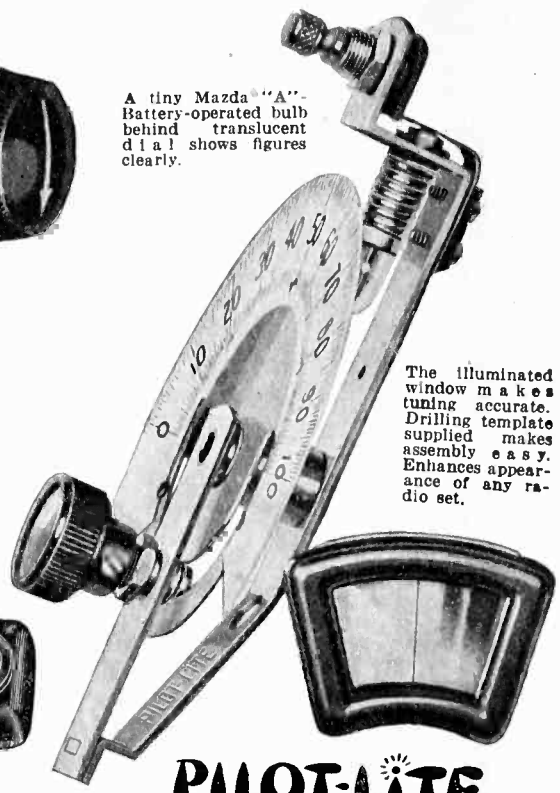
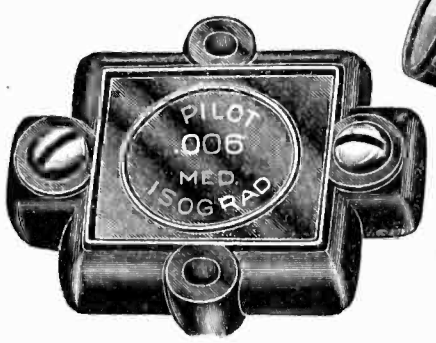
A tiny Mazda "A"-Battery-operated bulb behind translucent dial shows figures clearly.



The illuminated window makes tuning accurate. Drilling template supplied makes assembly easy. Enhances appearance of any radio set.



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volume. This apparent amplifying property of the three-electrode tube is one of its valuable properties.

In Fig. 38 are shown the various parts of a UX-201A tube. Looking from left to right we have the plate, grid, mounted filament, three-electrode assembly, assembly sealed in glass bulb, and the complete tube. Notice that in the final tube the V-shaped filament is in the center; around this is the spiral wire grid; and surrounding these is the solid metal plate.

The actual change in plate current due to change in potential on the grid is shown in Fig. 39 by the characteristic curve. This can be obtained by measuring with a milliammeter — a sensitive current measuring instrument—the amount of plate current passing when there is a definite voltage on the grid. The C battery, Fig. 37, allows a potential to be placed on the grid. It can be made stronger or weaker by varying the battery, and can be made positive or negative by reversing the connections of the battery.

The grid voltage can be varied and the plate current measured for each step, the plate voltage and filament current remaining constant. Three curves are given for various plate voltages. At zero grid potential, point A on the curve, the plate current has a definite value. As the grid potential is made more and more negative, the plate current decreases. As it is made more and more positive the plate current increases. The curve has two distinct bends; one at B and one at C. These are called the knees of the curve.

It is interesting to note that in the region of the negative grid potential, since there is no grid current flowing, we have the condition where a mere change of potential on the grid circuit controls the energy in the plate circuit.

In the practical operation of the tube, the temperature of the filament and consequent electron emission must be sufficiently high so that the normal plate and positive grid voltages do not cause saturation of the tube, for if this happens, the grid cannot control the plate current and the tube becomes inoperative.

Effect of Gas in A Vacuum Tube: The foregoing explanations of the actions taking place in vacuum tubes were based on the supposition of a very perfect vacuum in the tube. Under those conditions the tube operates entirely by the normal, unimpeded electron stream in the tube. If the space in the tube contains more than the slightest trace of gas, and the plate voltage is high, the operation is somewhat more complicated, and a larger plate current will usually flow for a given plate voltage, provided ionization takes place.

