RECEIVERS

FIG. 6

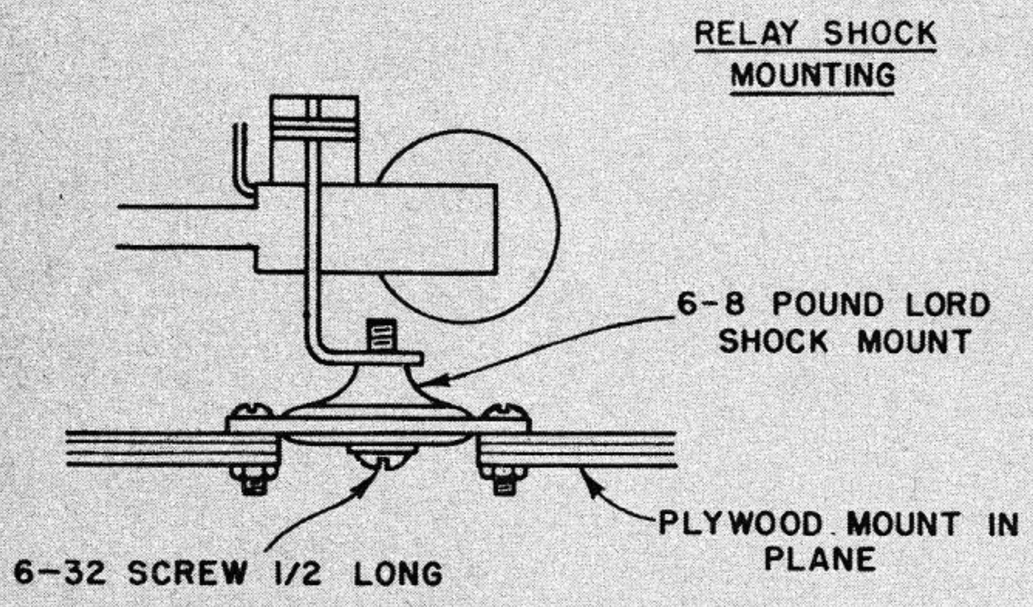


FIG. 7

