THE PILOT SUPER-WASP

By ROBERT S. KRUSE

VERY seldom is one permitted to hear anything about a receiver except an explanation of the good points of the final set. This story will violate the traditions by telling how the receiver came into existence, and what it will *not* do. This is done with the conviction that the prospective buyer will be better off if he knows these things and that in the end he will find more uses for the Super-Wasp, whose performance need not be apologized for.

Some months ago the Pilot organization became displeased with the short-wave receivers then available. Analysis showed that without exception they suffered from one or more defects, which may be listed as follows:

Flimsy plug-in coils.

Poor contacts between coils and set.

Difficult tuning because of hand capacity or by reason of tuning effect of regeneration control.

Noisy or inadequate regeneration control.

Set of no use in the ordinary broadcasting range of 200-500 meters.

The first two defects were cured at one motion by the adoption of a ribbed bakelite coil form with pins fitting a UY tube socket. This was a construction which the writer had vainly tried to introduce to several makers. It has been rather amusing to watch the haste with which they followed the Pilot lead.

The set was also made useful in the broadcast range by adding a 200-500 meter coil to the usual short-wave coils.

There remained the regeneration problem. Resistance control is smooth but frequently not adequate, beside being subject to a distressing tendency toward noisiness. Condenser control was used.

Thus we had a Pilot UY-base coil connected to a tube which worked as a regenerative detector. With a set of five of these coils a continuous range (with good control) could be obtained over the whole region of 17 to 500 meters, which is to say, the short-wave region plus the important part of the broadcast range.

About the Author—

MR. ROBERT S. KRUSE, the designer of the new Pilot Super-Wasp, is without question one of the world's foremost short-wave experts. For five years he was technical editor of "QST," the official organ of the American Radio Relay League, and in that capacity was probably more intimately concerned with the extraordinary development of the short waves than any other single radio engineer. We are sure our readers will be greatly interested in this fine receiver, his latest development.—EDITOR.

THE WASP TUNER

Having a satisfactory short-wave-and-broadcast detector system, the question now was whether we should merely add an audio amplifier or at once attempt a stage of R.F.—or perhaps two stages. Even a very brief analysis showed that it would be wise to defer the R.F. stage until several questions could be replied to in better form than that represented by the short-wave tuners then on the market. The Wasp therefore appeared with an audio amplifier only. Having but three tubes it made small demand on batteries and was therefore offered as a battery-driven set in preference to encountering the added cost of an A.C. set.

Seemingly the set so devised was satisfactory, for it has been exceedingly well received by short-wave broadcast listeners, by those who wanted a portable set for regular broadcast reception and by radio amateurs who desired to receive amateur radio-telegraph (so-called "code") signals. Since the amateur bands are very narıuw a modification of the usual Wasp set is useful in spreading them over the dial and the way of doing this has been described in an article by Harold P. Westman in the September, 1928 issue of QST. It is altogether the nicest "band-covering" tuner I have seen and those interested in this sort of work should obtain a copy of the issue mentioned.

THE NEW SUPER-WASP

Having found the Wasp to be satisfactory in the field as well as in the laboratory, we were encouraged to proceed with the original purpose of using a stage of tuned R.F. This has been done in the Super-Wasp, to the final form of which the entire Pilot staff has contributed in one manner or another. A considerable portion of the work was done simultaneously in New York, by John Geloso and Robert Hertzberg, and at the writer's home in West Hartford, Conn., so that independent information might be used to disclose any of those errors which happen too often when all work together at one place and become victims of an opinion.

Beginning with the matter of shielding, one had at once the question of the material to be used and the thickness required. Aluminum has some evident advantages in that it does not tarnish readily, may be formed easily and is light. It was therefore used and a light gauge made possible by placing the R.F. shield and the detector shield at opposite ends of the set. The baseplate or "subpanel" of the set was made of much heavier sheet aluminum so as to provide a zero-potential plane which would not be upset by currents flowing in it. For the same reason also the panel was made of heavier material.

There is not space here to discuss the reasons which led to the particular location of the wiring, the use of a ground at each socket, the series feed of the 222 plate supply through the tuned detector-feed circuit, or the rather unusual circuit arrangement inside the cans. We can say only that the R.F. amplification obtained has been so adjusted that it produces a very handsome improvement in performance (as compared with the Wasp) while at the same time assuring a gratifying freedom from "crankiness." Since the set is to be used with all sorts of antennas this obviously means that the R.F. gain cannot be pushed to extremes.

For this no apology is offered. On the contrary, I wish to assert that any materially greater gain would be worse than useless since the "useful selectivity" of the set would be ruined thereby, besides creating operating difficulties in the way of uncontrolled oscillation when the set is worked under improper conditions. The practical set for sale in kit form is the one which *works* when correctly assembled—not the one which works *if* everything is exactly and critically adjusted.

Reference to selectivity and sensitivity naturally calls for comparison with normal broadcast receivers, since the set also covers this range. At the time that this is written my measurements are not complete. They do, however, show that the sensitivity is materially better in the short-wave region than that of any other set I have encountered, excepting only double-detection receivers using six or seven tubes and much more equipment.

The Best Short-Wave Set—

THAT is the comment made by everyone to whom the advance models of the Super-Wasp were shown. The points of superiority are as follows:

1) *Increased sensitivity and selectivity made possible by the TUNED screen-grid R.F. stage.*

2) *Universal wavelength range. Tunes from 14 to 500 meters. An excellent broadcast receiver as well as the finest of all short-wave sets.*

3) *Absolutely no "hand capacity" effects.*

4) *Completely shielded.*

5) *Easily assembled and wired from kit of parts.*

6) *Inexpensive.*

And last, but most important,

7) *Ability to bring in short-wave broadcasting stations better than all previous short-wave receivers.*

Build a Super-Wasp and experience the greatest of all radio thrills—hearing foreign broadcasting stations. The editor of RADIO DESIGN, while testing a Super-Wasp for a few minutes after dinner and then again before going to bed (location: New York), heard stations in Chelmsford, England; Manitoba, Canada; and Costa Rica, Central America! These were broadcasting voice and music, NOT CODE.

