DATA SHEET No. 6

Plugin Coils

17 to 500 Meters

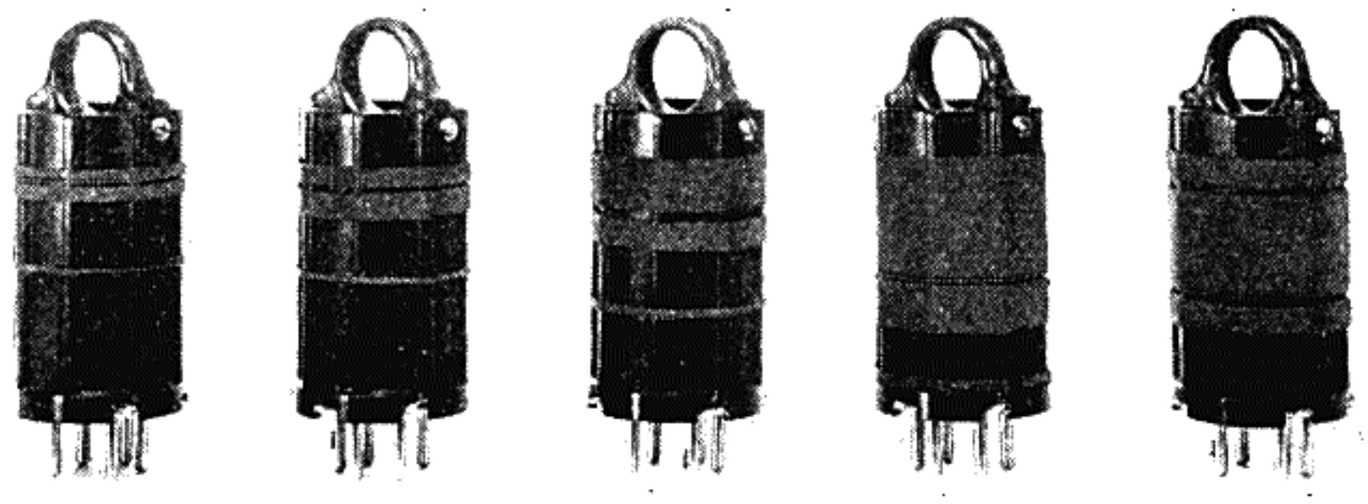
WORLD'S LARGEST RADIO PARTS MANUFACTURER

PILOT ELECTRIC MFG. CO., Inc., 323 BERRY ST., BROOKLYN, N. Y., U. S. A.

Coils for
PILOT WASP SET
Manufactured by
TWIN COUPLER CO., Inc.
Poughkeepsie, N. Y.

