The Pilot
A.C. SUPER-WASP

The First Short-Wave Receiver that Works Successfully on Alternating Current; Additional Features are Tuned Screen-Grid Stage, Double Shielding and 14-500 Meter Wavelength Range

by DAVID GRIMES

THE usual procedure in describing a new circuit is to delve at once into the various peculiar ramifications of that particular hook-up. We have decided to adopt a slightly different method of approach for the A.C. Super-Wasp, because the laboratory development of this unique arrangement has been most romantic. More than half the interest of the story would be lost if we were to confine ourselves solely to the technical description, without taking you with us over the path of progress which was so persistently pursued for almost a year. Accordingly, our narrative starts with the successful completion of the battery-operated Super-Wasp; for no sooner was this task accomplished than the laboratory facilities were concentrated on its complete electrification on A.C. circuits.

Now in view of the satisfactory electrification of other types of receivers, the problem confronting us seemed rather simple. It didn't take very long, however, to completely disillusion us on this point. The A.C. operation of broadcast sets was an entirely different proposition than that presented by the multi-range Super-Wasp. It was one thing to design a receiver that was commercially humless in loud speaker performance and quite another to find a circuit combination that would permit the use of telephone receivers.

WAVELENGTH DIFFICULTIES

Then, again, a few circuit experiences were sufficient for quelling the hum in any one receiving band; but the difficulties of the problem were considerably multiplied by the necessity for the Super-Wasp to properly perform over a multiplicity of wavelengths. Circuit combinations that were absolutely noiseless on the broadcast range were impossible on the shorter waves. And last, but not least, the regenerative detector of the Super-Wasp added a particularly knotty problem, as hums that were not noticeable on straight detection became veritable Niagaras when the regeneration control was brought near the sensitive point.

So you see, the job we had cut out before us was a mean one and well destined

Front panel view of a completed A.C. Super-Wasp.

No more batteries! At last you can enjoy the thrills of short-wave reception with all the conveniences of full lamp-socket operation

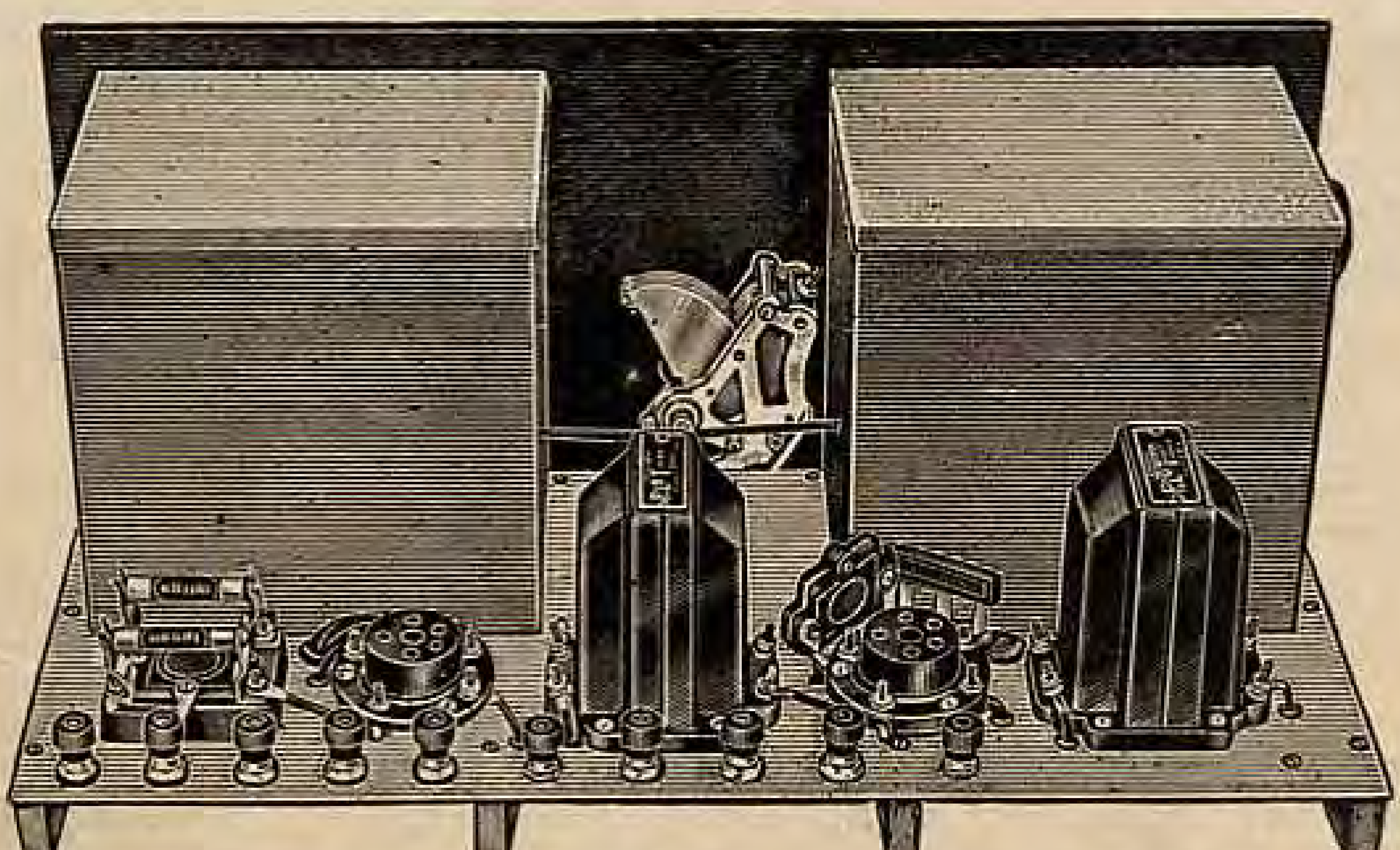
to consume the year that was finally devoted to it. Well, naturally our first consideration was to see what troublesome requirements of the Super-Wasp could be eliminated; thus placing the set in the category of solvable circuits. Could the headphone operation be relegated to the discard and could we insist solely on loud speaker hook-ups? We just placed ourselves in the position of the short-wave fan and tried operating the battery Super-Wasp for a few nights on loud speaker only. It was emphatically decided that earphones were a necessity as far as the rest of the household was concerned. We enjoyed the loud speaker but the family did not! Telephone receiver operation must be retained and the hum level reduced accordingly.

A DETERMINATION

Next, we certainly could not confine the performance of the set to one set wave band. One of the real features of the Super-Wasp was its efficient operation on all of the accepted channels. No! The hum must be conquered on each and every group of tuning coils at present used in the receiver. And as regards the third predicament, it would be useless to consider the set at all if it could not be made to regenerate, for CW reception would be impossible without that feature. Hence the hum must be positively eradicated on any regenerating action. Our requirements are clear cut enough! There is no mistaking to be done. We must produce the first successful A.C. regenerative, short wave, headphone receiver in existence!

Well, let's get into our story. We found that there were in general two classes of "hums". The first class was what we termed a "residual hum" because it could be heard in the headphones at all positions of the tuning dials. It was arising from the audio circuit. The second class was what we choose to term "tunable hums". This latter class was very numerous and could be brought in on several places on all of the coils. All of these could be tuned in or out by operating the tuning dials. They appeared to have definite wave lengths.

We set about to eliminate the residual hum as a starter. It was fairly easy to trace it right down to the detector tube. It was a pure question of 60 cycle induction caused by the construction of the tube itself. It was also present in the two audio tubes, but the succeeding amplification was, of course, not as great as the total following the detector. Hence it was not as noticeable from these latter sources. Anyway, a study of the design of the tube was started. Meanwhile, during the progress of this tube study, a re-design of the entire audio circuit was undertaken. It was obvious that too much audio gain was undesirable for other reasons than A.C. hum amplification. Microphonic detector noises are always an annoyance resulting from excessive audio amplification. Incidentally,



Back view of an assembled A.C. Super-Wasp, with shield cans in place.

two stages of transformer coupled audio amplification are not as good for tone quality as more recent combinations of resistance and transformer coupling.