AN EXCELLENT BROADCAST SET

In the broadcast region the Super-Wasp can be thought of as comparing very nicely indeed with other four and five-tube sets. Obviously one must not expect the same selectivity from two tuned circuits as from three or four, nor will a single 222 develop the same gain as a number of the same. It is therefore not pretended that seven-tube performance has been obtained. None the less, both the sensitivity and the selectivity are such as to permit good use of the set to be made in the normal broadcast band whenever the short waves are behaving badly. Similarly, when the normal receiver is struck by a "dead evening," the Super-Wasp need but be shifted to the short waves.

Thus far nothing specific has been said as to either sensitivity or selectivity. With regard to the short waves this cannot be helped. We have no really reliable method of making gain-measurements at (for instance) 20 meters. One is referred to listening tests, the results of which are never too good. However, work on signals and on a weak oscillator produced figures which at least justify the statements that have been made.

In the broadcast region the usual rating by input microvolts is less important here than some comparisons with familiar receivers. Here a detour is necessary.

The first model Super-Wasp had been provided with R.F. coils carrying primaries, also providing for condenser feed from the antenna to the top (grid) end of the tuned circuit. This was the same arrangement that had been used in the original Wasp receiver. It was found that the condenser feed was not well suited for use in the broadcast region of 200-500 meters for the reason that satisfactory coupling could not be obtained unless the feed condenser was enlarged materially. When this was done the condenser was of a capacity which tuned the antenna as a series system and produced a condition of two-frequency response—a wholly inoperative condition.

AUTOMATIC AERIAL CHANGEOVER

The user would find this out for himself, just as he had in the simpler Wasp receiver, but the shifting of the antenna is less convenient in the case of a shielded set of larger dimensions. It was therefore decided to use a device suggested by Mr. Geloso. This was a set of coils so connected that the 200-500 meter coil carried an antenna, or primary, coil, while the others had none and were so connected that the feed-condenser was automatically connected in when they were put into the socket. Thus without any need for two antenna posts it was possible to use the primary coil in the 200-500 meter region while retaining the convenient feature of variable coupling through a small condenser at shorter waves.

Having arrived at this point, it was believed that the short-wave performance could be taken for granted, with the possible exception of the regeneration control. The broadcast-range response was again checked and the primary, or antenna, coil adjusted so that the average receiving antenna will have somewhat more coupling than is strictly necessary. The proper value may then be obtained by putting into the antenna lead a "postage stamp" mica condenser whose value is to be found by trial. There is nothing critical about this and the proper value will be found by trying .0005, .00025 and .0001 mf., all of which are usually at hand. With smaller antennas the condenser is not needed.

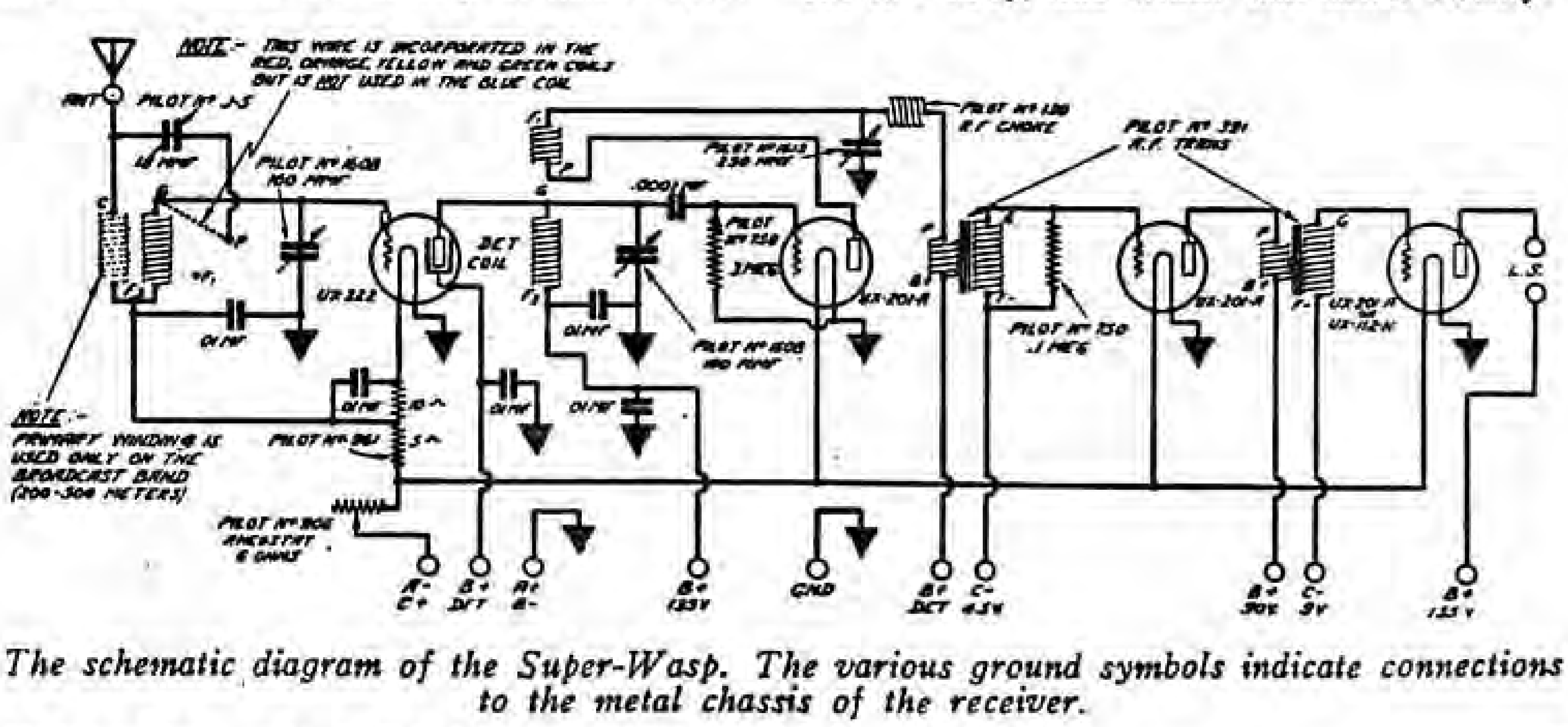
This is the antenna arrangement in the present receiver. Using a moderate but steady broadcast signal from WEEI and one from WCAC, as fairly well representing the ends of the broadcast spectrum, some rough measurements were made of the voltage across a loud speaker, first obtaining the resonance voltage and then detuning until the signal was supposed to be "tuned out." For the latter there was taken the arbitrary value of one per cent as high a voltage. The difference in ear-response is materailly greater than 100 to 1, and the assumption is therefore fair enough.

