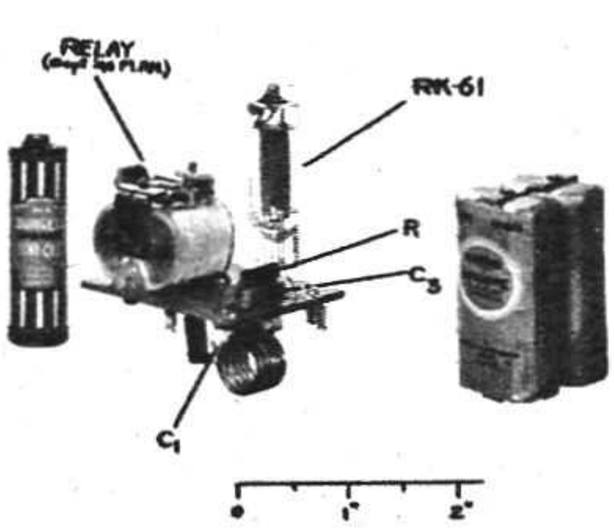
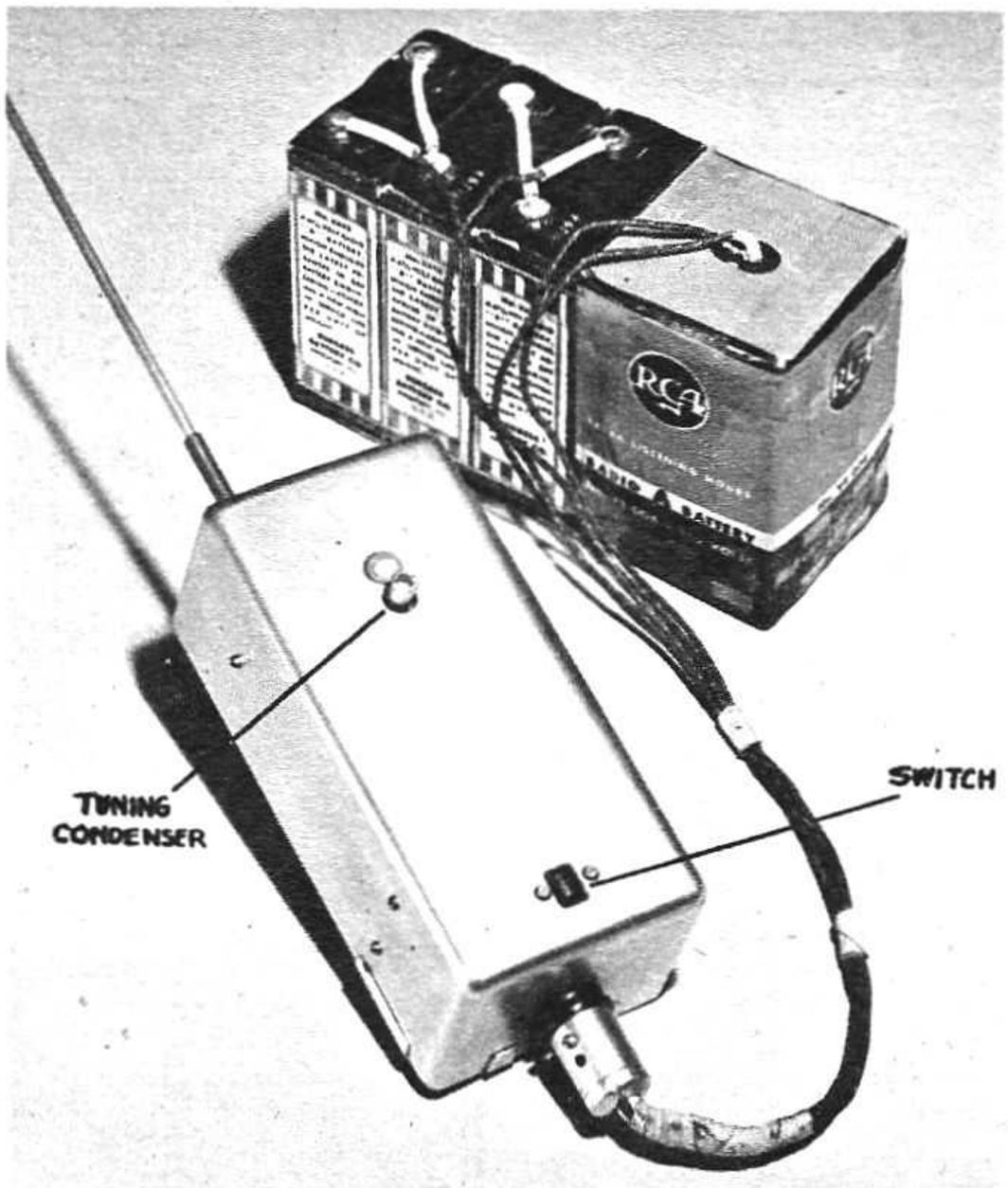