TWIN COUPLER

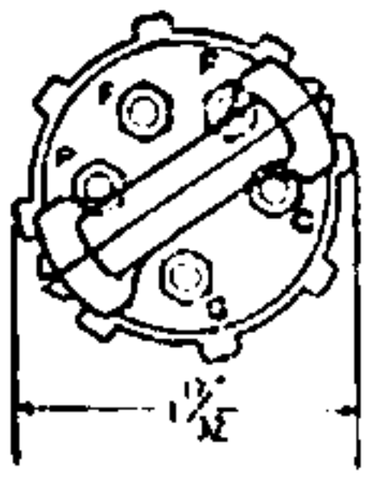
Trade Mark

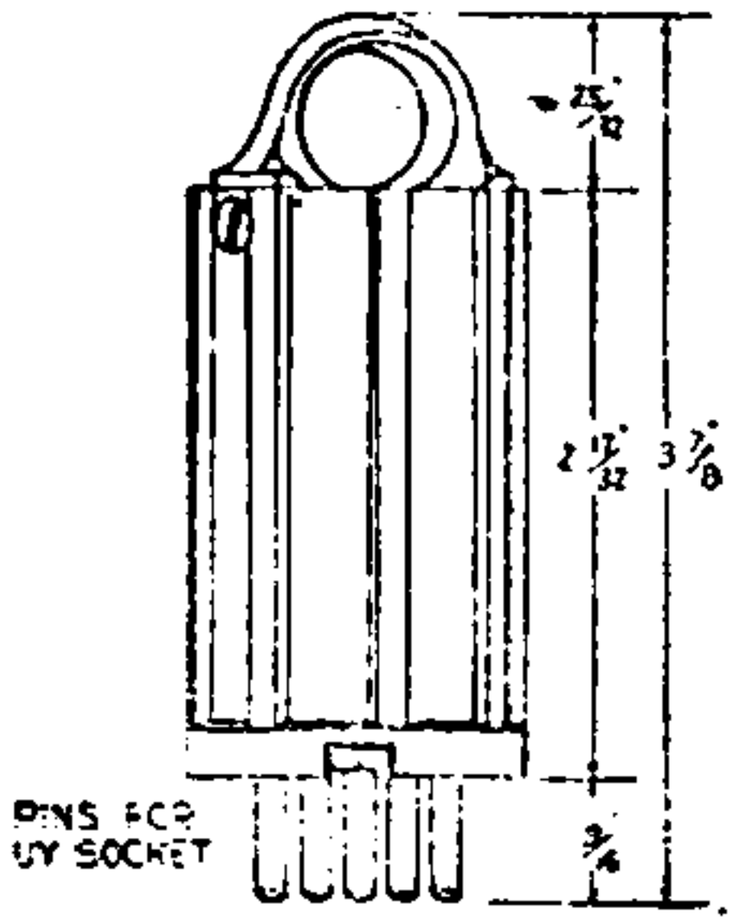


No. 180 Red | No. 181 Orange | No. 182 Yellow | No. 183 Green | No. 184 Blue

17 to 30-meter plugin coil, red ring	—No. 180—Code YAYOS—	$1.75
30 to 52-meter plugin coil, orange ring	—No. 181—Code YEANK—	$1.75
48 to 105-meter plugin coil, yellow ring	—No. 182—Code YECYA—	$1.75
73 to 202-meter plugin coil, green ring	—No. 183—Code YEDYG—	$1.75
200 to 500-meter plugin coil, blue ring	—No. 184—Code YICUJ —	$2.00
Kit of 5 coils as above	—No. 180-4—Code YUVUM—	$9.00
Bakelite tube with handle and pins	—No. 185—Code YIDYL —	$ .85

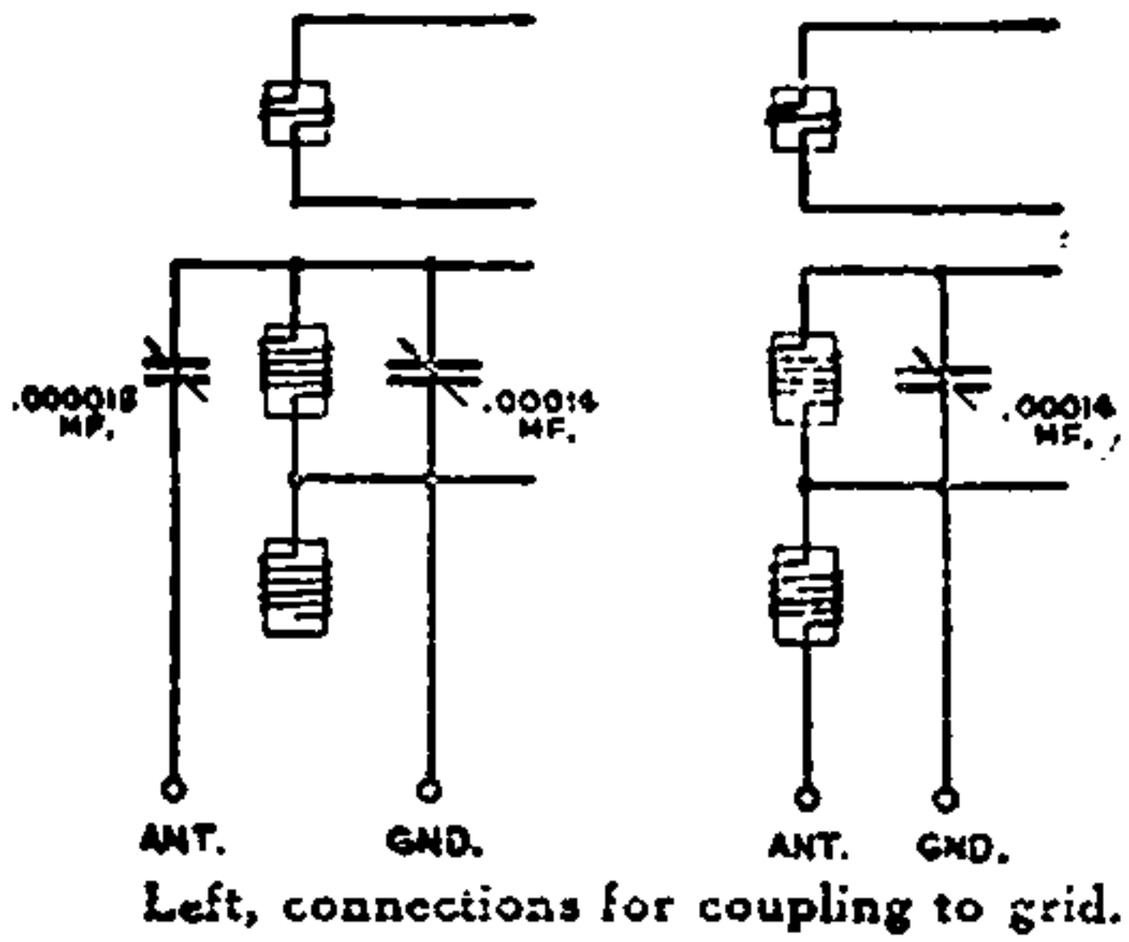
HERE is the new conception of plugin coils for short wave receiving—and as new in results as in appearance. Built to meet the requirements of A.R.R.L. short wave experts, they make obsolete the old clumsy, flimsy designs. No more spread-out sets with long, high-capacity leads, for the Pilot plugins take up no more room than a vacuum tube. In fact, any UX-227 type socket, such as the PILOT No. 211, 212, 215 or 217 can be used as the socket for the plugin coils.