It was not desired to strike any particular value of sharpness of tuning but rather to make sure that over the 200-500 range the sharpness compared decently with sets that have been found acceptable for regions in which battery-operated sets are used for broadcast reception. It was realized fully that one cannot, with two tuned circuits, obtain extreme selectivity except by the use of a small antenna. This does no harm, since the city-dweller can use such a 10-30 foot antenna with perfect satisfaction. It is effective on short waves and his 200-500 meter signals are strong because of their nearby origin, hence can also be received on such an antenna.

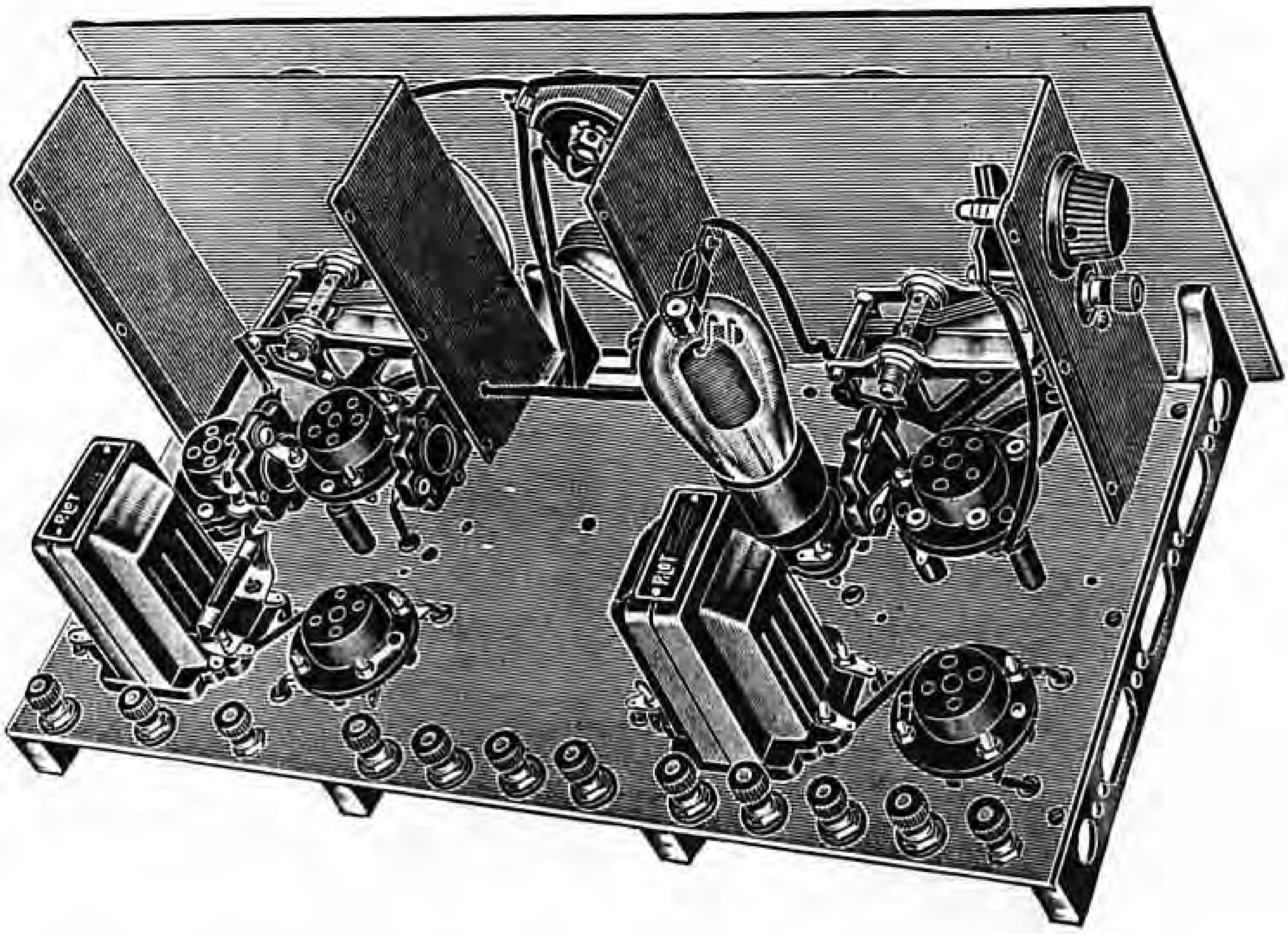
The comparison was therefore made as to both sensitivity and selectivity (by the detuning method mentioned) on the Super-Wasp, on a very popular set with a stage of 199-tube tuned R.F. on a set with an "untuned" 222, and on a set with a tuned 222 having its condenser ganged with that of the detector. All of the sets used a regenerative detector and two audio stages.

Next after the Super-Wasp the set with the 199 stage showed the best gain, likewise the best flatness of response over the 200-500 meter region. The Super-Wasp had a considerable advantage, however. The gang-tuned job was very uneven because the condensers did not run together, especially on the smaller coils. For this exact reason the Super-Wasp was made two-control.