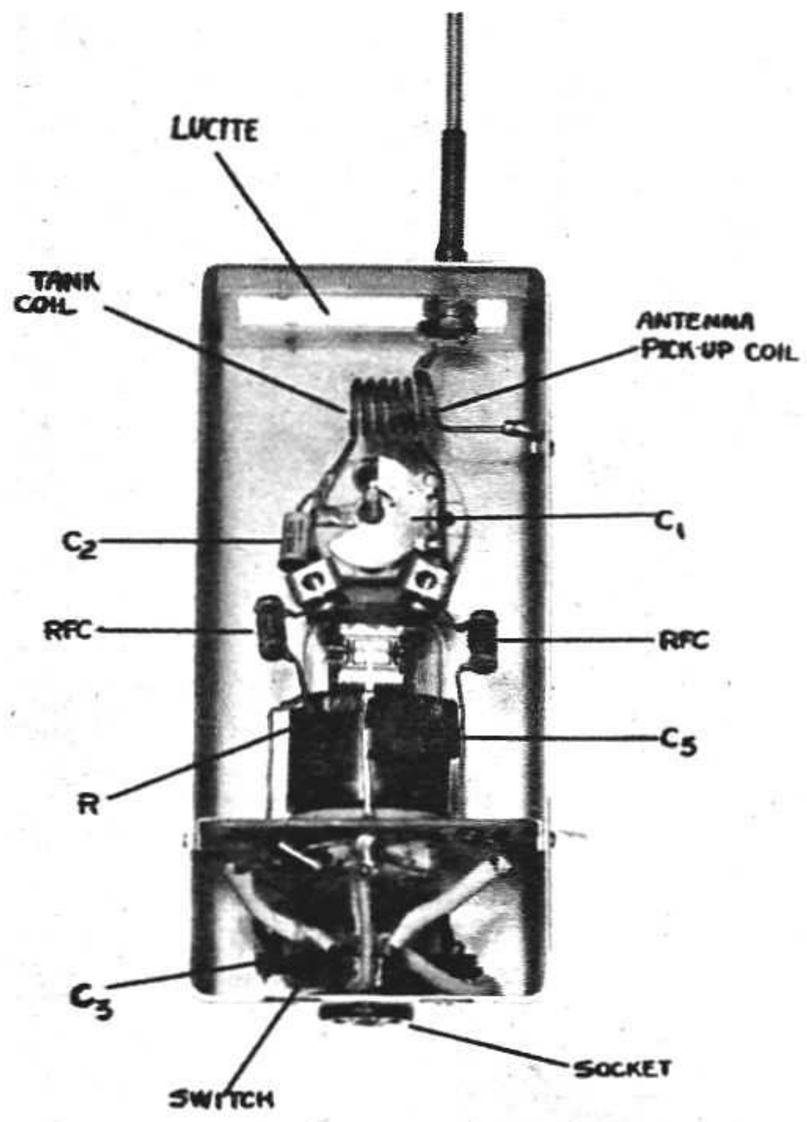
RADIO CONTROL SYSTEM