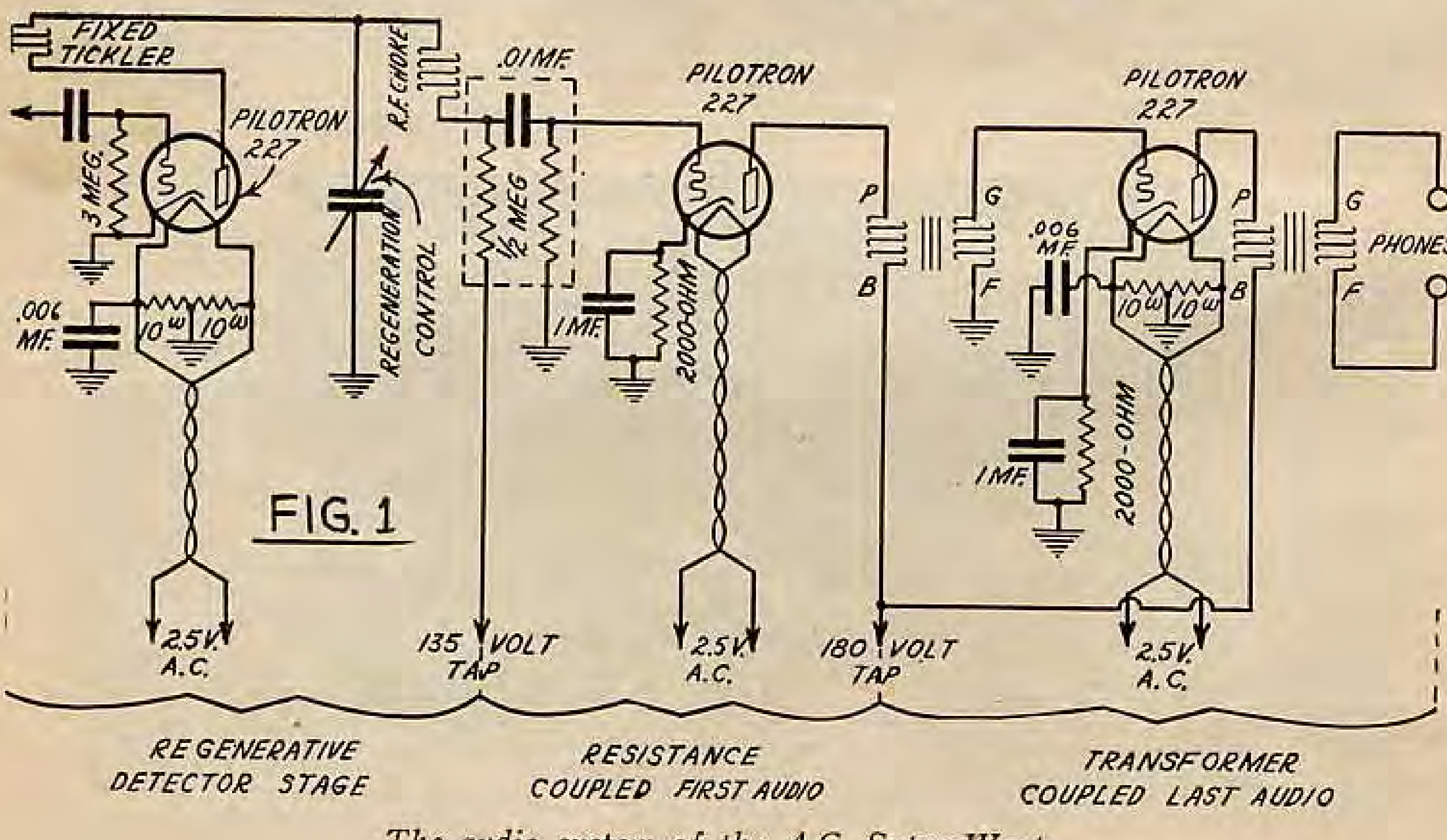
TONE QUALITY

It was felt that with the ever increasing number of short wave broadcasting stations, the question of good tone quality would shortly become a paramount issue. Consequently, we took the bull by the horns and incorporated a modern audio amplifying system. This is illustrated in Figure 1. It consists of a detector working directly into a high resistance-high capacity coupling unit, onto the grid of the first audio tube. This audio stage is then coupled to the last audio tube thru a standard transformer with the primary phase arranged for negative howl tendency. A tube with the standard electrical amplification characteristics of the 227 is used in all three positions. Other features of this tube are entirely different, as will be subsequently shown. The use of this first resistance stage reduced the residual hum much more than the reduction in audio amplification explained. It was found that a net gain in hum reduction resulted from the use of the resistance coupling in the first stage. The resistance units did not act like A.C. pick up coils, as did the transformer windings in this location.

You may wonder why, in our effort to obtain good tone quality, we did not employ a power tube in the last audio stage. The 227 type was deliberately retained. You see, power tubes are operated on raw A.C. filaments. This is quite all right on loud speaker sets, but if you want to know just how much hum is really present with such a tube, listen to the output of a standard broadcast set with a pair of phones. If we are to use phones on this short wave set of ours, we simply cannot tolerate a raw A.C. filament tube, even in the last stage. Hence it is ruled out. Furthermore, by installing an output transformer in the plate of this tube to connect it to the reproducing unit, the impedances may be approximately matched so that the tone quality is not particularly compromised in spite of this 227 type in the last stage.

TUBE TROUBLES

Our tube research laboratory by this time had a report ready for us. The substance of this report is shown in Figure 3. **It developed that the** hum was caused by an unbalanced field created by the filament. The standard 227 tube has a straight filament run thru the center of the heated cathode. It is apparent that at one instant the bottom of the filament will be positive while the top is negative, shortly followed by a reversal of the heating current which makes the bottom of the filament negative with the top positive. The electronic field within the cathode is thus rapidly twisted back and forth during each alternation of the heating current. A noticeable hum results. Now the construction shown in the Pilotron 227 is purposely designed to avoid this very thing. The heating filament is doubled back on itself within the cathode cylinder after the fashion of a hairpin. In this arrangement, the electronic field is neutralized at every point and no upheavals take place on the reversals of the heating current. The Pilotron 227 is a very quiet tube and has been specially designed for the A.C. Super-Wasp for use in the detector and audio stages.



The audio system of the A.C. Super-Wasp.

Two other things also contributed to the total amount of hum which were entirely separate and distinct from the hairpin filament assembly. There have been and are several makes of special tubes which employ the doubled filament mounting, but the results from these were somewhat disappointing. Other hum sources there were that were annoying even tho they were of less intensity. These were found to be located in an insulating sleeve that was in-

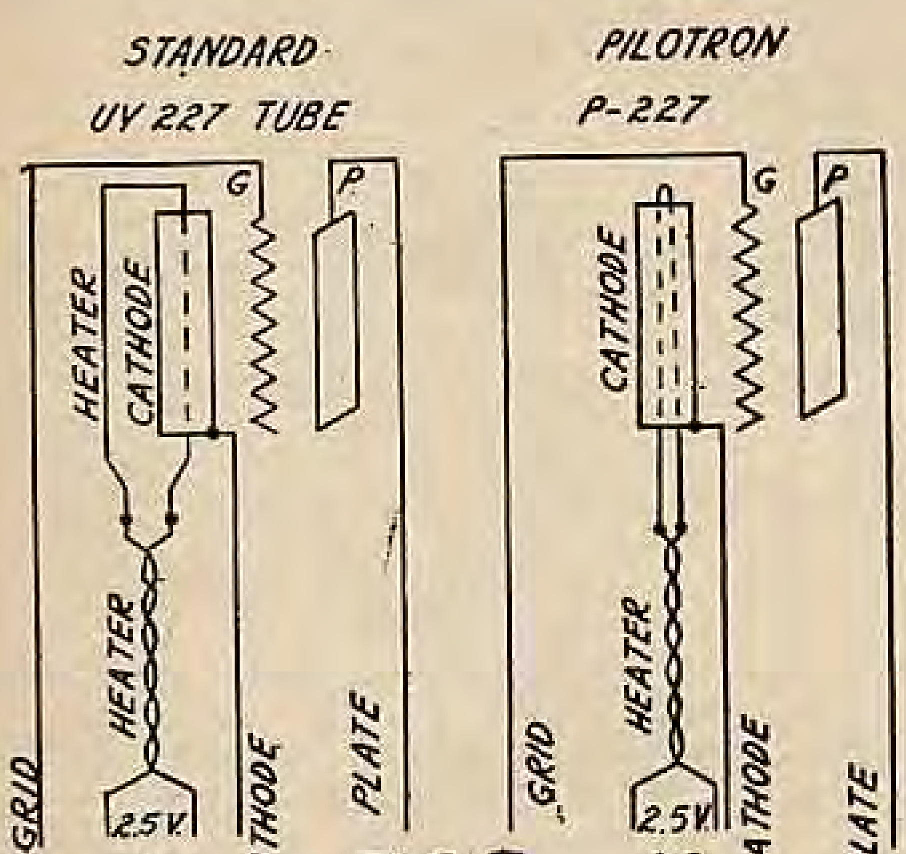


FIG. 3

The difference between the P-227 and ordinary tubes.

corporated to hold the filament in place and in the amount of residual gas still remaining in the tube. The P-227 Pilotron was accordingly built with a high degree of vacuum and the insulating sleeve was omitted. Correct mounting of the elements makes this sleeve unnecessary anyway.

TUNABLE HUMS

The above precautions killed the A.C. residual hum or, at least, reduced it to a negligible minimum. The tunable hums next came under surveillance and these were the most exasperating puzzles. But, like most complicated problems, they were confusing only because they were resulting from many different causes. Each hum and its cause was finally found to be a very simple function, and the remedy in each case has been as simple. To confine ourselves to the problem at hand, we studied the hums with the antenna entirely disconnected from the set. This removed some of the disturbances which were coming in from the ether. This class of disturbance, and sometimes hum, is beyond our power to solve. Such effects would be as noticeable on any other type of set. These hums must not be confused with those arising in the set. *If there is ever any doubt in your mind as to the source of a hum, merely remove the antenna. Its marked reduction or disappearance will prove it to be of external origin, falling within the incurable class.*

TUBE CAPACITY TROUBLESOME

But by far the greater number of our hums continued to persist, even after we had removed the antenna. These obviously existed in the receiver itself and, as such, fell under the curable classification. Those on the red and orange coils, within the wavelength bands of 14 to 50 meters, were the strongest. They must have arisen from some high frequency oscillation in the set modulated by the 60 cycle current. Some combination of inductance and capacity was acting as a transmitting circuit. This was finally found to be actually true. One of these circuits is shown in Figure 4. The capacity of the oscillating system is the internal capacity of the cathode-heater combination. The inductance is that of the leads combined with that of the center-tapped resistance. This resistance unit actually has enough inductance to be troublesome at the very short waves. The cure consists in merely adding a capacity across one side of this center-tapped "inductance" so as to kill the resonant combination.