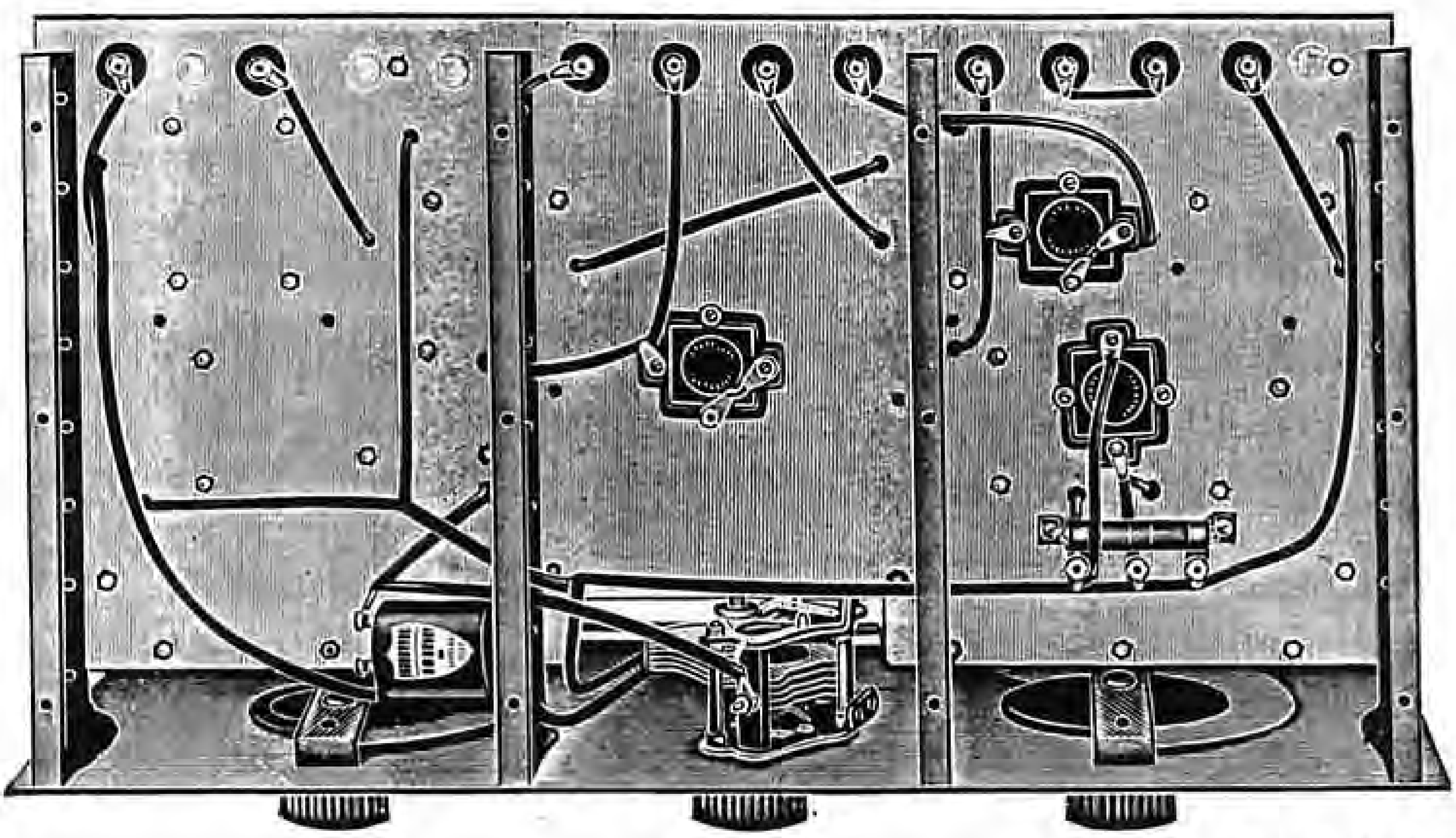
As to sharpness of tuning, the Super-Wasp gave a performance which can be measured by the dial-movement required to produce the 100-to-1 drop, and which was about twenty-



The schematic diagram of the Super-Wasp. The various ground symbols indicate connections to the metal chassis of the receiver.



Above: The assembled and wired Super-Wasp with the backs of the two shield cans removed to show the placement of the parts. Notice how the two five-prong sockets for the plug-in coils are elevated above the sub-panel by insulating bushings. Below: what you see when you turn the set over. The three fixed condensers are spaced away from the sub-panel by ¼-inch hexagonal spacers. The various wires running through the sub-panel pass through eyelets which have smooth sides that will not cut the spaghetti.



five per cent better over the whole region except at the 500-meter end, where the difference was smaller.

REGENERATION-TUNING

One thing that one does not want in a receiver is to have the regeneration control affect the tuning. Since condenser control of regeneration is being used, the suspicion naturally arises that a disagreeable amount of this effect will be found. In the broadcast (200-500 meter or blue coil) region this will be found to be entirely wrong, the tuning effect being exceedingly small. As the smaller coils are used the effect begins to be perceptible, though never very serious. When the smallest, or red, coil is used it will be found that the antenna tuning is somewhat less sharp than before and one may therefore set it at about the right value, after which the regeneration control and the detector-tuning may be handled easily together.

When proceeding in this manner one does not become particularly conscious of the remaining tuning effect, while one does at the same time remain thankful for a control method that works on the smallest coil as well as the largest—which is not the least important manner in which the Super-Wasp differs from current practice.

THE RECEIVER ITSELF

Now that something has been told about the background of the Super-Wasp, we can proceed to a description of the final receiver as it is assembled from a complete kit of standardized parts made up by the Pilot company. The illustrations on these pages show a finished set made exactly in accordance with the following instructions and with the accompanying illustrations. When you buy a kit you will receive with it a set of full-size blueprints which will greatly facilitate your work.

It should not take you more than an hour and a half to assemble a Super-Wasp. Once you have mounted everything, you should be able to wire the whole outfit in another hour, or even less. The arrangement of the parts has been worked out so carefully that most of the connections are only an inch or two long; all the longer leads are part of the filament circuit, which is not critical as to length of wiring.

Before tightening up a single screw, take out all the parts from the box, unwrap them, and place them before you on the table. Study the illustrations and drawings very carefully, and identify each piece of apparatus. Don't rush right into the assembly work the minute you receive your kit; the few minutes you spend in studying the various parts will make up for themselves many times over when you start mounting sockets, condensers and transformers.

THE NECESSARY PARTS

The following Pilot parts are used in the construction of the Super-Wasp:

1—No. 705 metal front panel, 7½ x 18 by 1/16 inches, drilled and engraved.

1—No. 706 metal sub-panel, 8 x 17 by 1/16 inches, drilled with all mounting and wiring holes.

4—No. 37 metal sub-panel brackets.

2—No. 1608 .00016-mf. variable condensers.