by E. J. LORENZ

Details of finishing the receiver started last month and plans for a transmitter to actuate it

LAST month we gave plans for a sensitive relay and the base of a pre-tuned superregenerative receiver. In this issue are plans for completing the receiver and for building a transmitter to go with it. These two items along with a midget escapement, which was described in the July issue, will transform a Class A gas model into a radio controlled ship and give you many hours of pleasurable flying. The receiver uses an RK-61 tube which is the miniature version of the old reliable RK-62. The RK-61 may be purchased directly from the Raytheon Manufacturing Co. of Newton, Mass. The parts needed for this midget lightweight receiver are as follows:

C_1—3 mmfd. cond.
C_2—3 mmfd. cond.
C_3—100 mmfd. mica
C_4—.01 mfd. paper
R—2 megohms ½w
L—see text.
1 penlight cell for the filament supply
2 Eveready Mini-Max hearing aid batteries type 412-E
Wire and screws as described in the text

The base of this receiver is laid out so there is a minimum of work in actually adding the components and completing the set. The photographs are self explanatory as to construction. Keep all leads as short as possible and do not apply the soldering iron too long near the tube or condenser leads since these leads are cut to a minimum and the heat is not readily dissipated. A pencil type iron is recommended for small soldering jobs such as this. *Do not use acid core solder when working on radio equipment.*

When all soldering is done on the receiver and the transmitter, go over all solder joints and the base surrounding them with a toothbrush or mascara brush dipped in Energine or similar cleaning fluid. This removes all excess rosin and oily film on the parts.