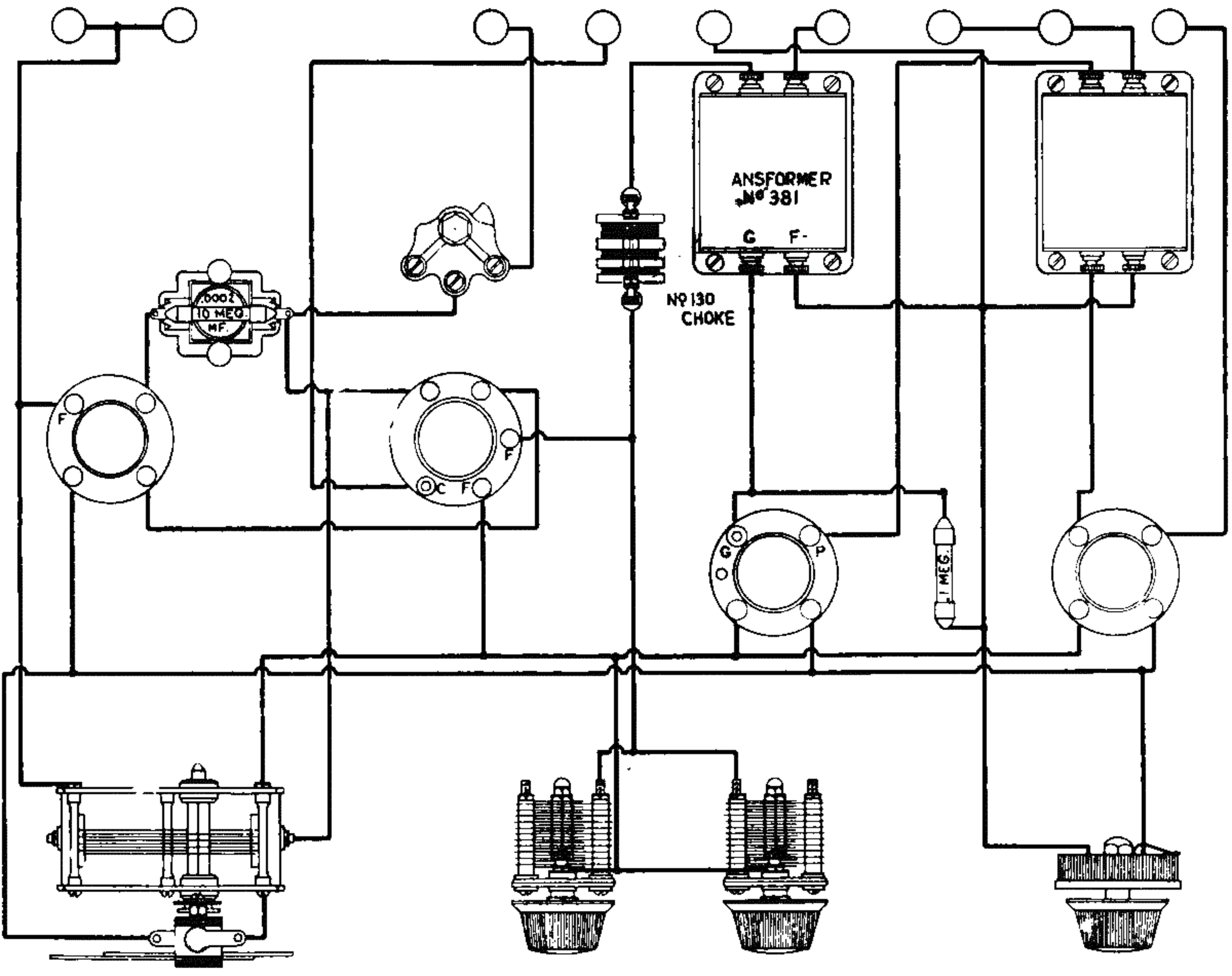


One-half size drawing

The wavelengths given above are for the coils when connected with antenna coupling to the grid, and in the circuit shown on page 2 of this Data Sheet. Generally, grid coupling is preferred, although inductive coupling is provided. The former has the advantage that any broadcast antenna can be employed. A Pilot J-5 condenser, of special construction to give a low minimum capacity, is used for coupling to the grid.