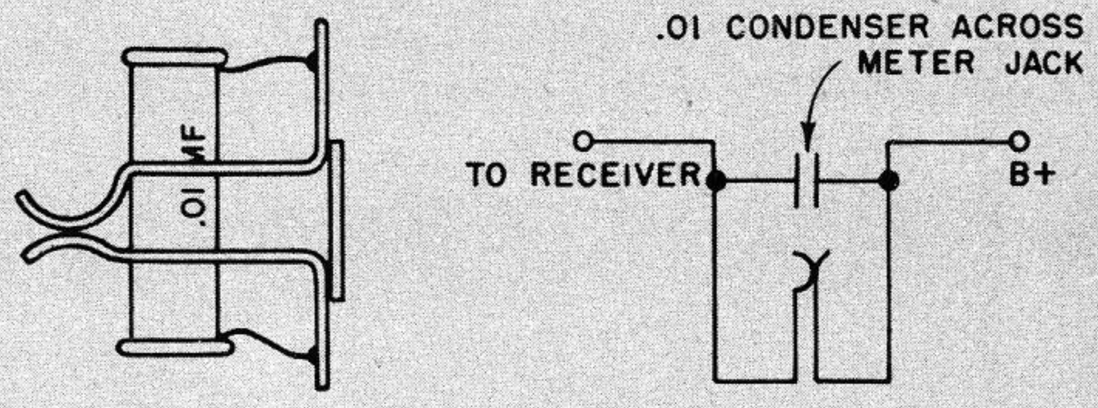


FIG. 8

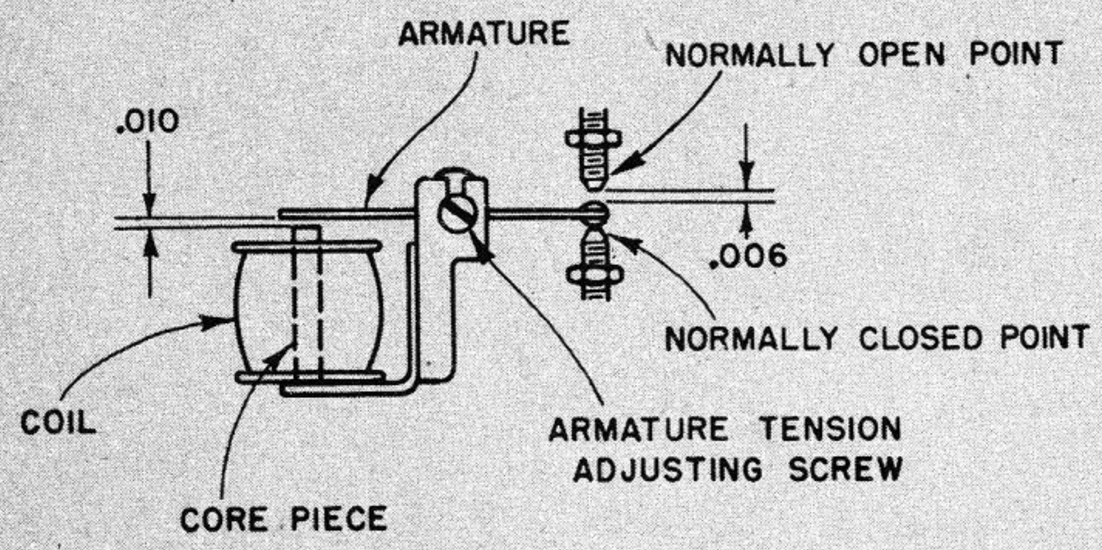