The antenna is connected directly to one end of the antenna coupling condenser, C_1, or it may be terminated, along with the free end of the condenser, at an eyelet in the corner of the base. The RF choke is made by winding 30 turns of No. 34 enameled copper wire on a 1/2" length of 5/32" diameter bakelite rod or tubing, to which two heavier wire leads have been twisted on each end, as shown in the drawing. The tank coil consists of 5 turns of No. 16 bare copper wire wound on a 3/8" diameter form and stretched to a length of 9/16".

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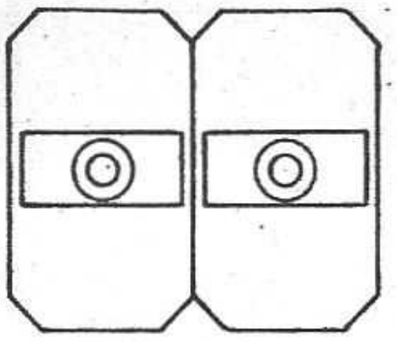
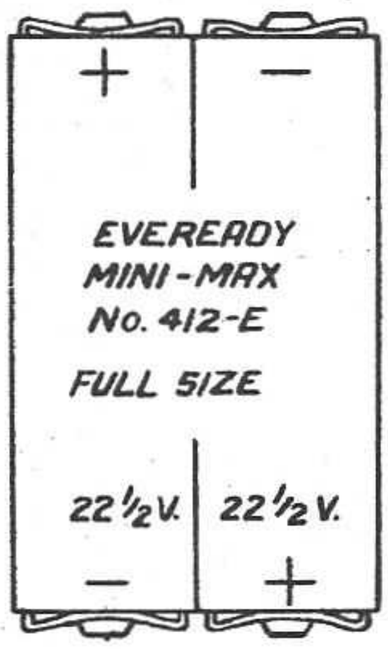
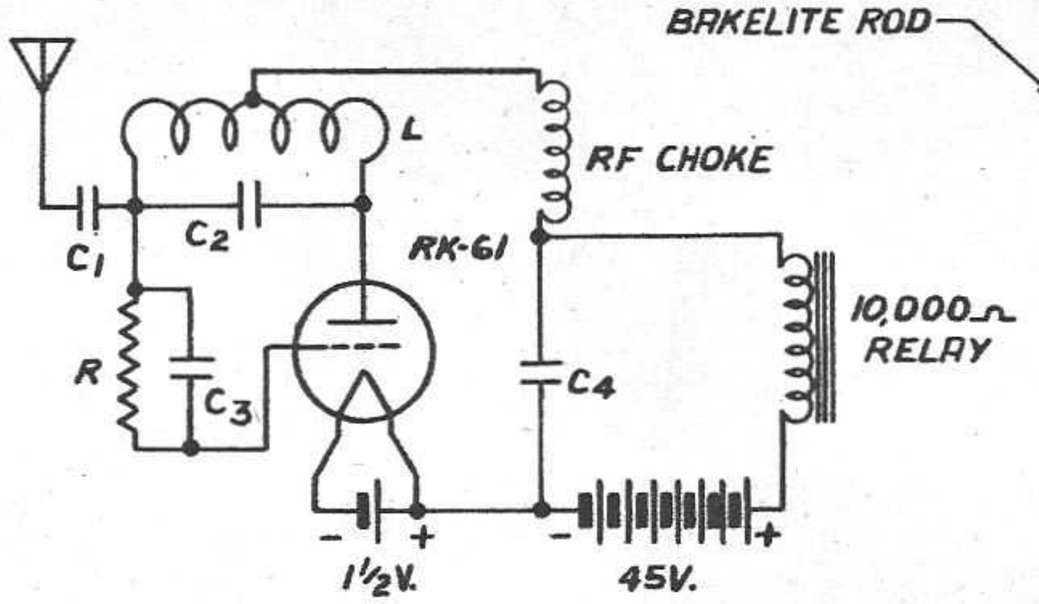
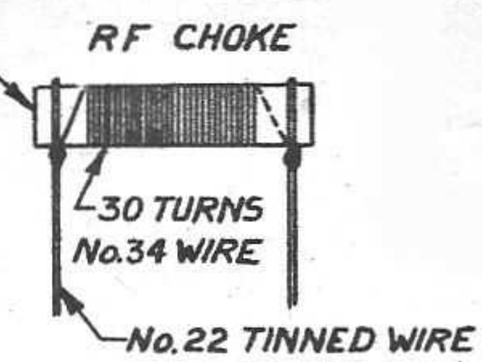
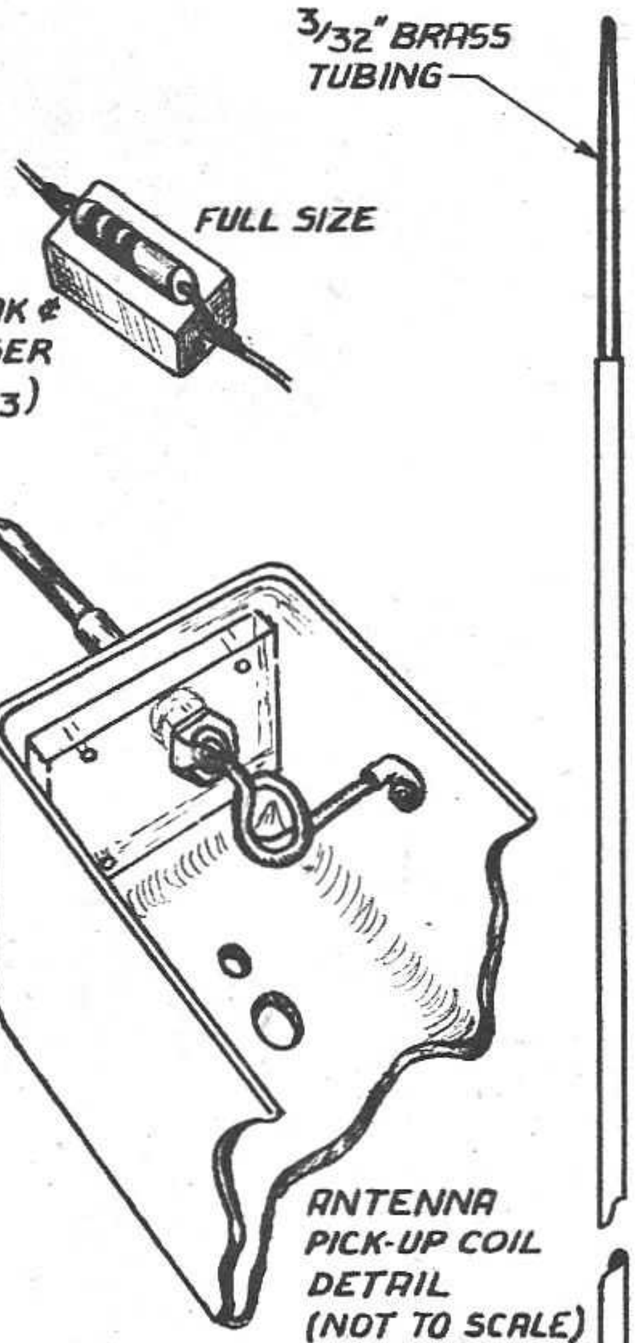