Left, connections for coupling to grid.
Right, connections for inductive coupling


.0002
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HOW TO BUILD A SUCCESSFUL SHORT WAVE RECEIVER FOR 17 TO 500 METERS

By R. S. KRUSE*

THE THRILL OF THE UNKNOWN

FROM exploring jungles to visiting haunted houses, the same rule holds—the biggest interest and suspense comes from not knowing what to expect next.

That is why, for twenty-one years, short-wave radio has been an immensely fascinating plaything for me, and that's why I am sure that you in turn will enjoy hearing some of the queer things about short waves for the first time.

It's been my privilege to be one of a rather small group that put over the first short-wave transatlantic work when everyone was sure the thing was nonsense—until it had worked for evening after evening and two of us had added another European country just to make it emphatic. The same two ran a transcontinental schedule for months when there wasn't another short-wave station in the world except the two that made our circuit. Those things seemed thrillers. Again I thought we had our great thrill when we were mixed up with the discovery of the **skip distance**, which will be explained later, and we had another piece of rare luck in being in on the discovery that such waves as 20 meters are better in daylight than at night—and that was against the rules, too.

After that there seemed to be no discoveries left to fall into and we thought we were losing interest—but it wasn't so. As soon as we found out that everyone was really certain that the 5-meter wave was absolutely worthless we had to start fussing with that, and now the latest **great moment** is the one in November when I sat in Don Goode's radio room in San Diego and heard 5-meter signals from Phelps in New York and Douglas in Kansas.

What will be next?

That's the way of the thing—there's always something else to hear, and only the weather gods can tell you where it will come from tonight. One thing is sure—if you haven't a lightning storm on the block then you will hear something—or else the set is as dead as Pharaoh's aunt.

However, it will not be even a little bit like the usual broadcast bands. In the first place the short waves hum and crawl and flutter and swarm with other kinds of stations, and in the second place the signals act in new and peculiar manners—but always there is something to hear.

Now before you think this is a fairy story of radio we'll have to admit that it isn't all perfect, in spite of the silly stories and semi-silly advertisements one sees at times.

THE WHALE AND THE MINNOW

Do you remember Colonel Roosevelt's remark that every important movement has a "lunatic fringe" hung on it?

The lunatic fringe of short-wave radio has been longer and gaudier than most, and it's about time we sharpened up the scissors and clipped it off right along the edge of the real facts.

Very well—what are the facts and what is the nonsense?

First of all, you have all seen newspaper stories to the general effect that, "John Blank, with his little home-made set, using a single UX-210 7.5 watt tube, talks with amateurs in all parts of the world every evening."

Very well—that's a lie. It is a whopper—John caught a minnow and the reporter made it into a whale. The true story is:

*For six years Technical Editor of Q S T Magazine.

"John Blank, with his little home-made set, has for hundreds and hundreds of hours called amateurs all over the world and through his persistence has finally managed to work them in some 15 countries. He worked a British officer in India once and hopes to live long enuf to do it again."

So it is with short-wave reception—one can attain amazing distances—but the results are highly erratic over great distances. No—that isn't fair. They change greatly from time to time but if one understands the rules it is almost always possible to hear someone at a very great distance with simple apparatus. Almost every evening it is a new someone—but you hear him—he is a long way off, and that's where the thrill comes in.

If anyone starts to boil over onto the stove and claim that HE can "always" hear so-and-so in Europe or always talk to such-and-such in Africa, don't worry—we have a complete answer. We will just ask this man how he would like to take on a contract to do it at $100 per night, and on nights when messages or music didn't get thru in good style, lose the $100 and pay a penalty of $100 in addition. It is safe enuf to make the offer.

THE CATFISH AND THE TROUT

I suppose if one were purely interested in getting some fish for the frying pan, one ought to go catfishing. The catfish—in New England that's a bullhead—isn't pretty, but he is easy to catch, has lots of weight, practically always bites on whatever you have, and is filling.

On the other hand, if you want sport instead of panfish you will try something more difficult, and it will be interesting exactly because it is more difficult.

The apparatus for the more difficult stunt may not weigh any more pounds—but you will need more skill—more attention, and therefore you will get more thrill from it.

RIGGING UP THE TACKLE

That's enuf of that. Let's get started putting the receiver together and at the same time we will talk about the things we hope to hear.

First of all—what do we really mean by short wave, anyway? Of course it is purely opinion, but generally we mean the waves below 200 meters—which are arranged for 1929 as follows. In this list we will of course remember that the way to decide which wavelengths the receiver must cover is to see where we find those things we are interested in—and that's quite a story which must be told later.