The actual rate of emission from the filament is not affected, but the liberated electrons on their way to the plate collide with the atoms of the gas. The electrons in the gas atoms revolve in orbits around the central nucleus and some of these orbits are quite distant, relatively, from the nucleus. Some of these far-out electrons of an atom collide with the emitted electrons from the filament and are carried along to the plate, by the action of the positive charge on the plate. The process of losing electrons from an atom is called ionization, and the part left behind is called an ion. Since the ion has a preponderence of positive charge because it is derived from an atom minus an

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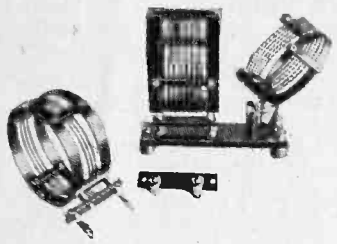

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Kit contains 2 AERO Coils, 17 to 50 meters each, 1 AERO Antenna Coil Mounting Base, 1 AERO Grid Coil Mounting Base, 2 AERO Essential Choke Coils. If you desire to have this set tune to 90 meters, simply buy two AERO 40 to 80 meter transmitting coils, which plug in the same mounting bases, and work efficiently with the above items.

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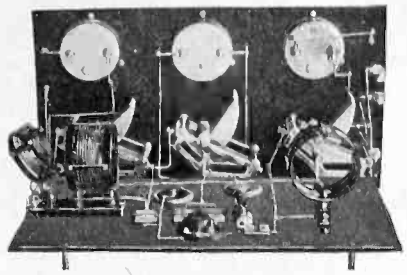

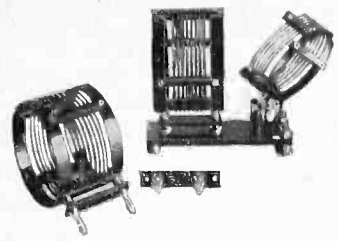

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AERO Essential Choke Coils
The finest Choke coil made.
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electron, it moves toward the filament and tends to reduce the negative space charge in the tube. Thus both parts of the disrupted atom contribute to the increased electron and plate current flow through the space. The action of a colliding electron upon an atom is called ionization by collision, and on account of it, larger plate currents will usually flow with given plate voltages in tubes having a poor vacuum.

Present day vacuum tubes of the common type are made with a high degree of vacuum so that no appreciable ionization takes place. In some special purpose tubes, as the Donle Sodion detector, ionization is employed to produce certain desired characteristics.

Ionization in a tube might at first seem desirable since its effect is to increase the plate current. Actually, however, it is undesirable since it stops the normal operation of the tube. Also, since the ions which are driven violently against the negatively charged filament are much more massive than electrons, the bombardment actually seems to tear away the surface of the filament, disintegrating it and reducing its useful life. Ionization in a tube is accompanied by a visible blue glow discharge. The tube becomes very erratic in behavior when in this condition. It is not sensitive as a receiver since the plate current becomes so large that it is unaffected by variation of the grid voltage. Some of the old gas filled detector tubes could be made to ionize strongly at plate voltages as low as 100 volts.

HARD AND SOFT TUBES: Soft tubes are particularly useful as detectors. Tubes having a very high degree of vacuum are called hard tubes. They make the best amplifiers.

WHO GETS THE GOOD RADIO JOBS?

(*Continued from page 321*)

to build on. Every radio manufacturer and dealer is continually pestered by enthusiasts who have an entirely superficial knowledge of radio, but notwithstanding this, sincerely believe themselves to be radio experts, and think they should be considered as such. When these untrained enthusiasts get up against real radio work and try to hold down a job that will make them money, they—and their employers—soon discover the error.

Serious consideration of the requisite qualifications of the radio expert and how they can be acquired is needed to guide into the right path enthusiasts of this nature—who wish to hold radio jobs but are doomed to inevitable failure by their lack of preparation.

FOUR WAYS TO SUCCESS

The various ways to attain proficiency in radio may be summed up in four general classifications, which will be taken up in the order of their merit.

Leading all others, of course, is the college course in electrical engineering, followed by post-graduate work in radio communication. If you have an ambition for a radio career, and your age and circumstances and previous education are such as to justify your doing so, by all means attend a recognized engineering college for

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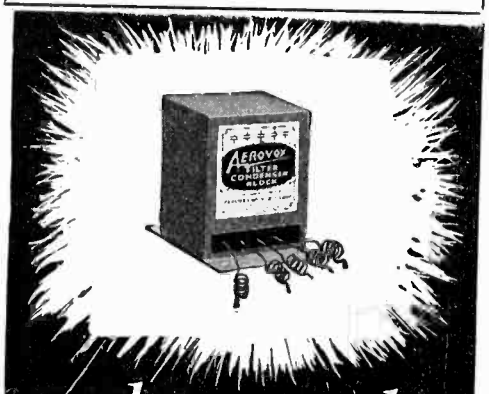

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at least four years. If you can continue your studies after you obtain your bachelor's degree, do that too. Six years of college engineering training are not too much preparation for the man who can afford it and who is at an age when he can spare the time, for such technical training, combined with ability and application, will prove a key to the very highest posts of the radio profession.