There were two of these cathode-heater oscillating circuits. One was in the last audio tube and the other was in the detector. The latter seems reasonable enough, but one would never think to look at the last audio tube as a possible source of short-wave radio-frequency disturbance. Nevertheless, there it was and it was the strongest of the two, due to the higher plate and grid voltages employed. These apparently acted as shock exciters of the oscillatory circuits—the shocks taking place on every half wave of the 60 cycle current. This effect is shown in Figure 5. A casual glance at the audio circuit of the A.C. Super-Wasp will reveal these .006 mf. by-passing condenser across the mid-tap resistors in both the detector and last audio

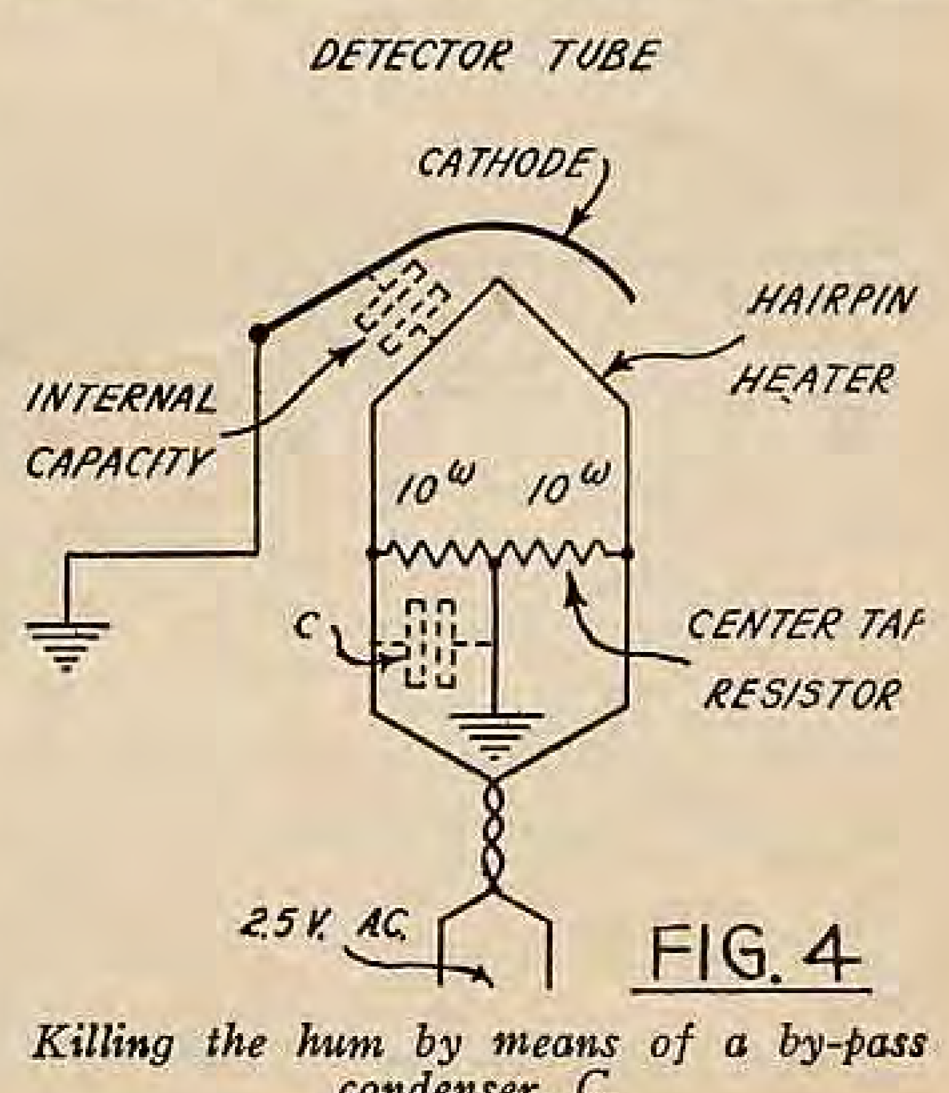


FIG. 4

Killing the hum by means of a by-pass condenser, C.

circuits. Of course, removing these center-tapped resistors entirely will open up these oscillating circuits and the hums on the lower wave length coils will cease. In fact, it was this that first led to their discovery. But, removing the resistors only cures one trouble to bring in another. The residual hum greatly increases in the straight audio system when these center-tapped grounds are removed. They must remain and the high frequency oscillation must be killed by the by-passing method.

USING R.F. CHOKES

With these two culprits put away, there still remained other sources of hums, the latter occurring on the higher wave length coils, up in the green and blue range. These were obviously caused by similar circuits except with higher inductances and capacities, so that the wavelengths were longer. As a further clue to their cause, they did not occur until the plate and grid connections were made for the screen grid tube. They existed in these leads and were obviated by the insertion of the .2 mf. by-passing condensers and the small chokes. The chokes are commercial, cylindrically wound, resistors; but their main function in the plate and screen grid leads is a choking one. They are indicated on the sketches as 450 ohm resistors. These are shown in Figure 6.

There is one other point of special mention that should not be overlooked. Many of you are already familiar with the "squawking" of the ordinary regenerative receiver at the very point of oscillation. It is most annoying, not only because of the racket, but because that particular point is the one at which signals are most likely to be heard. This was given considerable attention in the A.C. design and, as a result, it has been completely subdued. The high resistance in the plate circuit of the detector accounts for this. There appears to be a highly critical condition existing in the grid circuit at the starting point of oscillation. Just as the grid tends to change from the slight positive bias, which it normally has, to the negative value which the rectification gives it, it undergoes an oscil-

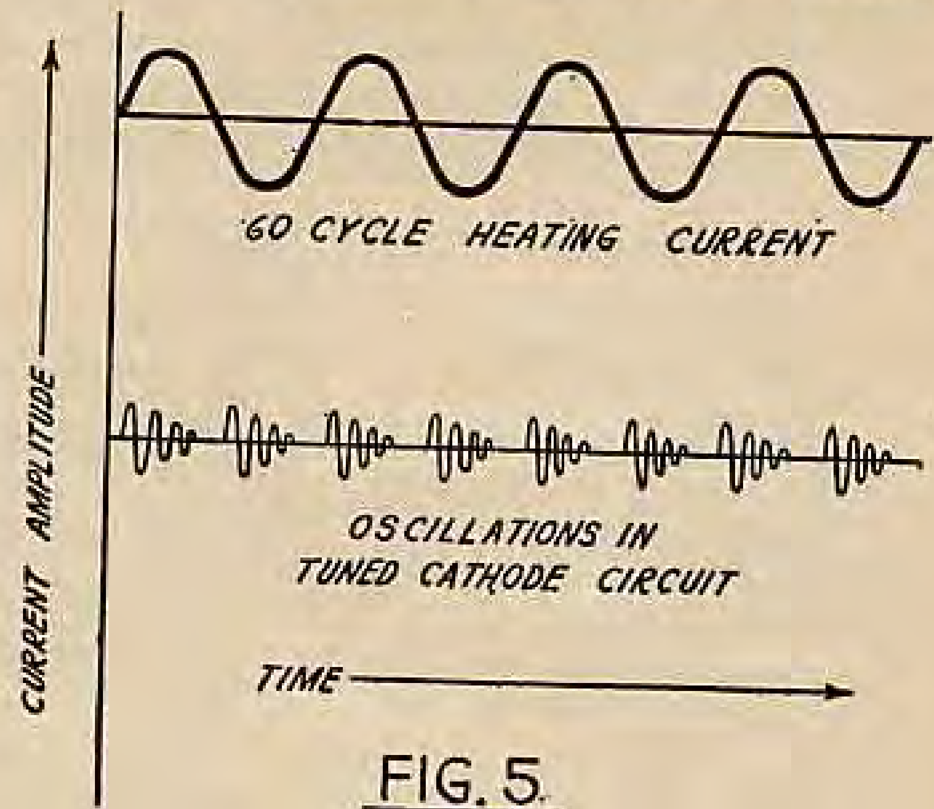


FIG. 5

How the 60-cycle current causes oscillation.

latory condition which causes a bad "squawk" when the plate voltage is fed thru a transformer. But when the plate potential is supplied thru a high resistance, such as the .5 megohm shown in Figure 2, the effective plate voltage drops when this condition occurs and this decline immediately stops the oscillation or "squawk". The result is that the new A.C. Super-Wasp goes into R.F. oscillation in a very smooth manner, permitting perfect regeneration on even the weakest stations.