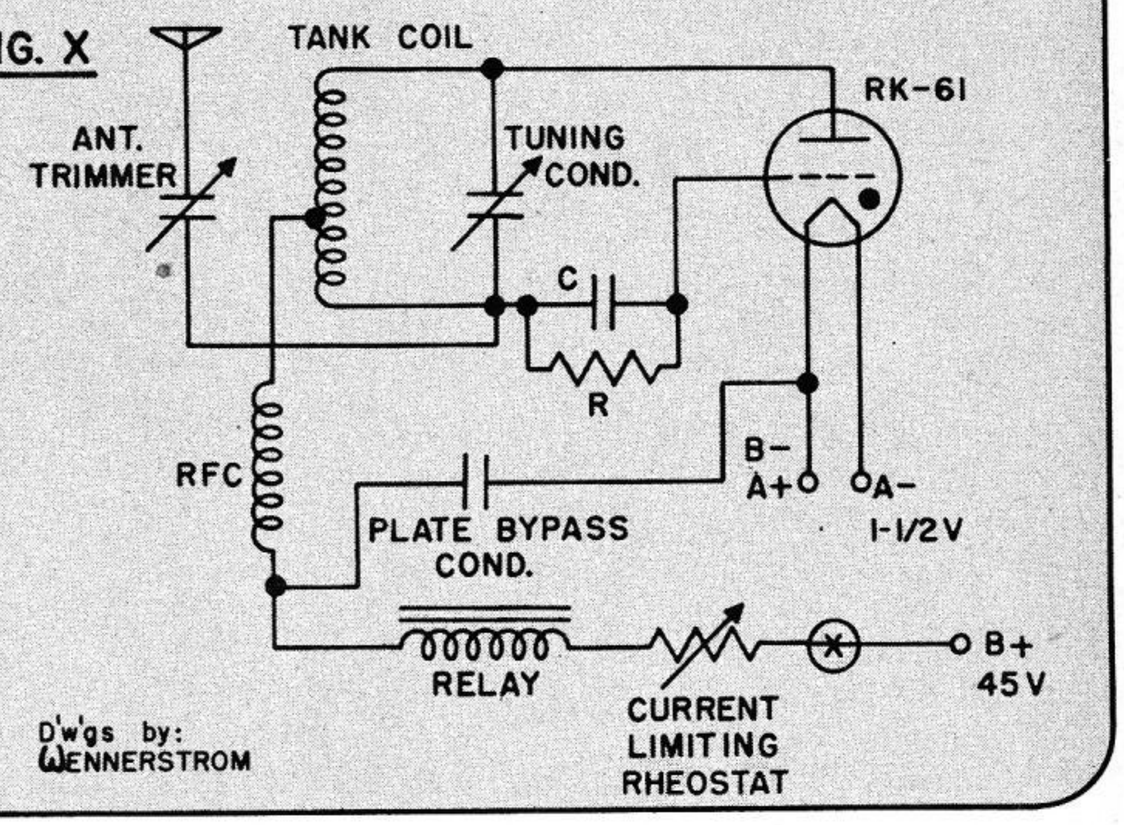
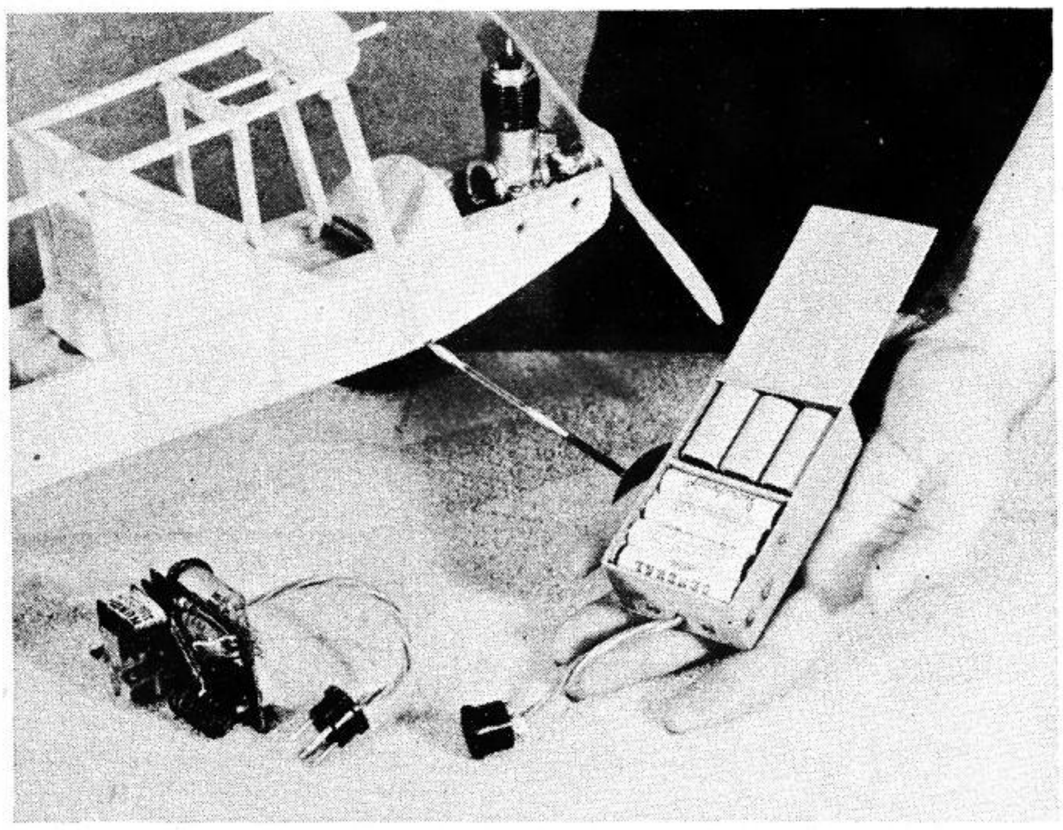