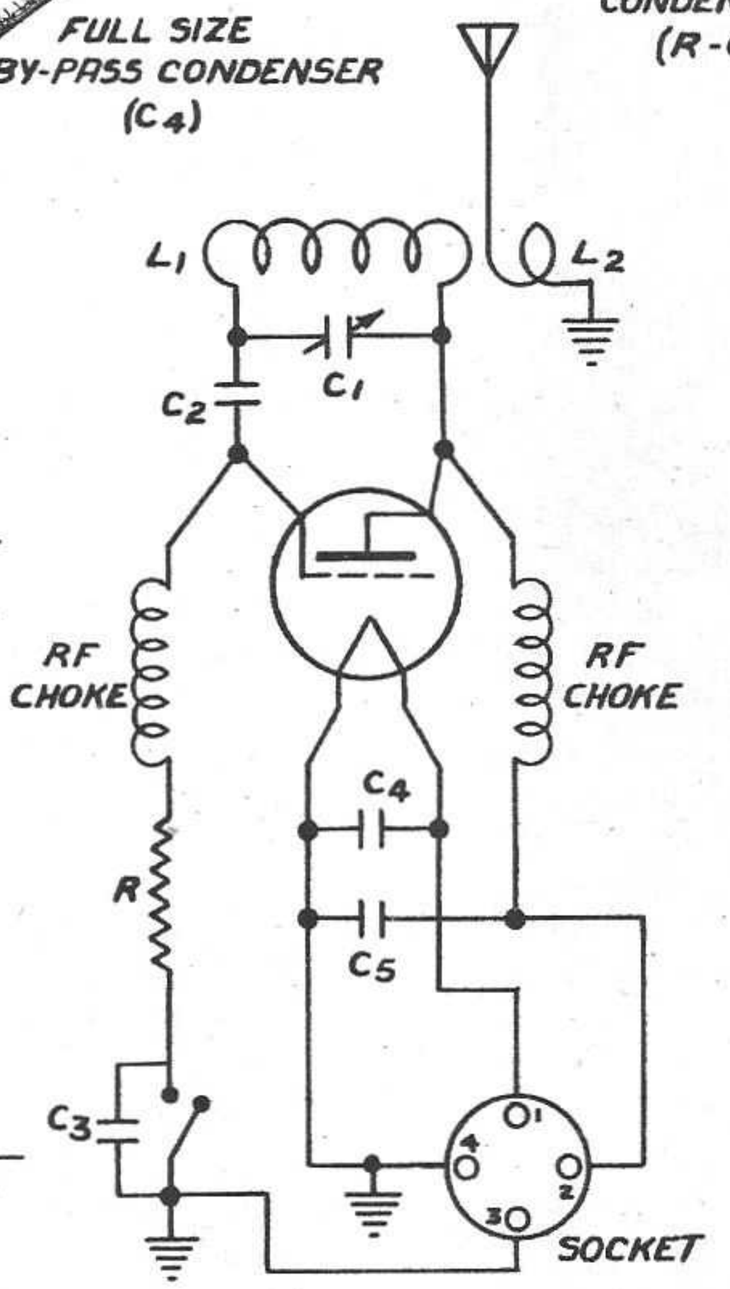
RECEIVER DIAGRAM



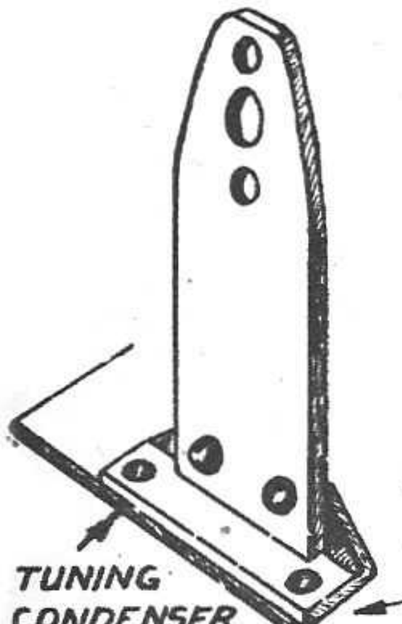


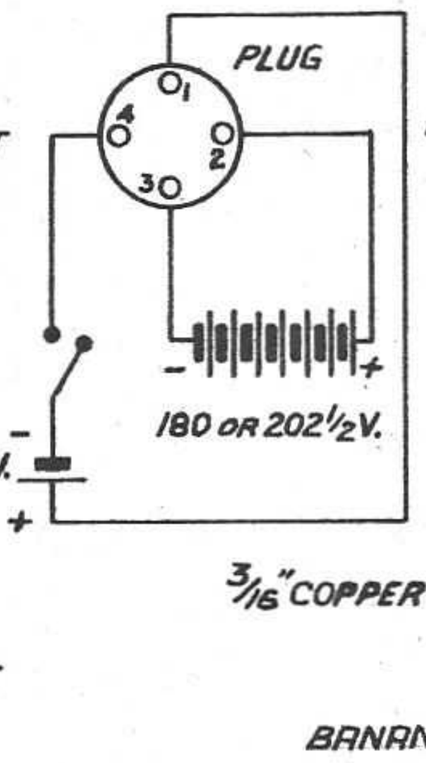
FULL SIZE
BY-PASS CONDENSER
(C_4)

FULL SIZE
GRID LEAK &
CONDENSER
(R-C_3)