Figure 7 gives the overall circuit layout of the complete set, including the Pilot K-111 "A" and "B" pack. This is shown intact because it is quite necessary to operate the receiver on a given "B" eliminator to insure the proper plate voltages. The success or failure, particularly of a

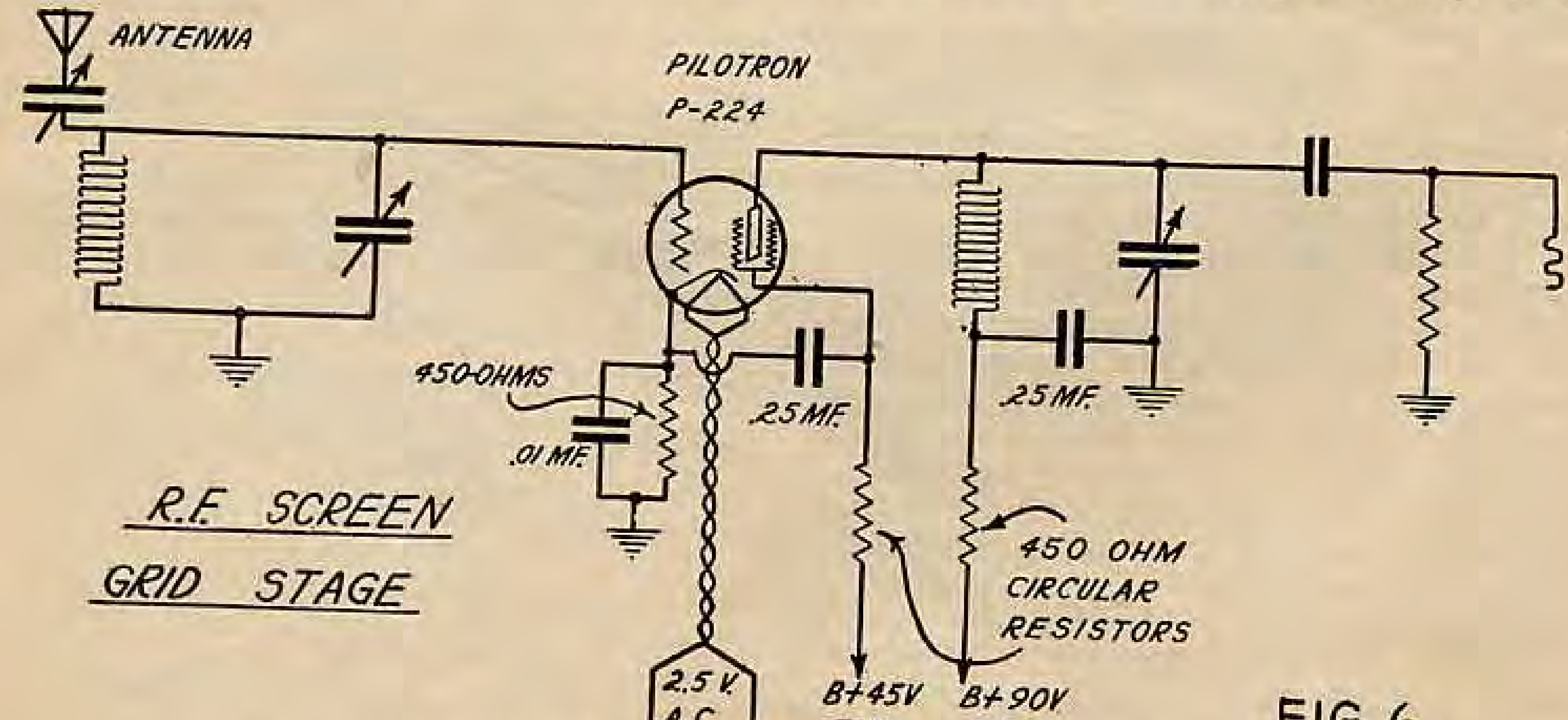
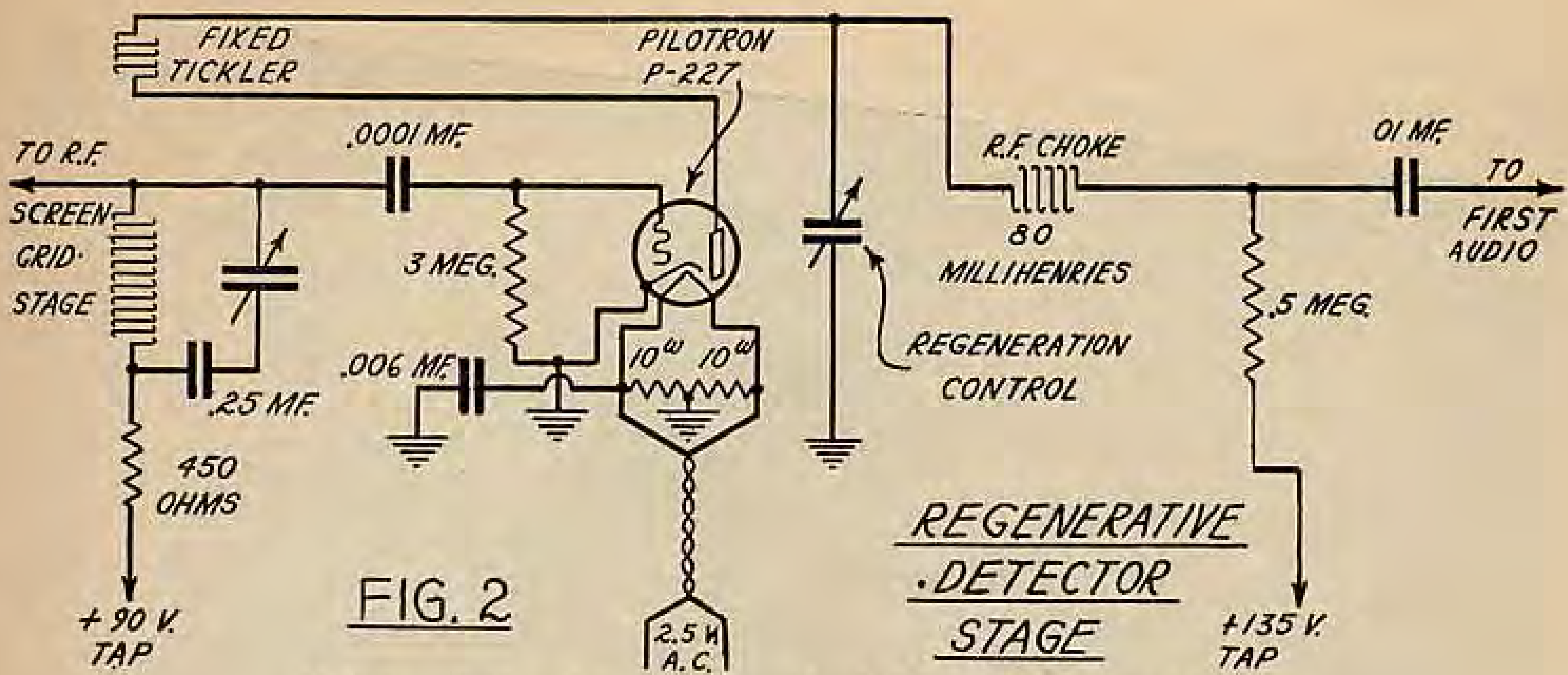


FIG. 6

How 450-ohm circular wound resistors are used as R.F. chokes.



Details of the detector circuit of the A.C. Super-Wasp.

regenerative receiver, depends largely on the correct plate potentials. For instance, too much voltage on the detector will make the oscillation uncontrollable, while too little will stop it altogether. The taps have been worked out so that no audio or radio feedback is present in the eliminator. Any other combination may cause trouble.

No stress has been placed on the rest of the A.C. circuit, as the connections are entirely conventional. There is nothing unusual in the methods for obtaining "C" bias by means of a voltage drop in the minus "B" lead to each tube where the bias is required. The resistance is by-passed by a large condenser so that no fluctuating feed-back will occur. Sometimes a common bias can be employed by two tubes which operate under like conditions, such as the two audio stages shown in the diagram. This has not been found feasible for this circuit and is not recommended.

Like its famous predecessor, the A.C. "Super-Wasp" is marketed in kit form, all the necessary parts being supplied. The front panel and the sub-panel are drilled with all the holes, so the constructor need only tighten up several dozen small nuts and bolts to assemble the kit into a working radio receiver.