FIG. X





Control Research single tube receiver with plug-in type connections.

RECEIVERS

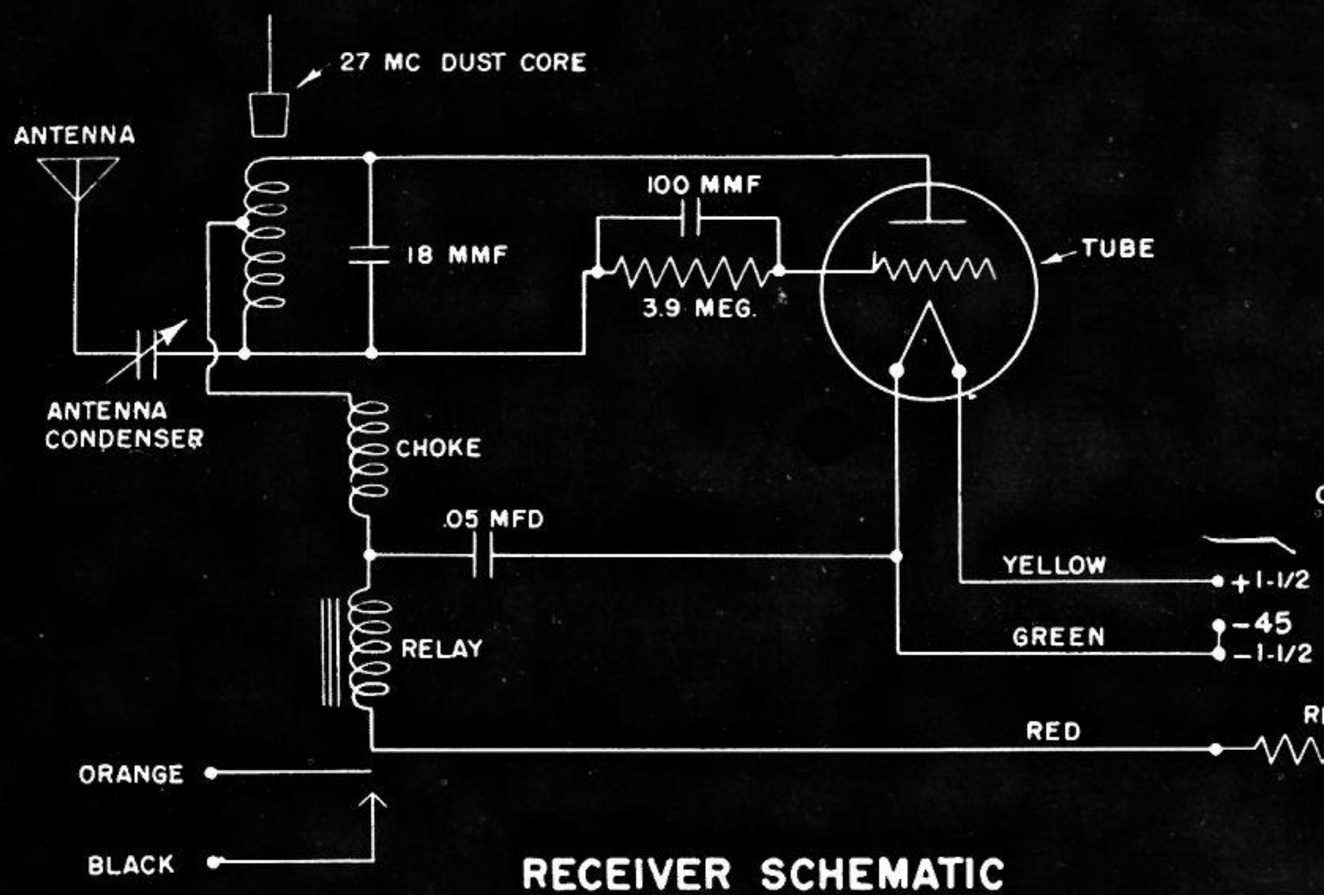
When the rc flier thinks of receivers, he thinks of tubes. Why? It's a long story, here told with clear simplicity that will help the novice get his feet on the ground.

▸ The receiver, "heart" of the control system, is located in the plane where compactness and weight are a prime consideration. Present receivers can be divided into two basic types, those using high vacuum tubes, and those using the RK-61 type, or thyraton. A high vacuum tube has the glass or metal envelope, or "bottle," evacuated in the same manner in which a regular light bulb is made. Life runs into a thousand hours or more. Operationally, it is stable and relatively non-critical of fluctuating voltages, such as might be encountered in batteries after long use.