Many men, however, cannot attend an engineering college because they do not have a high school education. Still more cannot spare the money involved, or undertake the years of study required. For such men there are three other methods of entering the radio profession on a basis of sound preparation.

It is true that only by attending an engineering college for four years or more, can all the advantages of such training be gained. But it is possible to strip from such a training many elements which are not strictly essential to entering the radio profession and succeeding in it. Obviously, what a man really must know to be a radio expert is radio. The higher mathematics, general physics, and chemistry—not as applied to radio—and many other allied subjects, while useful and deserving of their place in the college curricula, are not requisite to an entrance into the radio profession.

Practical schools, organized to give technical training to the man who cannot go to college, have recognized this truth, and they supply the basic idea of their training courses. Such schools, teaching both by the resident and home-study methods, constitute two of most widely-used means of getting into the radio profession. The writer has conducted both resident and home-study radio schools of this type since 1914, and has been able to watch growth and development in this field from the beginning. Starting as training schools for radio operators—for ship operating and commercial land jobs—the best of such schools have amplified and developed their courses with the growth of radio, until now they offer in short courses about all the purely radio knowledge that can be given in a college engineering course; and actually do far more in the way of teaching

from A to Z

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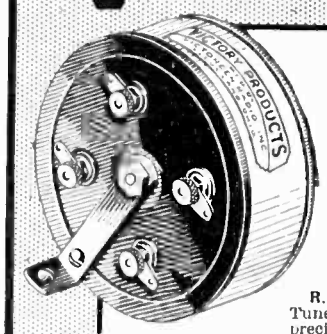

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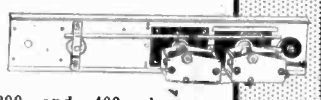

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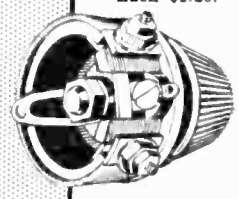

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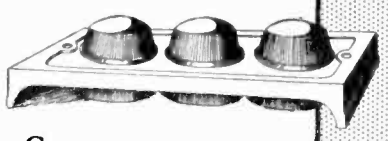

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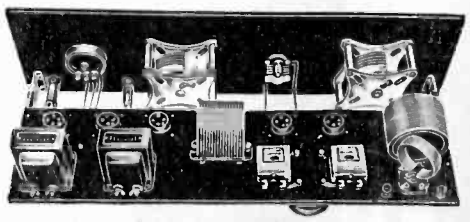

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practical applications of this knowledge than do the colleges.

For the man who can afford to leave home and live some months without earning anything, there are resident schools of this nature; for a man who is tied down by responsibilities, the necessity of holding a job, or financial matters, there are correspondence courses by means of which he can learn radio at home in his spare time, in about a year's study.

After completing these practical technical courses the student finds himself well equipped to enter the radio field, and the theory is that should he find later on that his work would be helped by any subject allied to radio, such as the higher mathematics, he can learn the allied subject at that time.

The last, and least satisfactory method of entering the radio field is by the "experience route".

There are numerous handicaps imposed on a man who endeavors to acquire the radio science in this way. First is the insuperable obstacle that no man who works with him can teach him more than that man himself knows. Then there are only a few men with the ability to impart knowledge clearly, and the chances are that the aspirant will not be directly associated with one of them. A radio business is not a training school, and the ambitious beginner who tries to learn through an apprenticeship will find it a long and difficult route, with no certainty that his goal is to be found at the end of it.

Radio engineers developed by the engineering colleges as yet are few in number. Not many engineering colleges at present have the facilities to offer adequate specialization in radio to their electrical engineering students. It is true, there are a few notable exceptions. But many undergraduates in the engineering colleges today are studying with the practical radio schools, by correspondence, in order to get the specialized radio knowledge they want. The great majority of the trained men in the radio profession today have come from these practical, specialized radio schools.

The conclusion of Mr. Smith's article will appear in the May issue