The kit includes the following parts:

1—No. 699 Front panel
1—No. 698 Sub-panel
1 pair—No. 600 shield cans, with covers
4—No. 37 metal shelf brackets
2—No. 1282-L vernier dials
1—No. 46 lever type snap switch
2—No. 1611 variable condensers (with No. 1259W knobs)

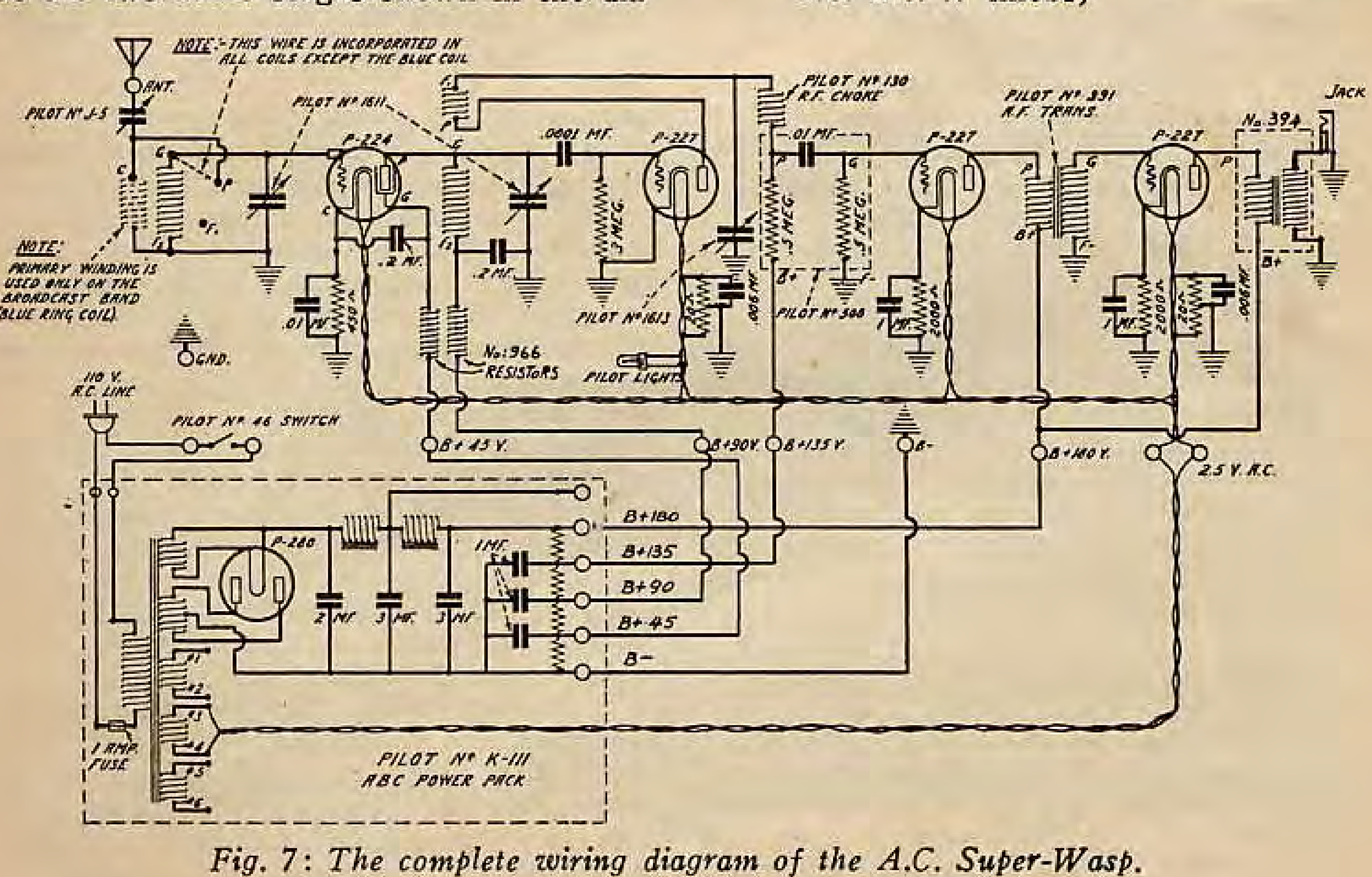
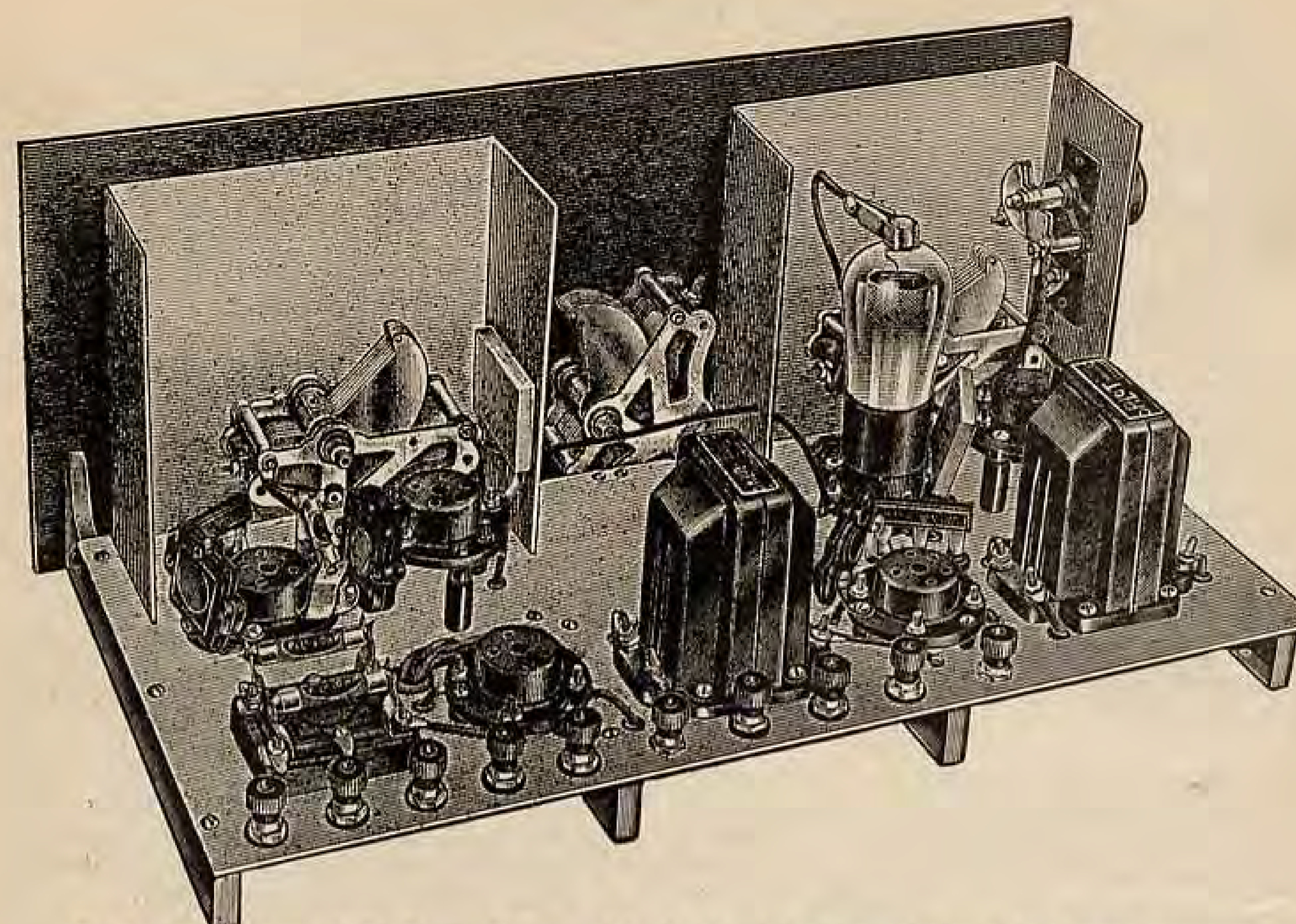


Fig. 7: The complete wiring diagram of the A.C. Super-Wasp.



Back view of an A.C. Super-Wasp with the back halves of the shield cans removed.

1—No. 1613 variable condenser (with No. 1259W knob)
1—No. J-5 midget condenser (with No. 1259W knob)
1—No. 59 condenser (.01 mf.)
1—No. 50B fixed condenser (.0001 mf.)
2—No. 58 condensers (.006 mf.)
2—No. 801 by-pass condensers (1. mf.)
2—No. 805 condensers (.2 mf.)
1—No. 500 Resistoblock
1—No. 391 audio transformer
1—No. 395 output transformer
1—No. 130 R.F. choke coil
3—No. 966 resistances (450 ohms)
2—No. 958 resistances (200 ohms)
2—No. 354 center-tapped resistances (20 ohms)
10—No. 29 blank binding posts
1—No. 20 "ANT" binding post
2—No. 752 grid leaks (.5 megohm)
1—No. 758 grid leak (3 megohms)
2—sets of plug in coils; No. 601A, antenna coils; 601D, detector coils
1—No. 697 Hardware package, which includes all nuts, bolts, washers, soldering lugs, special fixtures, connection wire, etc.

DETAILED ASSEMBLY INSTRUCTIONS

The parts of the A.C. Super-Wasp are laid out in such a manner that the connections are very short and direct—an important feature in any short-wave receiver. If you assemble the set in the proper order, you will find the job an easy and interesting one, and you will have no trouble to look for later. Therefore, read the following instructions carefully before starting on your kit. If you rush right into the work you'll encounter difficulty in making certain of the parts fit.

As with any other kit, the first thing to do is to remove all the parts from their boxes. Get all the paper and cardboard out of the way and line up the instruments on the table. Identify each part and study the drawings to determine just where it belongs. Put aside the two boxes of plug-in coils, one of the shield can covers, and the two back halves of the shield cans—the sections that do not have a large hole in the front section. Pour the various nuts, bolts, washers, lugs and other incidental hardware into one of the can covers, so that they will not be spilling all over the place.