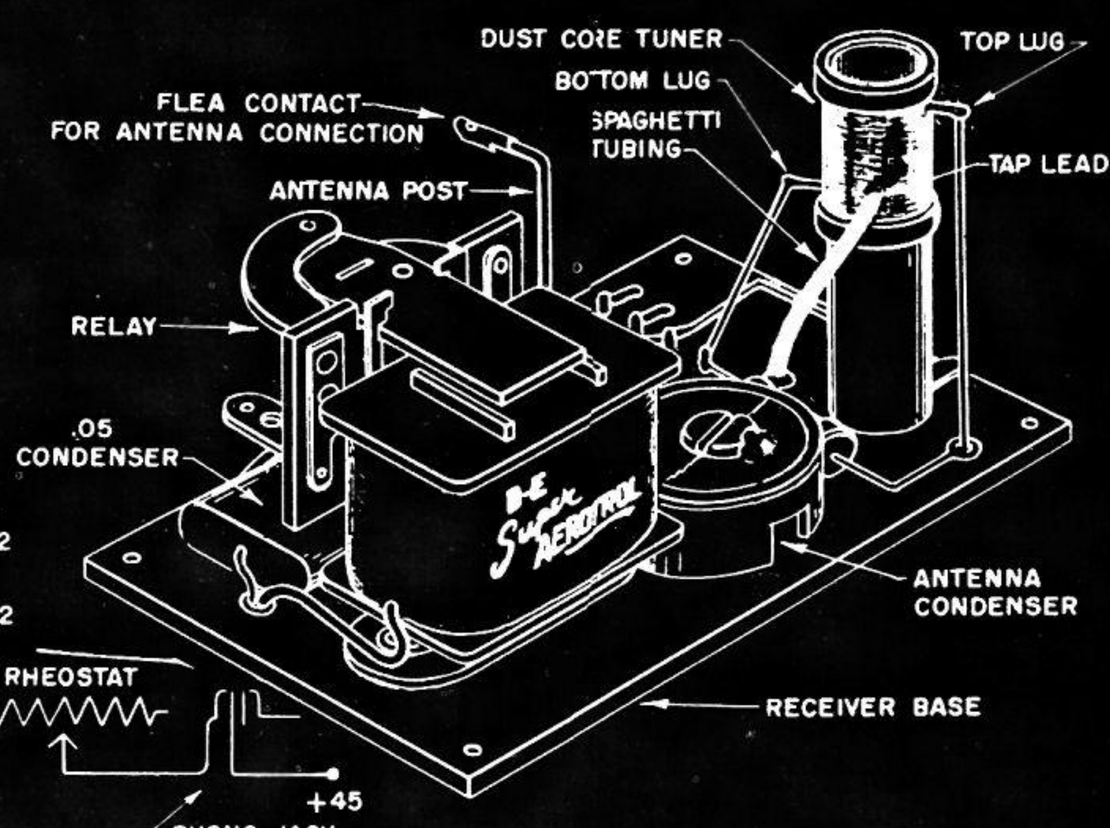
A thyraton tube has its glass envelope evacuated and then filled with an inert gas. This enables the tube to handle much more current through the plate circuit and, in the case of the RK-61 and XFG-1, makes it more sensitive, since a small voltage sent in to the grid will cause a greater change in plate current. The life is much less than that of a high vacuum tube but the increase in sensitivity and plate current changes makes up for its shorter life in most cases.

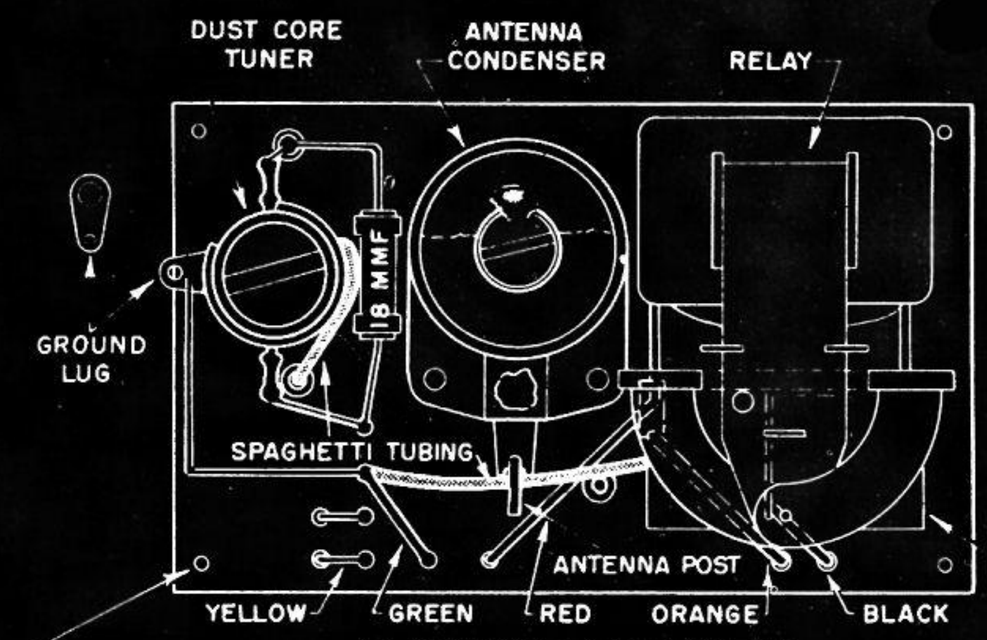
The high vacuum tubes are subdivided into receivers operating only on a carrier frequency, such as the Good Brothers, and the multi-stage receivers used for operating a relay on a modulated signal, such as Rockwood's tuned reed system and the audio filtered type of receiver used in the Army target drone. The RK-61 is primarily used for receipt of a straight carrier and is usually a single tube receiver.