1—No. 1613 .00025-mf. variable condensers, with bakelite knob.

2—No. 1282 illuminated vernier dials.

1—No. 906 rheostat, 6 ohms.

1—No. 961 tapped resistor.

2—No. 600 special Super-Wasp shield cans.

1—No. J5 midget condenser, 5 plates.

2—No. 931 audio amplifying transformers.

2—No. 212 five-prong sockets (for plug-in coils).

2—No. 206 four-prong shock-proof socket (for 222 and detector tubes).

2—No. 213 four-prong sockets (for audio tubes).

2—Pairs grid-leak clips.

1—No. 758 3-megohm grid leak.

1—No. 750 100,000-ohm grid leak.

1—No. 50B fixed condenser, .0001-mf.

5—No. 59 fixed condensers, .01-mf.

1—No. 130 R.F. choke coil.

2—Sets of plug-in coils, made especially for the Super-Wasp; Nos. 601A and 601D.

4—Packages of hardware, including thirteen binding posts, ten sets of insulating bushings for them, four lengths of spaghetti tubing, 12 feet of tinned copper wire, all necessary nuts, bolts and washers, Mueller clip for connection to screen-grid tube, and six special double-end lugs for mounting of fixed condensers.

The only tools you need in assembling the Super-Wasp are a screwdriver, a pair of long-nosed pliers, and a Spintite wrench to fit the small 6-32 nuts used throughout in the set.

GETTING STARTED

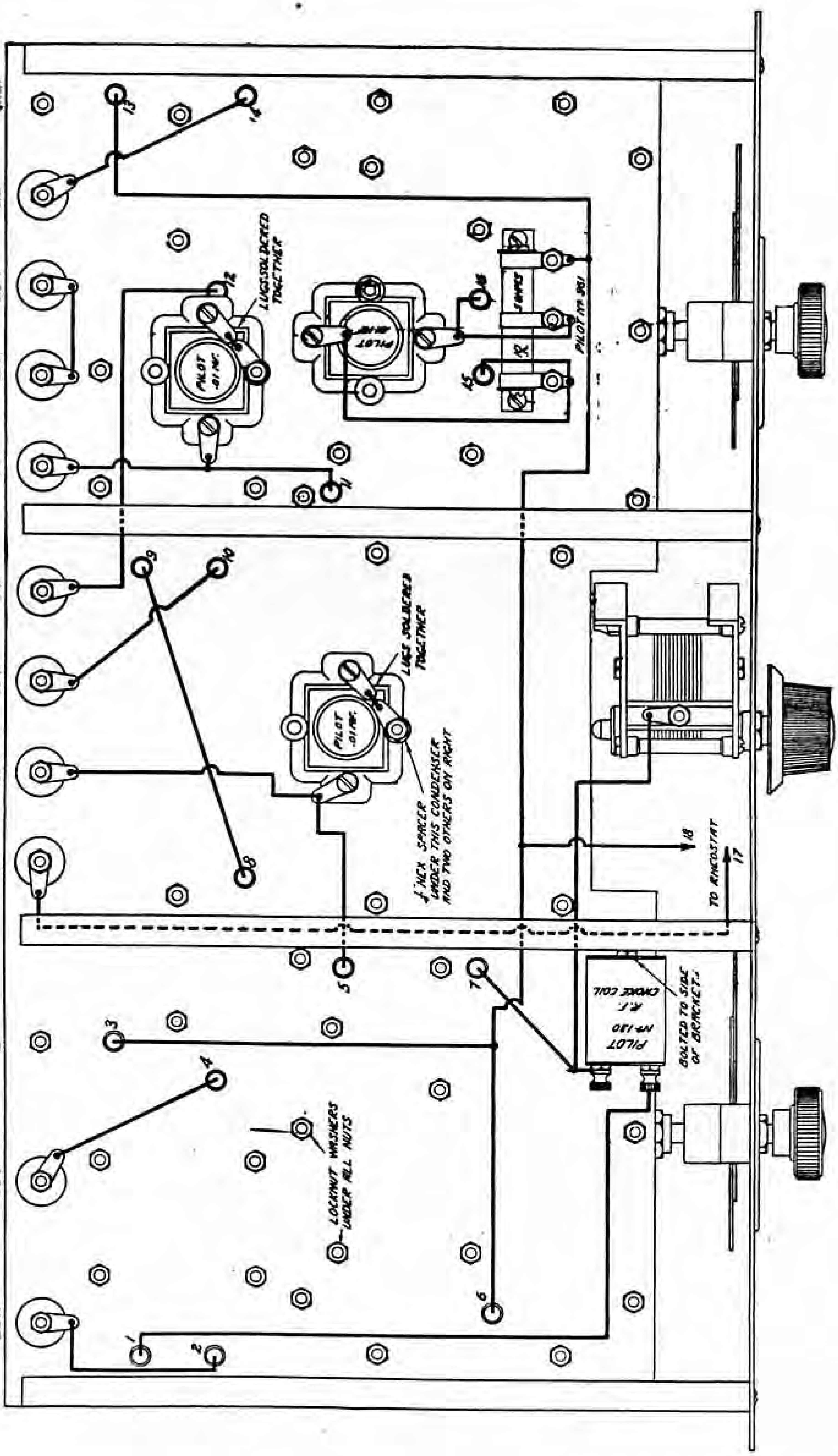
Commence by screwing the sub-panel to the four brackets. Put three ⅜ inch oval head screws through each, using a lock nut washer and a nut on the under side. The brackets are spaced uniformly along the sub-panel, and you cannot mount them incorrectly because of the accurate drilling of the holes.

Now place the front panel against the upright feet of the brackets, and screw it in place with two nuts per bracket. Again do not fail to place locknut washers under the nuts. The panel will now be straight and rigid, and you will be able to work on it comfortably.