To start, mount the shelf brackets to the extreme ends of the sub-panel. Face the curved ends of the brackets toward the long edge of the sub-panel that has a rectangular opening cut in the center. Use the very short oval-head screws for this purpose. Now mount one of the 450-ohm resistors and the R.F. choke coil to the side of another of the brackets, in t..e positions shown in the under view of the receiver (page 13). Mount another 450-ohm resistance on the side of the fourth bracket, and then screw both brackets to the sub-panel, using three screws apiece. You can spot the proper holes in the sub-panel by merely sliding the brackets along until you can look thru both the sub-panel and the edge of the brackets. Have the soldering lugs of the resistors point outward.

MOUNTING THE RESISTORS

The sub-panel now has four strong feet to stand on, and you can proceed with the mounting of the other parts. First line up the two 2000-ohm resistors between the two center brackets. Use one screw to hold the overlapping feet of the resistors, in the center of the sub-panel. Put a lug under this screw, as shown in the under view. Put lugs under the binding posts of the two 1. mf. by-pass condensers, and mount the latter by passing screws through their feet, along the edge of the rectangular cut-out.

Get the binding posts out of the way by mounting them along the back edge. The "B"— and "*gnd*" posts are not insulated, but merely connect with the aluminum. The others are insulated by means of double hard rubber washers. One section of the latter is placed over the large binding post hole on the top of the sub-panel, the other on the underside. The screw of the binding post is simply passed through and tightened on the underside. Of course, put soldering lugs under all the screws.

Turn the sub-panel top side up, and mount the socket for the screen grid tube by means of three screws. Note that the screw marked "C" (between the F posts) holds, on the underside of the sub-panel, one end of a 450-ohm resistor. Now mount the socket for the antenna coil by raising it above the sub-panel with three of the one-inch hard rubber bushings and passing long screws through the holes. One of these long screws, marked "B" holds the other end of the 450-ohm resistor. You will have to spread the feet of this resistor to make them fit the screws; this is easy, as the metal is thin.

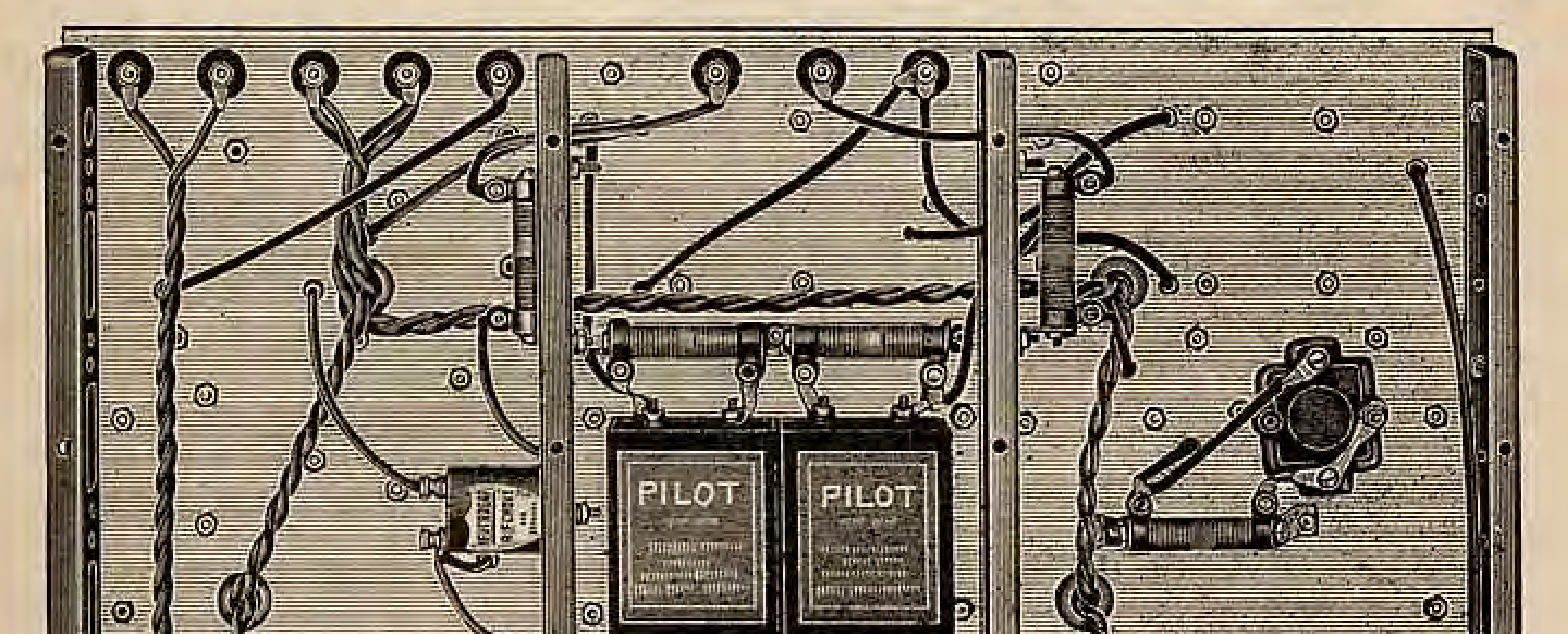
Another of the long screws, marked "A", passes through the .01 mf. condenser, which is spaced away from the underside of the sub-panel by a hexagonal spacer. Take one of the double-end lugs supplied with the 1 mf. by-pass condensers and bridge it between screw "A" and one terminal of the condenser, putting an additional soldering lug under the latter terminal.

In mounting the two sockets, study the drawing carefully to determine the correct placement to the binding posts.

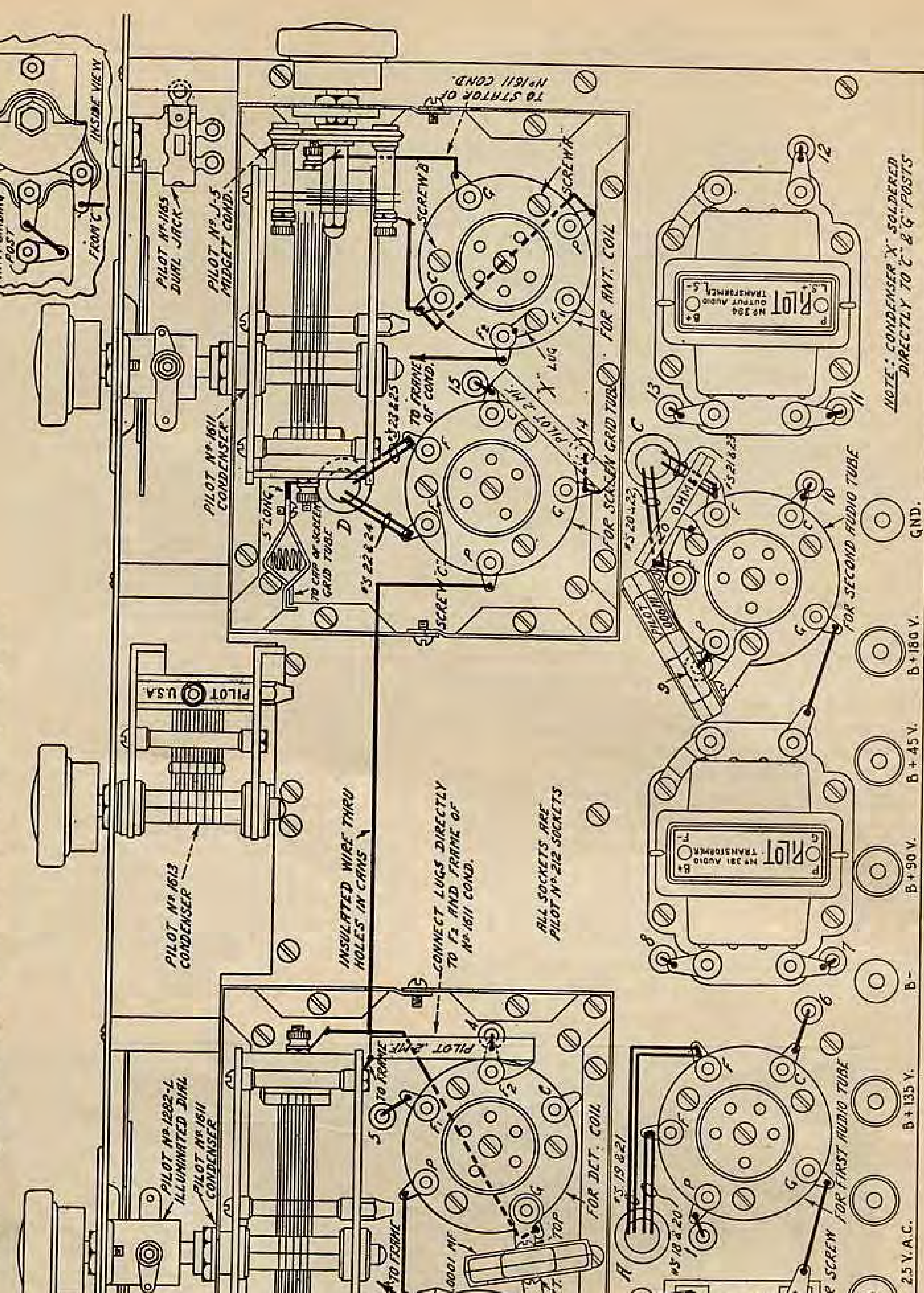
Now shift to the left side of the sub-panel and mount another pair of sockets in a similar manner, elevating the coil receptacle by means of the three remaining hard rubber studs. The screws holding the coil socket in this case do not hold anything else. However, the detector tube socket supports a .006 mf. condenser. This is held in a vertical position by means of two double-end straps (which you will find in the hardware package). Screw one end of each lug under one condenser screw, and bend the other ends so that one will fit under an F post on the socket and the other under a screw passing through the socket near the P post. Put a soldering lug under the screw passing between the two F posts; you'll need it later.