KILOCYCLES	WAVELENGTH, IN METERS	CLASS OF STATIONS
1500—1715	200—175	Mobile
1715—2000	175—150	Amateur Fone and C. W.
2000—2250	150—133	Mobile and Fixt
2250—2750	133—109	Mobile
2750—2850	109—105	Fixt
2850—3500	105—85	Mobile and Fixt
3500—4000	85—75	Amateur C. W.
4000—5500	75—54	Mobile and Fixt
5500—5700	54—52	Mobile
5700—6000	52—50	Fixt
6000—6150	50—48.8	Broadcasting
6150—6675	48.8—45	Mobile
6675—7000	45—42.8	Fixt
7000—7300	42.8—41	Amateur C. W.
7300—8200	41—36.6	Fixt
8200—8550	36.6—35.1	Mobile
8550—8900	35.1—33.7	Mobile and Fixt
8900—9500	33.7—31.6	Fixt

9500—9600	31.6—31.2	Broadcasting
9600—11,000	31.2—27.3	Fixt
11,000—11,400	27.3—26.3	Mobile
11,400—11,700	26.3—25.6	Fixt
11,700—11,900	25.6—25.2	Broadcasting
11,900—12,300	25.2—24.4	Fixt
12,300—12,852	24.4—23.4	Mobile
12,852—13,350	23.4—22.4	Mobile and Fixt
13,350—14,000	22.4—21.3	Fixt
14,000—14,400	21.4—20.8	Amateur C. W.
14,400—15,100	20.8—19.85	Fixt
15,100—15,350	19.85—19.55	Broadcasting
15,350—16,400	19.55—18.3	Fixt
16,400—17,100	18.3—17.5	Mobile
17,100—17,750	17.5—16.9	Mobile and Fixt
17,750—17,800	16.9—16.85	Broadcasting
17,800—21,450	16.85—14	Fixt
21,450—21,550	14—13.9	Broadcasting
21,550—22,300	13.9—13.45	Mobile
22,300—23,000	13.45—13.1	Mobile and Fixt
23,000—28,000	13.1—10.7	Unassigned
28,000—30,000	10.7—10	Amateurs and Experiments
30,000—56,000	10—5.35	Unassigned
56,000—60,000	5.35—5	Amateurs and Experiments
60,000 and up	5 and down	Unassigned

That is a rather awful mess of figures and leaves the beginner up in the air. He can do one of two fairly simple things. One of them is to rig up a tuner that will cover all the wavelengths he might wish to listen to. The other is to make a tuner that will cover those bands that will hold most of the interest. Tuners of both sorts will be suggested.

The ordinary broadcast band after January 1, 1929, will be 200-580 meters, which is to say 515 to 1500 kilocycles. This makes the band 985 kilocycles wide and, as we all know, our standard broadcast receivers cover this 985 k.c. band nicely.

Now the short-wave region from 5-200 meters is 58,500 kilocycles wide! This is more than 58 times as much as our broadcast receivers are called on to cover, and we can see at once that we will have to use interchangeable coils. To make this convenient we will have to make them of the plugin variety.

THE PILOT PLUGIN COIL

Most of the plugin coils have been too big, too flimsy, and in some cases did not make good contact with their sockets. In addition to that it was not always easy to pick the right one in a hurry. Beside this, special coils were hard to get.

The Pilot coils were designed to avoid all of these things. They fit into a standard 5-prong socket of the UY type, such as Pilot No. 212, therefore making good contact. The diameter is small, as is the length, but at the same time the losses have been kept down by use of a ribbed form of genuine Bakelite. Shielded stages will be possible with these coils. Furthermore, the coils are fitted with pull-out rings of colored Bakelite so that the right coil can be spotted instantly. The colored ring is removable if anyone has a notion that it will do the least harm. Finally, the coil is very solid in construction. Blank forms can be bought also if you want to wind your own coils.

THE TUNING CONDENSER

Of course a condenser is needed with the coil—and that's another question. In a broadcast receiver we are used to condensers running about .00035 mfd., which takes us up to 600 meters—or down to 500 kilocycles if you'd rather say it that way.

One would therefore guess that to go no higher than 200 meters one might choose about one-third this—and the guess isn't far wrong if one wants to make a continuous-range tuner to go from 17 to 200 meters with about four coils. This is a good sort of tuner to have, and will be mentioned later. The condenser is too big for wavelengths below 17 meters. Pilot Centraline condenser type No. 1608, of .000150 mfd., is right for this.

The range from 17 to 200 meters is still 15,500 kilocycles, and if divided more or less evenly between the coils this is about 4,000 kilocycles to be covered by each coil, or something like five times the amount covered by the usual broadcast tuner. The tuning will, therefore, be rather cramped, and while a good vernier dial will aid greatly in separating stations, there will be those who prefer to pick out particular regions and spread these across the dial by using a smaller tuning condenser and a somewhat larger coil.

THE GENERAL ARRANGEMENT

The tuners to be described are all of the three-tube type, using a regenerative detector and two stages of audio amplification.