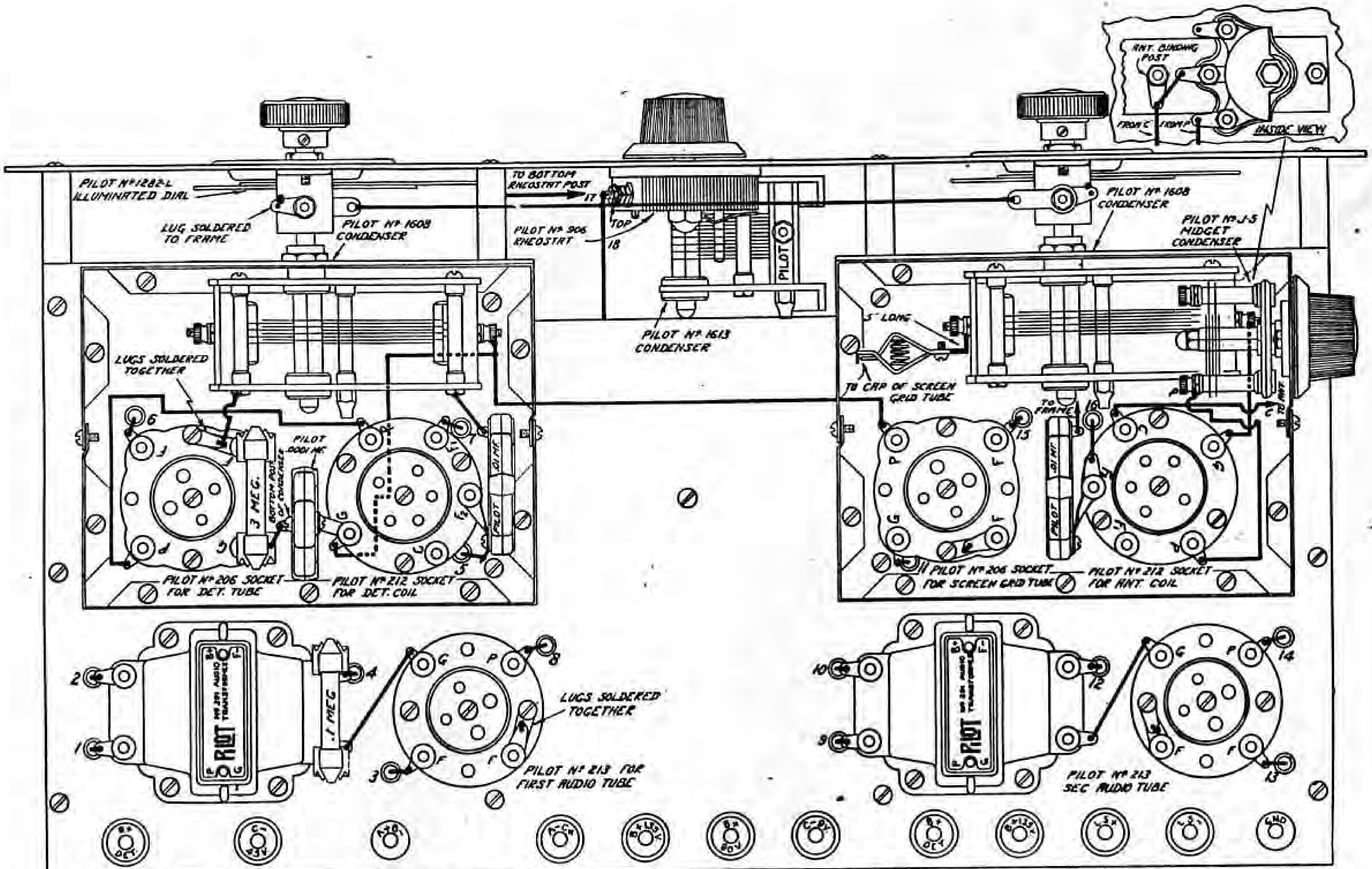
The first thing to mount on the front panel is the single No. 1613 .00025 mf. variable condenser, which is the regeneration control. This fastens with a single nut. Mount it upright, as shown, so that the rotor plates open out to the left. Put a soldering lug on the bottom stator binding post.

All directions as to right and left will be given with the understanding that the rear edge of the sub-panel is nearest you, as you will do most of the work from the back.

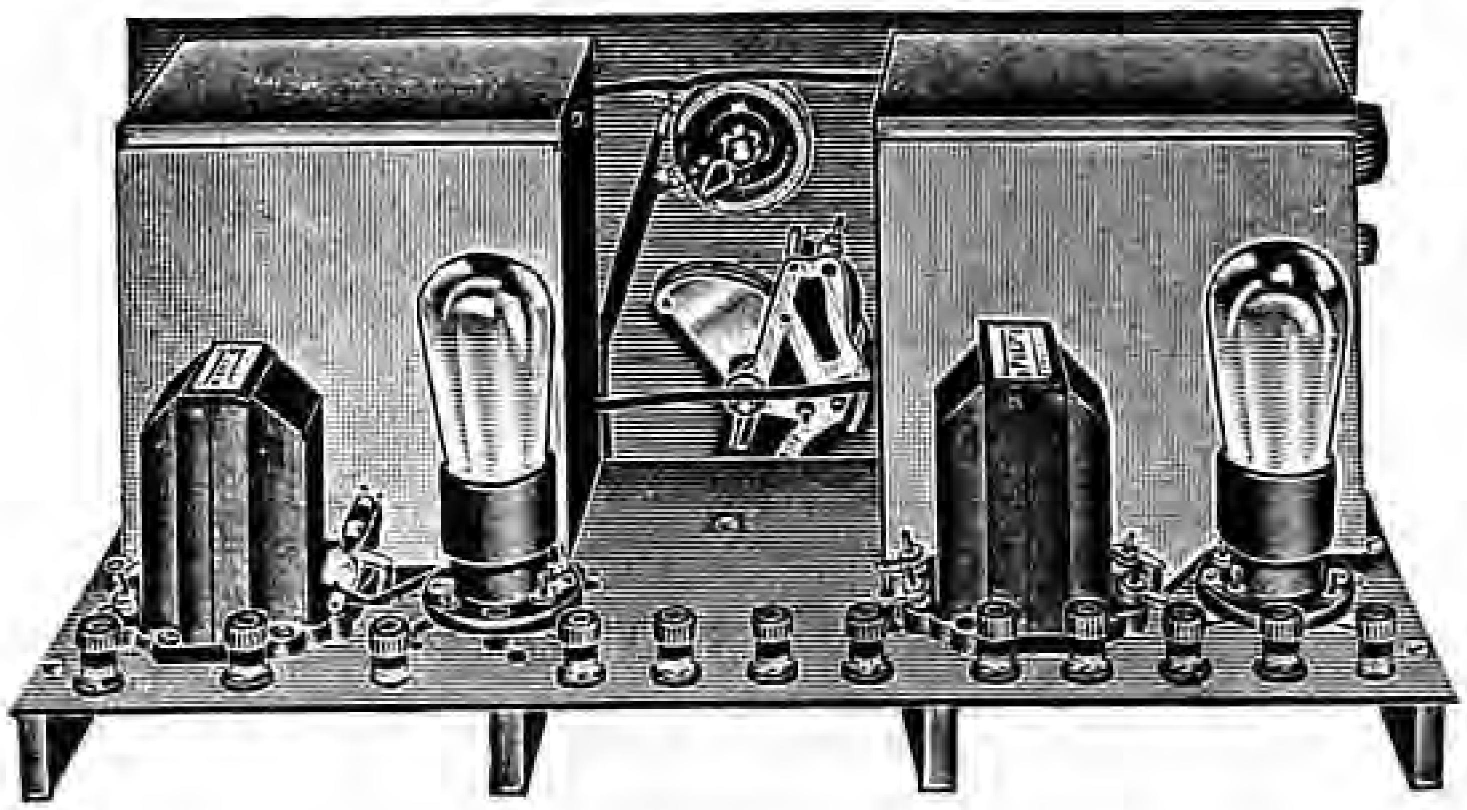
Next comes the rheostat, which fits directly above the regeneration condenser. Break through the two holes in the bakelite base, using a nail or a scriber, so that 6-32 screws ½ inch long can be pushed through. Mount the rheostat with a couple of these screws, keeping it spaced away from the back of the front panel by means of two of the special ¼ inch hex spacers slipped over the mounting screws. The idea of this spacing, and also