The .0001 mf. condenser is supported between the G posts of the two sockets in a similar manner, by means of two more double-end lugs. These lugs also act as connectors. While fastening the bottom

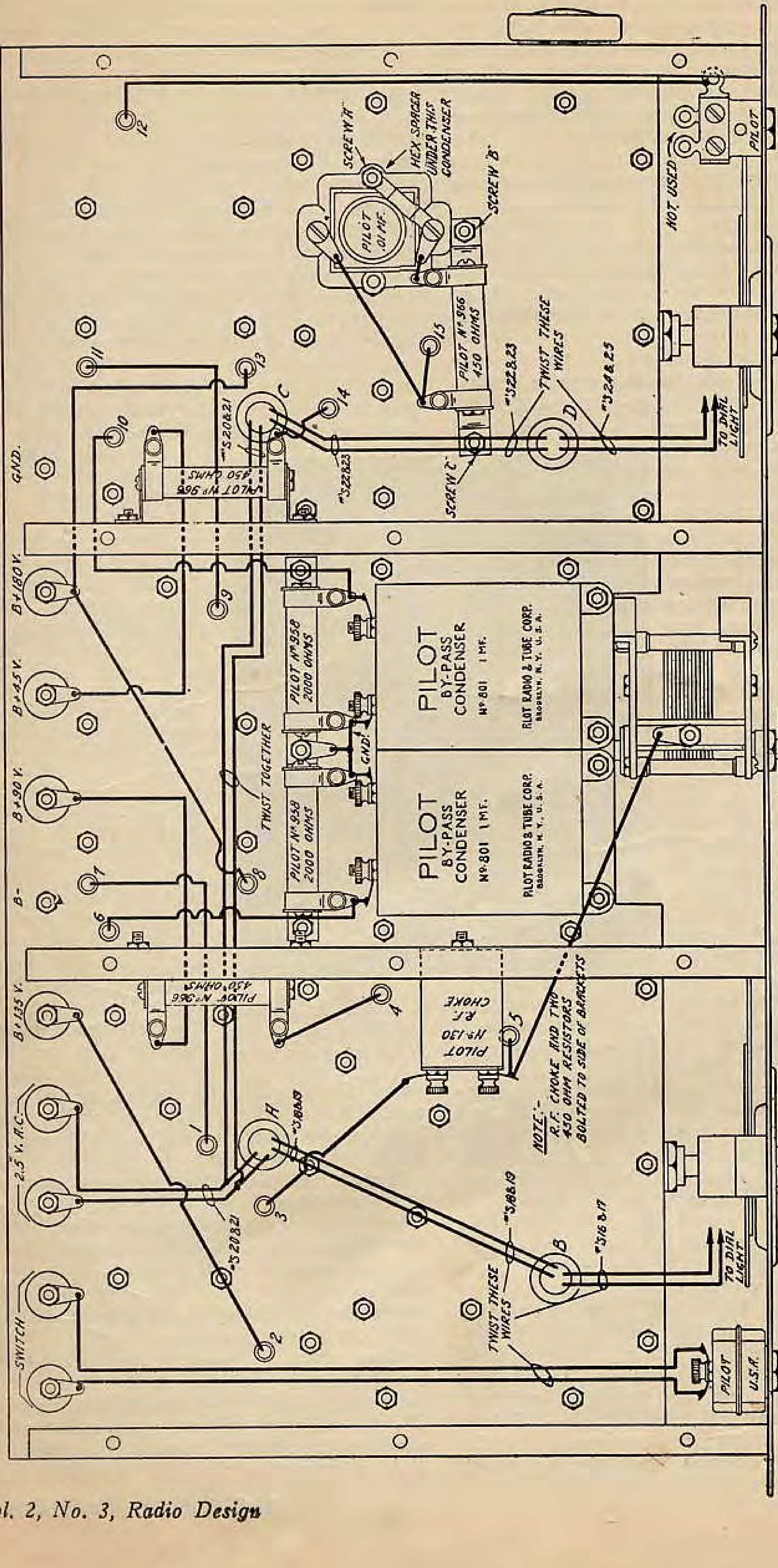
(*Continued on page* 14)



Under view of the A.C. Super-Wasp.



Top view of the A.C. Super-Wasp, showing the wiring and the exact placement of the parts.



Bottom view, showing the resistors and the condensers and the connections to them.

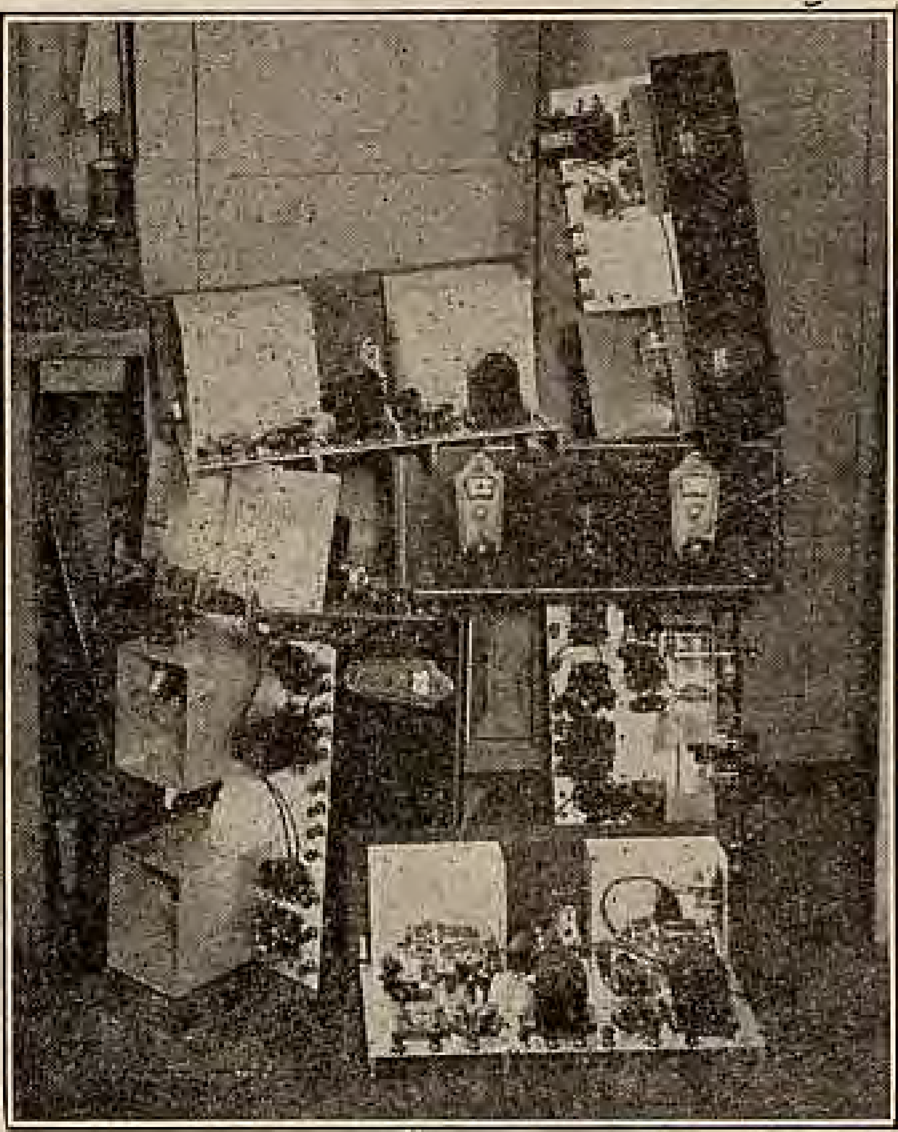
lug to the G posts of the detector tube socket, fasten one of the grid leak clips to this post at the same time. Put the other clip on the C post. The 3 megohm leak will just clear the detector tube if the clips are bent over a little.

Special note: use lock washers under all nuts, throughout the receiver.

The rest of the assembly work on the sub-panel is easy. Place the Resistoblock, the two remaining tube sockets, and the two transformers. Note that the socket for the second audio tube supports a .006 mf. condenser in exactly the same fashion as the socket for the detector tube. Likewise, a lug is needed under the screw between the F posts.

In mounting the No. 391 transformer, bridge the F— post to the nearby mounting screw by means of another of the thin double-end lugs furnished with the 1 mf. by-pass condensers. Do the same with the LS— post of the No. 394 output transformer.