TRANSMITTER DIAGRAM





RADIO CONTROL
RECEIVER TRANSMITTER
144-148 Mc

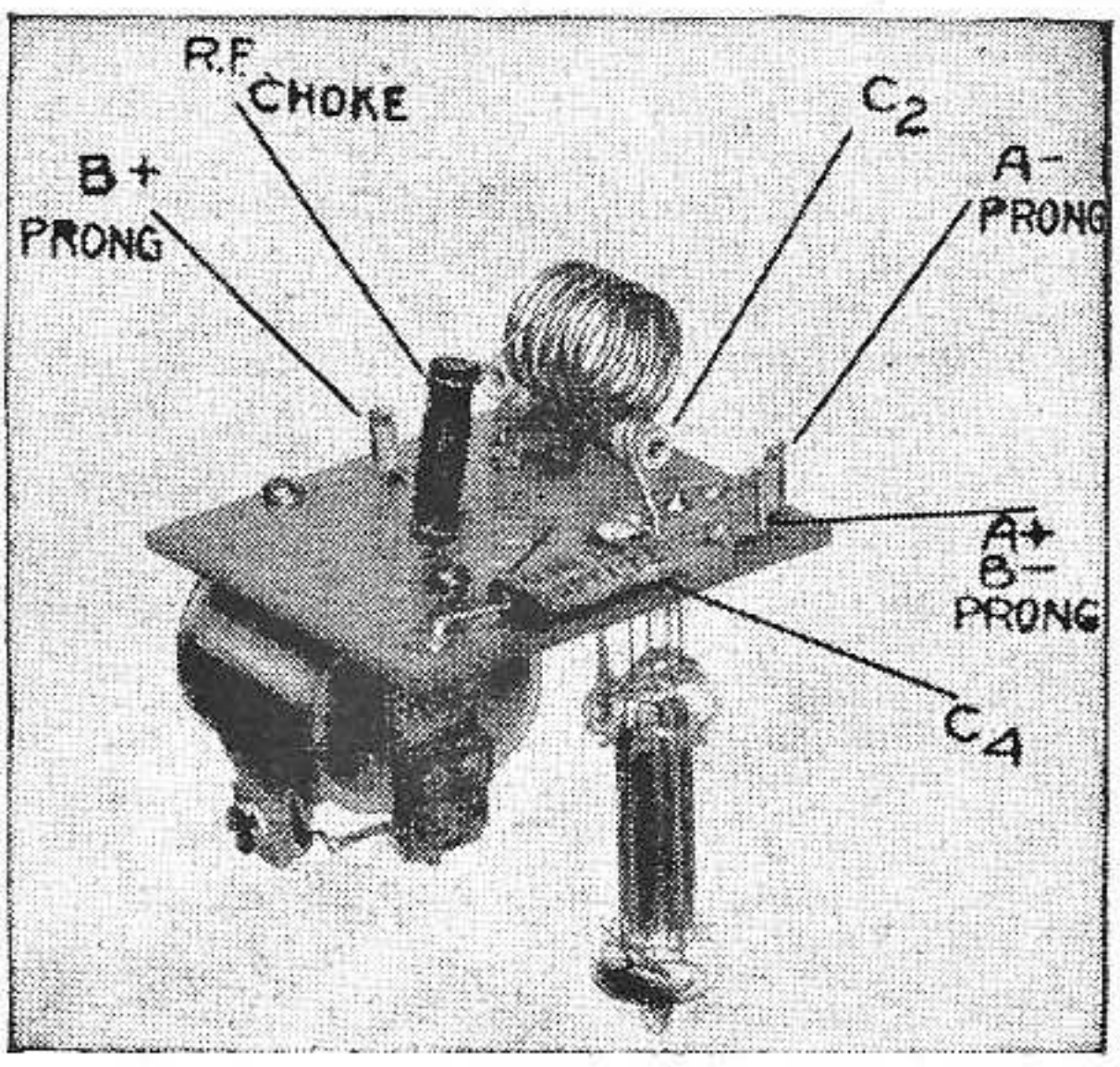
DESIGNED & DRAWN BY E.J. LORENZ

Radio Control System

(*Continued from page 22*)

When testing the receiver use heavier batteries than the small hearing aid type and the penlight cell. You will also need a pair of headphones and a 0/3 milliammeter. When a super-regenerative receiver is functioning properly, a hiss can be heard through a pair of headphones when they are inserted in the plate lead. Upon receipt of a signal this hiss stops. The complete theory and operation of a receiver of this type is too detailed to explain without running into a lengthy discussion. Information may be obtained from any radio book dealing with super-regenerative receivers.