B+ DET.
C- 4.5 V.
A+ B-
A- C+
B+ 135 V.
B+ 90 V.
C- 9 V.
B+ DET.
B+ 135 V.
L.S.+
L.S.-
GND.
LUGS SOLDERED TOGETHER
LUGS SOLDERED TOGETHER
PILOT .01 MF.
PILOT .01 MF.
LOCKNUT WASHERS UNDER ALL NUTS
TO RHEOSTAT
BOLTED TO SIDE OF BRACKET
PILOT No 130 R.F. CHOKE COIL



Complete picture wiring diagrams of the Super-Wasp. When you wire the set, put a tack through the center of the preceding page and into the wall, so that will be able to view both these drawings at once. Notice particularly how one F post of each four-prong tube socket is grounded to the chassis through the adjacent socket mounting screw. Study the litte notes on the drawings carefully before starting the wiring.



Rear view of a complete Super-Wasp with the shield cans in place and with the two audio tubes in their sockets. The antenna plug-in coil and the screen-grid tube are enclosed in the can at the right, and the detector coil and the detector tube in the one at the left.

of the large hole for the shaft, is to insulate the rheostat completely from the panel. Put one soldering lug on the lower binding post, and two on the upper post, one facing down and the other up.

Take the vernier dials, and mount them in accordance with the directions included in the packing boxes. Remove the slotted back pieces entirely, as they will not be used. Do not turn in the panel screws and nuts tightly until after you have mounted the variable condensers and the back sections of the shield cans. You will notice that the dial mounting holes in the front panel are slightly oval in shape, to allow the screws to be tightened in the best positions.

Put the covers of the shield cans and their back sections out of the way, as you will not need them until you have assembled and wired the whole set; the back sections will then slip nicely in place, and you will fasten them down to the sub-panel with a few screws.

MOUNTING THE SHIELDS

Mount one of the No. 1608 .00016-mf. condensers on the rear side of the shield can that has a small bakelite strip riveted to its right side. Use only the single large mounting nut, and twist the condenser so that the edges of the stator plates lie parallel with the top edge of the can. Mount the J5 midget condenser in the large hole in the bakelite strip, and an "Ant" binding post in the other hole.

Put the shield aside for a moment and mount the No. 961 resistor on the under side of the sub-panel, using two ¼-inch round head screws pushed through from the top side of the sub-panel. It is necessary to do this now because the variable condenser will cover the holes after the shield is mounted in place. These holes for the resistor are near the inside edge of the sub-panel, and you can locate them by studying the picture wiring diagrams closely.

Place the can on the sub-panel so that the shaft of the No. 1608 condenser slides into the mounting stud of the right dial. Screw the can down to the sub-panel using ¼-inch screws through the drilled feet. Turn the dial to 0, pull the condenser plates out until they are entirely unmeshed, and then tighten the set screw in the stud of the dial. Finally, tighten up the screw and the nut that hold the dial on the panel.

Repeat these operations, except for the detail of the midget condenser, with the other No. 1608 condenser and the other shield can. The mounting of the condensers is really half the work of the set, and if you follow the foregoing directions carefully you will have no trouble.

ELEVATING THE COIL SOCKETS

In one of the hardware packages you will find six long 6-32 screws and six hard-rubber bushings one inch long. These are for the mounting of the five-prong sockets, in which the plug-in coils fit. Study the picture wiring diagram closely, and note the way the sockets are placed as regards the binding posts. The actual mounting is easy enough. Simply pass the long screws through the sockets holes, through the hard-rubber bushings, and then through the sub-panel, fastening them on the under side with locknut washers and nuts. Hold the heads of the screws with the screwdriver, and tighten the nuts with the Spintite wrench or the pliers.

The long screw that passes between the two F posts on the five-prong socket for the antenna coils also holds, on the under side of the sub-panel, one of the .01-mf. fixed condensers, which is marked C1 in the blueprint. Slip a ¼-inch hex washer over the end of this screw, place the condenser over it, and then tighten with a nut.

Another of the .01-mf. condensers is fastened and connected directly to the variable condenser and to the F2 post of the five-prong socket in the right-hand can, which houses the components of the antenna or R.F. stage. Put a double-end lug under each terminal screw of the condenser. Bend one lug at right angles and tighten the free end over the short mounting stud on the back of the variable condenser, using a ¼-inch screw. Twist the other lug so that its free end will fit over the F2 socket post, with the condenser standing upright.