The Wasp set is a band covering tuner designed to cover the main International amateur wavebands and some of the short-wave broadcast bands, spreading these bands out on the tuner scale so as to make tuning easy. The bands covered are the so-called 160-meter, 80-meter, 40-meter and 20-meter amateur bands and the broadcast bands at 50, 25 and 20 meters. This receiver is meant to be used with the headset, altho it will work a loud speaker on strong signals, and with the 200- to 500-meter broadcast plugin will give splendid loudspeaker results.

WHAT TO DO AND WHAT NOT TO DO

Of course a regenerative detector and two stages of audio sounds easy—and that is exactly why 99 out of a hundred are very badly made and not within a long way of being as good as they can be.

In six years of watching the questions that come in from the thousands of amateurs of the United States, and in trying many of their tuners at their stations I gradually became very sure that most of the tuners were not producing 25 per cent of the results they could give if worked over carefully—not fussed over but worked on carefully, taking one thing at a time and finishing it before going on.

The first thing is to place the parts and wire the set exactly as it is in the layout—not almost that way but exactly. Changes in the wiring may not do much harm at 450 meters but it is different at 45 meters—and still more so at 15. Unless you are really anxious for assorted trouble use NOTHING BUT ROSIN in soldering the joints. The soldering pastes and liquids are all bad—and most of them are worse.

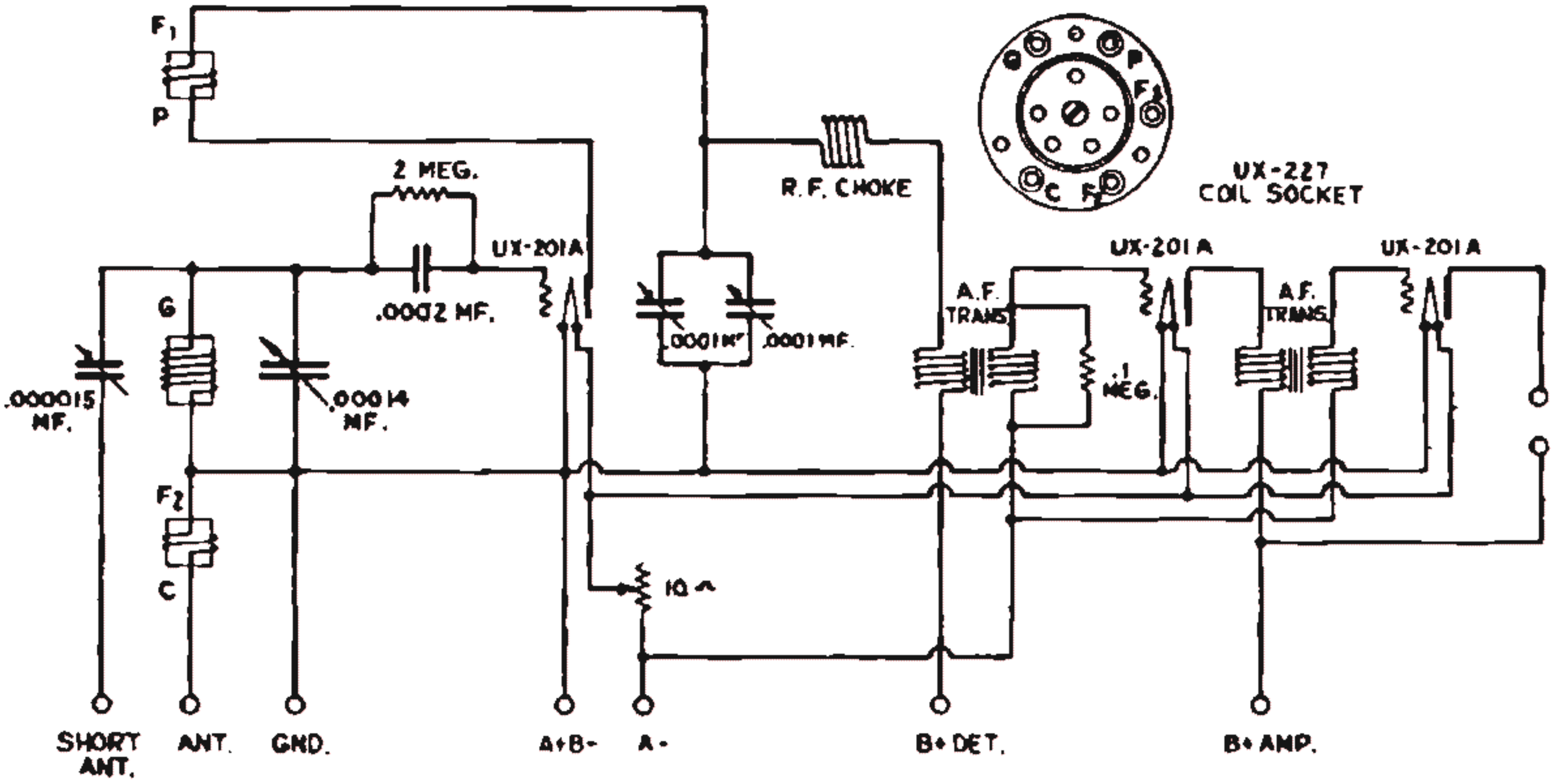
If you are not used to rosin begin by making the soldering copper perfectly clean and tinning it. This can be done by first filing it clean, then heating and rubbing on a bit of brick or tile with solder and a little rosin. If this does not work try some of the soldering paste after re-filing the copper. Then wash the copper thoroly so that none of the paste will carry over to the set when you go to work.