The recommended no-signal plate current on the RK-61 is 1 to 1.5 ma. When a signal is received this drops to .3 to 1 ma, depending on the strength of the signal. With this receiver operating on a frequency of approximately 146 mc the no-signal plate current is around 1 ma. Since the relay is very sensitive and has a high contact pressure, it will function on a small change of plate current. Adjust the armature spring screw so that a change of .3 ma will operate it. The tank coil may have to be squeezed together or pulled apart slightly in order to hit the correct frequency. This can be determined by adjusting the tuning condenser on the transmitter and then measuring the frequency of the transmitter when the correct setting has been obtained.



The antenna is a 16" length of No. 22 wire and should be trimmed down to obtain the greatest change in plate current when a signal is received. The physical length will differ slightly with each receiver and position of mounting the antenna, so it is purely cut and try before the correct length is obtained. Very flexible stranded wire, preferably the type used for the antenna of portable radios, is used for the battery to set connections. Short tips of No. 18 bare copper wire are soldered to the wires coming from the batteries and are used as connectors to fit the prongs on the base of the receiver.

This completes this compact and lightweight receiver, suitable for Class A gas models. The total weight, including the escapement, is slightly under five ounces. When mounting in the plane, suspend the receiver on four rubberbands attached to the base by four small hooks near each corner. If more than one control is desired, additional receivers will have to be employed, each one tuned to a different frequency, or else a stepping relay will have to be used. We hope to be able to give you plans for a midget self-neutralizing stepping relay in a later issue.

Now for construction of the transmitter

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which is a simple ultraudion oscillator using a Hytron 114B tube. It is entirely battery operated and has an output of approximately 1.1 watts on the 144-148mc band. This power is ample for good coverage at a range of 1/2 to 3/4 of a mile, which is just about the limit of a small Class A radio controlled model. Following is a list of parts needed:

C_1—7 mmfd. air trimmer
C_2—40 mmfd. ceramic
C_3—.01 paper
C_4, C_5 .001 mfd. mica
R—20,000 ohms 1/2 w
L—see text
1 Hytron 114B tube
1 Octal ceramic tube socket
1 midget micro switch
1 small banana jack and plug
1 four prong Amphenol plug and socket
2 R.F. chokes. (Described in text)
2 grid clips to fit grid and plate connections on tube
A drawn aluminum box 2 x 2-1/2 x 5-1/2 inside dimensions, or a built up case
Necessary wire and hardware as indicated in text

To begin construction, cut the base for the tube socket from 1/16" Mycarta as shown and insert 3/32" eyelets as indicated, placing small soldering lugs under all but the one marked "no conn". Place the tube socket in the base with the key of the socket pointing toward the rear (toward the three holes). Two short pieces of brass or aluminum angle are riveted to the sides of the base piece as a means of mounting in the case. Tap two holes in the side of each angle with a 2-56 machine screw tap; this will provide for fastening the base to the case with 3/16" long screws.

A short piece of wire is soldered between socket prong No. 7 and the adjoining eyelet and soldering lug. This is the A plus side of the filament. Remember that when working with VHF circuits all leads must be kept as short and direct as possible. A .001 mfd condenser C4 is soldered between socket prong No. 7 and the ground connection lug.

The tuning condenser bracket is cut from a piece of 1/16" Mycarta and attached to the base with a short piece of brass or aluminum angle, riveted in position as shown. Next make two R.F. chokes by winding 30 turns of No. 34 enameled copper wire on 1/2" pieces of 3/16" diameter bakelite rod. (See receiver text and drawing.) Wind the tank coil from a piece of No. 16 bare copper wire, making five turns over a 3/8" diameter form. Space the windings to make a coil 1/2" long. This coil is then soldered across the two plate condenser C_4, allowing the right hand lead of the coil, looking at it from the rear, to extend 1". Fasten the condenser to the bracket, using a short screw in the bottom hole only. Insert the tube in the socket and after tinning the grid clips, snap them on the grid and plate connections of the tube, making sure they are aligned so that they will slip off directly toward the rear.

The 40 mmfd ceramic condenser, C_2, is soldered between the grid clip on the tube and one side of the tank circuit. The other end of the tank circuit, the coil end with the 1" lead, is next tinned and carefully bent over and soldered to the plate clip. Care must be taken in soldering to both the grid and plate clips in order to avoid getting them too hot which would crack the glass of the tube. At the same time these connections are being soldered also solder one end of an R.F.

(*Turn to page* 79)

choke to each clip. The other ends of the chokes are soldered in place as shown in the diagram and photographs.