Proceed to the left can, and mount another of the .01-mf. condensers in the same manner. One lug goes under the F2 post of the five-prong socket, and the other under the nut that holds the right side of the condenser frame together. The .0001-mf. grid condenser is similarly mounted between the G post on the elevated socket and the G post on the No. 206 socket next to it.

GROUNDING THE FILAMENTS

This method of mounting the blocking and grid condensers practically eliminates wiring in the critical radio-frequency circuits, and is responsible to a great extent for the smooth operation of the Super-Wasp.

Proceed with the assembly work by mounting the three remaining tube sockets. Put a soldering lug under the head of one of the screws going through each socket, as shown in the picture wiring diagram; these lugs are soldered directly to other lugs fastened beneath the F posts, which are thus grounded to the aluminum framework of the set.

Mount the binding posts, using the insulating bushings for all posts except the "A" plus "B" minus, which is third from the left and "Gnd," which is all the way over on the right. Place soldering lugs beneath the mounting nuts on all the posts except these two, which automatically connect with the framework.

Fasten one pair of the grid-leak clips to the G and F posts of the detector-tube socket, which is in the left can, and the other pair to the G and F posts of one of the audio transformers. Do not mount the transformers yet.

Before going any further, do as much wiring inside the shield cans as possible with the audio transformers out of the way. The wire between the P post of the No. 206 socket in the right shield can and the stator post of the variable condenser in the left can passes through holes in the facing sides of the shields. Of course use a piece of spaghetti over the wire to prevent it from short-circuiting against the metal.

The wiring is so exceedingly simple that no detailed explanation of it is necessary. The three variable condensers are automatically grounded to the framework, as is one side of each of the tube sockets. The mount of wiring is thus reduced fully fifty per cent from what it would be with an unshielded set. Wherever a ground symbol is shown in the schematic diagram, it indicates a connection made to any part of the framework.

For the wiring, use the tinned copper wire and the fabric tubing ("spaghetti") furnished with the kit. Solder all connections with a clean, hot iron, and use nothing but rosin-core solder.

After you have wired the sockets and condensers in the shield cans, mount the audio transformers in place, putting the one with the grid leak clips on it in the left position—in back of the detector compartment. Use ½-inch screws through all the transformer holes except the one in the upper right hand corner of the right hand transformer—the one in front of the antenna shield can. Use a 1-inch screw here. Slip a ¼-inch hex washer over its end on the under side of the sub-panel, and then fasten down a .01-mf. condenser (C2 in the blueprint) by means of the same screw. Put a soldering lug under the fastening nut.

The last .01 condenser (C3 in the blueprint) is fastened by means of a separate ½-inch screw in the center of the sub-panel. After doing all this you can complete the wiring in short order.

You will notice that some holes in the sub-panel are fitted with eyelets, and that others are not. The bare holes are for mounting screws, while the eyeletted ones are for connections that pass through the aluminum. The eyelets are not insulated, but provide smooth holes through which the spaghetti can be pushed without being cut.

You will also notice in the picture layouts that the wiring holes are correspondingly numbered in the top and bottom views. This is to help you in locating the holes when you are turning the set upside down during the wiring process.

With all the wiring finished, place the backs of the shield cans in place, and screw them down. Use the very short 6-32 screws for fastening the upright edges together. You are now ready to connect the set to the batteries and to start receiving signals.

However, first make certain that none of the binding posts except the "A" plus and the "Gnd" is short-circuited to the sub-panel. Use the old battery-and-phones test.

GETTING INTO OPERATION

Two sets of plug-in coils are furnished for the Super-Wasp, one set acting as antenna coils in the R.F. stage and the other as interstage coils between the plate of the screen-grid tube and the grid of the detector. The red, orange, yellow and green ring coils for the antenna position contain only one winding apiece; the blue ring coil, covering the broadcast range, has two windings, a primary above a secondary.

(Continued on page 51)

The complete set of plug-in coils for the Super-Wasp. Left, antenna stage coils; right, detector stage coils. Their wavelength range is 14-500 meters.

THE PILOT "SUPER-WASP"

(*Continued from page* 15)

These coils are thus easily distinguished from the detector stage coils, all of which have two windings apiece, a grid winding above a tickler, and four connections pins in the base. The coils are always used in pairs; that is, if an orange ring coil is in the first can (the R.F. stage), the other orange-ring coil must be used in the detector can.

The tuning ranges of the coils are as follows:

Red: 14 to 27 meters, 21,420 to 11,110 kilocycles.

Orange: 26 to 50 meters, 11,540 to 6,000 kilocycles.

Yellow: 50 to 100 meters, 6,000 to 3,000 kilocycles.

Green: 100 to 200 meters, 3,000 to 1,500 kilocycles.

Blue: 200 to 500 meters, 1,500 to 600 kilocycles.

TUBES AND VOLTAGES

A 222 screen-grid tube is used in the R.F. stage—in the left can. (You are now regarding the set from the front). Tubes of the 201A type are specified for the other positions, but you may also use a 200A as detector, with increased sensitivity but also increased noise level, and either a 112A or a 171A in the second audio stage. You will notice that separate "B" and "C" leads for the plate and grid return leads of both audio stages have been provided, so that you may use any of the three combinations with the correct plate and biasing voltages as specified by the tube manufacturers.

If you use 201A's, run one wire from the 90 volt tap of the "B" batteries to both the first "B" + 135 post (next to the L.S. post) and the "B" + 90 post; similarly bridge the "C" — 4½ and "C" — 9 posts, and use 4½ volts on both. The "B" + Det post next to the "C" — 9 post takes 45 volts for the screen-grid of the 222 tube, while the other "B" + 135 post takes this much voltage for the plate of the 222 tube.

TUNING THE SUPER-WASP

For detailed instructions on tuning the Super-Wasp, see the article entitled "How to Get the Most Out of Your Short-Wave Receiver," elsewhere in this issue. You simply keep the left dial more or less in step with the right dial, and manipulate the regeneration condenser in the manner described. The setting of the small aerial condenser, on the left side of the left shield can, is not critical, and you can mark the best positions with pencil lines right on the aluminum.