Having the set put together, the filaments lighting properly and the B batteries connected, we are ready to make the adjustments on which the whole performance of the set depends. It is thoroly worth while to spend an entire evening—or two evenings—on getting this part of the thing dead right, just exactly as it is worth while to spend some time in getting the valve settings and the timing of a Packard or Franklin right—the result will be smooth and perfect performance that cannot be got any other way.

STARTING THE ADJUSTMENTS

We will suppose that the set is together without any dud parts, that the batteries are on straight and that we have NOT connected on the ground or the antenna.

Connect on a pair of phones—not a loudspeaker—push the phones off your ears a bit and plug in the next to the largest coil. Now turn on the filaments.



Schematic diagram of the Pilot Wasp short wave receiver designed by R. S. Kruse and M. B. Sleeper

The set should not make any wild noises when the regeneration control is turned clear down, but at the same time it must not sound dead. If there is no sound the A or B battery is reversed. If all these things are right—and be sure that they really are because one cannot see anything wrong when in a hurry—then there is an open circuit somewhere or a dead tube. That is a matter of detail—chase thru all the wiring and try replacing tubes.

THE TUBES

This is a good place to say that tubes are generally worth what you pay for them. A cheap tube will act cheap in a broadcast receiver but it will act nine times as cheap in a short-wave receiver. Better start with tubes that are not only good but also new.

OSCILLATION

When the circuits are complete and the bong is heard when the detector tube is tapped with a pencil, you are ready to see if the set will oscillate. Turn in one of the regeneration condensers gradually and see which of the three wrong things happens:

a. Nothing.
b. A plop and possibly a squeal.
c. A loud howl or squeal.

The first is the only serious one because it shows something definitely wrong. There may be an open circuit, a poor detector tube, the filament voltage may be too low or the plate voltage of the detector may be too low. Finally you may not have got the A battery right after all—look again. Once in a while the tickler coil may be connected backward, but that is really inexcusable with the plain marking of the Pilot coils.