Even though you haven't even touched the front panel and the shield cans, you can do most of the wiring right now, with those parts out of the way. Do the filaments first. Start with the socket for the screen grid tube, and through hole D run out two pairs of twisted wires from the F posts. Cut wires 24 and 25 about 10 inches long, and leave them alone; they will connect later with the dial light. Run the other pair, numbered 22 and 23, through hole C, up to the socket for the second audio tube, and bring out another pair from these same posts; the second pair is marked 20 and 21. At the same time, solder the outside lugs of a 20-ohm center-tapped resistance to the F posts of this socket, and the center lug to the lug between the posts.



Some of the experimental A.C. Super-Wasps piled up in a corner of the Pilot laboratory. These sets were rebuilt as often as six times.

Bring wires 20 and 21 up through hole A, to the socket for the first audio tube, and also bridge them to the binding posts marked "2.5 volts A.C." Bring another pair (marked 18 and 19) out from this socket and up through hole B, to the detector tube socket. Bring a last pair of wires from hole A (numbers 16 and 17), cut 10 inches long, and leave it hanging; this is for the other dial light. Solder the other center-tapped resistance to the F posts of the detector tube socket as shown.

Study the picture diagram and do as much more of the wiring as you can. The whole audio system can be wired with the front panel still off, and part of the radio.

In the kit you will find two special .2 mf. condensers in paper containers. Take one and solder its lugs directly to the G and C posts of the socket for the screen grid tube. This condenser is marked "X" in the drawing.

Now take the front panel, and on it mount the snap switch, the phone jack, the No. 1613 condenser and the two dials. In mounting the dials, put washers behind the back of the panel, to keep the scale and the back edge of the panel plate separated. Also discard the slotted back pieces supplied with the dials, as they are not needed. Leave the dials a bit loose; you will fasten them permanently afterward.

Proceeding to the shield cans, take the can section that has an insulating strip riveted to one side. Mount the J-5 midget condenser in the upper hole, and the "ANT" binding post in the other. Slide the shield along the edge of the sub-panel until you can slip screws through the holes in the mounting feet, and tighten them down.

Now take one of the No. 1611 variable condensers, fasten a lug under the right hand stator binding post and another over the threaded stud on the back of the frame. Cut a piece of flexible wire five inches long, connect one end to the left hand stator binding post and the other to the Mueller snap clip supplied in the hardware package. Mount the condenser in the large hole in the center of the shield, using the single large hex nut.

Repeat this assembly operation with the other shield and the other No. 1611 condenser, omitting the flexible wire. Take the second .2 mf. fixed condenser, fasten one lug under the F2 post of the detector coil socket, and the other lug under the screw that holds the right side of the No. 1611 condenser frame together.

Now place the front panel against the brackets and slip the studs of the two dials over the protruding condenser shafts. Using the brown colored screws, fasten the panel to the brackets first and tighten the dials afterward.

MORE AMPLIFICATION

Because the P-227 A.C. screen-grid tube has a higher amplification factor than the D.C. tube, the A.C. Super-Wasp is even more sensitive than the now-famous battery model, thousands of which have been built during the past few months. During one of the preliminary trials on the A.C. set, the following stations were tuned in ON THE LOUD SPEAKER during the course of three hours of alternate listening and experimenting: G5SW, Chelmsford, England (signing off with the midnight bells of Big Ben, the famous London clock); PCJ, Eindhoven, Holland (audible fifty feet from the speaker); W6XN, Oakland, California, (relaying an N.B.C. chain program; CJRX, Winnipeg, Canada; and KDKA (W8XK), Pittsburgh, Pa., (also relaying a chain program). This test was made at Yorktown Heights, N. Y.

The battery operated Super-Wasp has brought in short-wave stations from all over the world for its many satisfied owners. The A.C. Super-Wasp will bring in these stations louder and better.

Build an A.C. Super-Wasp and enjoy the thrills of the short-waves with all the conveniences of lamp-socket operation!

You can now finish the wiring of the set. With all the wiring in, slip the back halves of the shield cans in place, and screw the cans together. If you find yourself dropping the screws that go through the feet of the can, hook the end of a piece of wire and hold the screws in it as you push them through the holes with a screwdriver. To fasten the sides of the shields, use the very shortest round head screws in the hardware collection. You are now ready to "go on the air".

THE ACCESSORIES

You need a power pack and four Pilotrons—the new Pilot tubes. The A.C. Super-Wasp is designed to work particularly with the Pilot K-111 power pack, which is small, compact, and inexpensive. The binding post markings on the receiver correspond to the markings on the terminal plate of the K-111, although the actual plate voltages delivered by the latter are higher than the figures marked. This is due to the fact that the whole A.C. Super-Wasp draws very little current, hence the "B" output voltages are higher than they would be with a six or seven tube set, for which the K-111 will deliver its rated voltages. This is no disadvantage; quite the contrary, it is a fortunate circumstance, as the filtering action of the choke coils is better with the lighter current drain.

The B+ 90 post, for instance, actually develops about 135 or 140 volts (depending on line conditions) and the 45 volt post about 50 volts. This is a good combination for the screen grid tube. (Note that the plate voltage for the screen grid tube flows through the detector plug-in coil.) The B+ 180 post delivers about 200, which is not excessive because the 2000-ohm biasing resistors automatically control the plate current of the audio tubes. The B+ 135 gives about 180 volts. This sounds like a dangerous amount of voltage for the detector tube, but the tube actually receives far less than this because of the use of a .5 megohm plate resistor.

In regard to tubes, we wish to emphasize the fact that no ordinary 227's will work in the A.C. Super-Wasp. Pilot engineers, under the supervision of John Geloso, were forced to develop a special tube, and unless you use the new P-227's, you cannot expect anything more than a loud growl out of the receiver. Use a P-224 A.C. screen-grid tube in the left hand can, and P-227's in the other three positions, and you will enjoy all the thrills of short-wave reception with all the conveniences of full A.C. operation.

The plug-in coils are used in pairs to cover any one wave band. The wavelength ranges are approximately as follows:

Red coils: 14 to 27 meters; orange, 26 to 50; yellow, 50 to 100; green, 100 to 200; blue, 200 to 500 meters.

The red, orange, yellow and green antenna coils consist of a single winding, while the blue has a primary at the top of the form. All the detector coils have two windings, a grid coil and a tickler. After changing from one set of coils to another, always re-lace the tops of the shield cans.

The operation of the A.C. Super-Wasp is even more simple than the battery model. There is one less control, as the heating currents are furnished directly from the transformer windings. The filament rheostat has been eliminated. The left hand tuning dial, or antenna control, usually tunes just a little lower than the right hand condenser. This is due to the antenna effect and somewhat to the difference in tubes in the two circuit positions. However, the left hand control is somewhat broad, so signals may still be received even tho the dials are not at their exact tuning position.

An aerial totalling between 30 and 50 feet in length is satisfactory for both short and regular broadcast wave reception, while the ground may be a connection to a steam or water pipe. Little need be said about the operation of the set on the broadcast

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How to make the A.C. Super-Wasp

by DAVID GRIMES

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band, as it works very smoothly. As there are only two tuned stages, the selectivity naturally will not be as great as it is with complex broadcast receivers employing five or six, but it will be sufficient. You will be able to separate local stations without trouble, and will obtain loud signals of good quality. The selectivity is determined to a great extent by the setting of the midget condenser. If you live near a number of powerful stations, you will set this condenser to a low value. If you live in the country, you can short circuit it altogether.

On the short-waves, the setting of the midget condenser is of great importance. In general, it must be lowered as you go down in wavelength, although a single setting will hold for any one set of coils. The only thing to do is to experiment.

In hunting for short-wave broadcasting stations, remember that the tuning is going to be very sharp, and you will skip right by many powerful stations if you do not proceed carefully. If you start listening some evening after 8.00 p.m., plug in the yellow ring coils first, as you can practice tuning by getting W8XK, the 63-meter short-wave transmitter of KDKA, which is an old stand-by. Set the right hand dial at about 20, the left at about 25, and turn up the regeneration condenser until you hear the tell-tale rushing sound indicative of regeneration. Move the dials up or down a degree at a time until you hear a loud whistle. Tune in the whistle as loud as you can, and then start backing down the regeneration condenser. Juggle the tuning dials back and forth a trifle at the same time, and eventually you will be able to clear the whistle and hear the voice or music. If the signals are very weak, you may have to "zero beat" them. This is the operation of throwing the detector into oscillation, obtaining the whistle, and then tuning the set so carefully that the voice comes through just as the whistle disappears. It will reappear if the detector condenser is turned either up or down. Zero-beating is a very effective method of bringing in weak broadcasting stations, although it requires some experience in tuning. You will be able to master the trick after a few evenings.

GETTING THE FOREIGN STATIONS

In going after foreign broadcasting stations, you must bear in mind the time differences between the United States and the other countries of the world. Station G5SW, in Chelmsford, England, for instance, signs off at 7.00 p.m. Eastern Standard Time, it then being midnight in London. Thousands of short-wave set owners tune in this station regularly week days, and use its programs as dinner music. Station PCJ, in Holland, the star short-wave performer, is likely to be heard almost any time, as it puts on special programs for different countries of the world. It usually starts at about 10.30 p.m. Eastern time, and comes in with fine loud speaker strength.