This completes the "chassis" of the transmitter. Now for the case. If a drawn aluminum box (obtained at war surplus stores) is not available one may be made by bending .050 aluminum to shape and joining the corners with brass or aluminum angle. A hole is cut in the bottom for the four prong power socket, the center line being about 3/4" from the rear end of the case. A hole 1" x 2" is cut in the top, equidistant from the sides. A piece of 3/16" lucite 1-1/2" x 2-1/2" is next fastened on the inside of the case under this hole and is held in place by four self-tapping screws or small bolts. This provides ample insulation for the antenna fastening. A 1/4" hole is drilled in the lucite 7/16" from the right hand edge of the hole, looking at it from the rear. A midget banana plug with a soldering lug on the underneath side is inserted in the hole and a red or black cap is screwed on the top to fasten it securely.

The mounting of the midget micro switch depends on the size and type used and is left to the ingenuity of the builder. This switch provides for breaking the high voltage ground connection, thus keying the transmitter. The .01 mfd paper condenser C_3 is soldered across the points to reduce arcing. Before fitting the switch into the case, slide the "chassis" into the case, the underside being about 1-3/8" above the bottom of the case. Drill holes in the case to match up with the tapped holes in the angles. Before fastening the "chassis" permanently in the case, fit the switch in the front as shown in the photograph and make the proper connections to the four prong socket, switch and soldering lugs. An aluminum cover is made for the rear of the case if a drawn aluminum box is used; otherwise all six sides of the box can be incorporated together when the sheet aluminum is cut and bent to shape.

Before installing the antenna pickup coil *carefully* bend the tank coil so that it is in the center of the case and lines up with the banana plug in the top of the case. Solder one end of the antenna pickup coil, which is 1-1/2 turns of No. 16 wire 3/8" in diameter, to the soldering lug on the banana plug and ground the other end to the side of the case. The case is connected to the ground connection on the "chassis" by a short piece of wire which is riveted or bolted to the aluminum case. (See photo.) The ground connection for the pickup coil is made by soldering a small lug to the end of the wire and fastening it with a small bolt to the case. Make sure this coil is aligned with the tank coil and is about 1/16" away.

The antenna is made from a 14" length of thick walled 1/8" aluminum tubing. This is forced tightly into a 1" length of 1/4" or 3/16" copper tubing for a distance of 1/2". Into the other end of the copper tubing is soldered the banana plug jack. A 6" length of 3/32" brass tubing, slightly crimped for about 3" to insure a tight fit, is fitted into the top end of the aluminum tubing. This movable brass tube is the means for tuning the antenna. This antenna is a 1/4 wave vertical radiator and the total length from the bottom of the copper tubing to the tip of the brass tubing should be approximately 15-1/2" for 146 mc. This length will vary slightly on each transmitter due to the amount of coupling and the distributed capacity of the circuit and the case.

The power supply on the original model consisted of three 67-1/2 volt Burgess

(type XX45) batteries connected in series, giving a total of 202-1/2 volts. This is slightly higher than the recommended plate voltage of 180 volts for this type tube. Due to the very short time the high voltage is applied it should not prove detrimental. When testing, 180 volts is recommended. The filament supply is 1-1/2 volts and any of the small square type batteries will do. Make the necessary connections terminate at a four prong plug to fit the four prong socket on the transmitter. The leads should be about 12 to 14 in. long. The batteries may be built into a wood or metal case and suspended from the belt when out on the field.

Now for testing the transmitter and setting it to the correct operating frequency. A small neon bulb or a suitable meter is used for tuning. Set the tuning condenser at about two-thirds full capacity and apply voltage. With 180 volts on the plate it will draw around 9 to 9.5 ma unloaded. With the antenna plugged in this plate current will drop to about 6 ma. In order to get the maximum dip in plate current and the greatest amount of power into the antenna, the brass tubing on the antenna will have to be adjusted and also the degree of coupling between the tank coil and the pickup coil. The frequency should be determined by either a frequency meter or Lecher wires, details of which are in any radio amateur book. Remember that this transmitter operates in an amateur band and it is imperative that it not be allowed to fall outside of the 144-148 mc band. Also it is against F.C.C. regulations to operate a transmitter with an antenna attached if you do not have an amateur license.

This transmitter is not the most powerful or complicated for use in radio control of model planes but it is stable and efficient. It is compact and in the theme of Class A radio controlled models. In future issues you will be kept advised of the latest tubes and circuit components as they come on the market and we will try to incorporate them into efficient and compact radio gear to make the flying of radio controlled planes the most interesting phase of modeling.