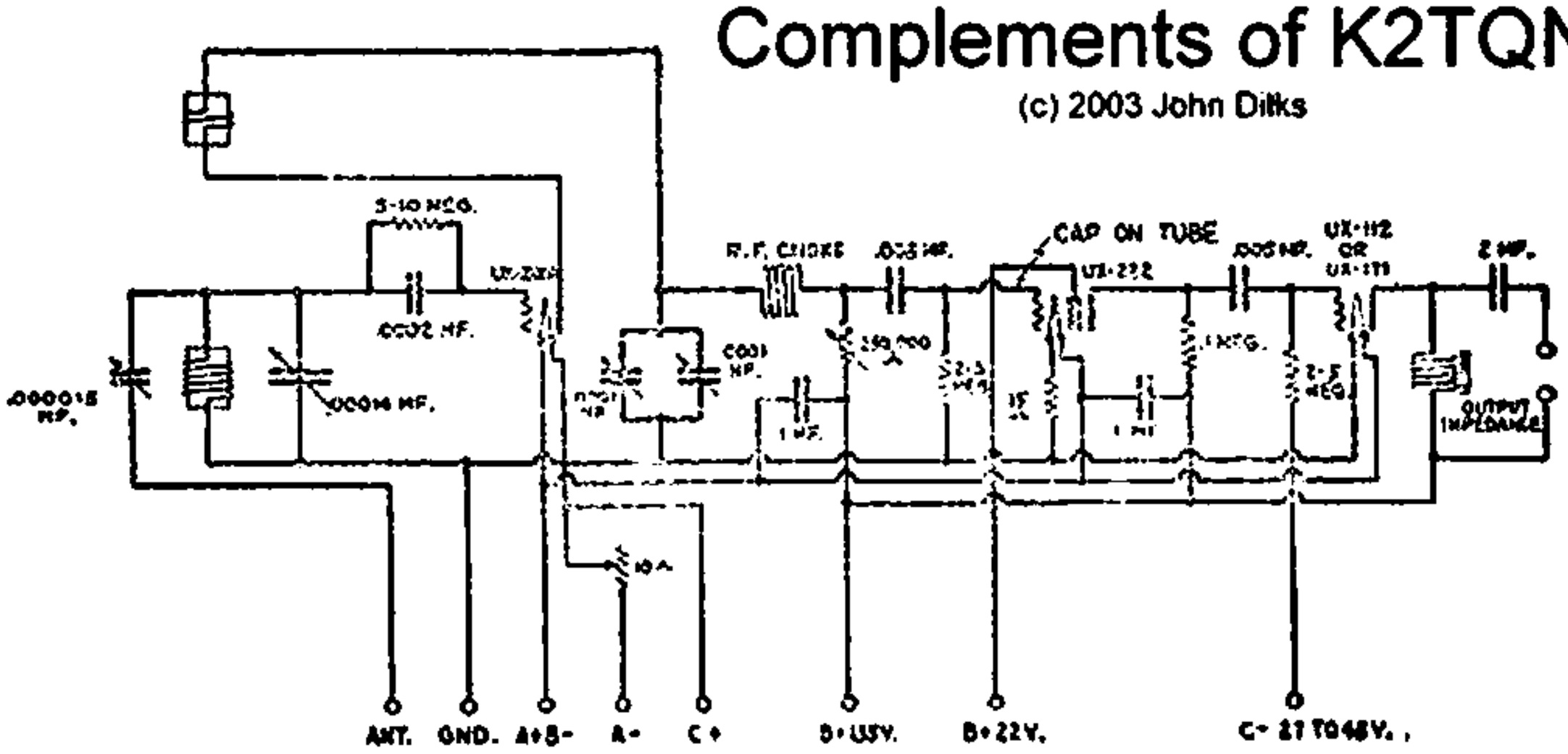
Having got the tube to howl or to plop—or both—we are all ready to adjust things for smoother work. First tho try all the different coils and see if the set will break over, when asked, with the tuning condenser set anywhere from 10 to 90 on the scale for each coil. If this part works O.K.—even tho the set tends to squeal—we have a good start.

SMOOTH REGENERATION

Connect on the antenna and ground and try for oscillation again with each coil, having the antenna series condenser set at its lowest value. Very likely the smallest coil will now refuse to oscillate, which means that a shorter antenna should be used for this coil, in fact, a few feet of wire strung around the room will probably work quite as well as the long antenna.

Now we will finally—by some cut-and-try—find out how to set the antenna series condenser for each of the coils.

Now the set is oscillating with the antenna on, but it is still rough and cranky. That must stop.



A special experimental hook-up using the UX-222 shielded grid tube

THE ANTENNA AND THE GRIDLEAK

Silly as it may sound, the ground connection and the grid leak are important in this matter. There is no way of improving a short-wave set that is so certain as to get these two things right. Maybe there was once a good waterpipe ground—I never met it. My rule is simply to run ground connections to everything that has a Chinese chance of being any good and then trying the various combinations on a WEAK station that keeps on going. Maybe the best combination turns out to be a gaspipe ground and a wire run down outside the house to a length or pipe driven into the earth—maybe the best ground turns out to be another wire stretched out 6 feet above the ground—or the roof. Locations differ, and while an experienced man can generally tell at a glance, the beginner had better cut and try—it is fun anyway.

The length of the antenna had better not be particularly over that of the ordinary broadcast receiving antenna—less will answer. Naturally it wants to be put up decently.

Now then for the gridleak. By tinkering with the gridleak we can usually change the loud plop and squawk of the breakover into a dull puff. Several sizes may be tried, altho the one indicated is generally right. If none of these things cure the difficulty try lowering the detector plate voltage or the filament voltage. In an extreme case take a turn off the tickler—enuf have been provided so that this is possible.

GETTING DOWN TO CASES

Now then—the set is quiet when not oscillating; when the control is turned up it gradually becomes a little more sensitive and the background rises a little, and then there is the soft puff and the set is oscillating.

Now you are all ready to begin combing the ether for signals. Start at one end of the scale and work thru, changing coils and starting over when necessary. When a signal is found, back off the regeneration, carefully holding it with the tuning control until you can make out if it is a phone or a code signal. If it is phone, keep on backing the regeneration off until the signal is loudest and then work very carefully until the detector puffs out of oscillation. You will find that the signal drops a good deal of strength when this happens but is now understandable unless too weak. If it was a code signal, of course you do not pull the detector out of oscillation at all but let it run, simply cutting down the regeneration for best signal.

ADDITIONAL SHORT-WAVE DATA

If you want more information than it has been possible to give in this space, send a dollar to Radio Design Publishing Co., Inc., 103 Broadway, Brooklyn, N. Y., for a copy of the 200-page Radio Amateur's Handbook, the official S. W. manual of the American Radio Relay League.