Just after the war, when Raytheon brought out a miniature version of their old reliable RK-62, first called the QF-1, and later changed to RK-61, the trend was immediately toward super lightweight and compact receivers. When Aerotrol was first introduced, it weighed two ounces with relay. One and one-quarter ounces was taken up by the relay alone.

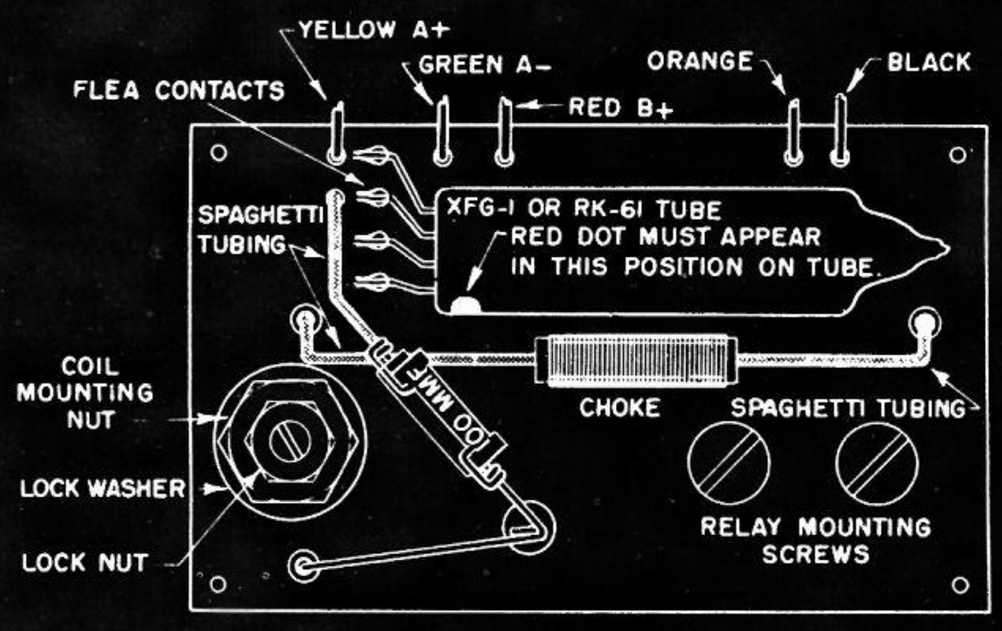


RECEIVER SCHEMATIC





RECEIVER TOP VIEW



RECEIVER BOTTOM VIEW

These life-size drawings of the Aerotrol receiver are intended only to give the uninitiated reader a concept of parts that make up a typical radio.

Considerable controversy has arisen over the merits of the high vacuum tube receiver and the RK-61 type receiver. If lightness, compactness, and simplicity are desired, the RK-61 type must be used. By using the RK-61, the chance of shorter tube life is taken in comparison to a high vacuum tube, and perhaps more of a variation in operating conditions is found with the RK-61 when used in a single tube circuit. However, do not regard the RK-61 or the XFG-1, which is the English equivalent, as being unsatisfactory. A two-tube circuit, to be published soon in M.A.N., using either the RK-61 or XFG-1 in the first stage, makes the life and reliability considerations of these particular tubes much better. The first tube idles at .3-.4ma and the second, or relay tube, at zero. Upon receipt of a signal, the first tube drops to .05-.1ma and the second tube goes up to 1.8-2.8ma, depending upon relay resistance and the type of tube used. One cannot expect long life from the RK-61 or XFG-1 if the plate current is run continually at 1.5ma. Many users run the plate current at 1.2 or 1.3ma but that only subtracts from the reliability of the relay with a given setting. If this type of operation with the tube is desired, it is suggested that a Sigma type 4F relay be used. This relay has sufficient power sensitivity to insure reliable contact pressure at low currents.

Control Research began a trend of separately mounting the relay and the receiver. This method distributes the weight better and lessens the inertia on the two items during a hard landing. Since the receiver less the relay weighs only about three-quarters to one ounce, it may be set into a box lined with sponge or foam rubber, thus eliminating rubber bands or springs and making a neater and more compact mounting. The wires making electrical connections to the set may be terminated at a four or five-prong plug, which is plugged into a mating socket mounted securely in the plane. The relay is best mounted on a six or eight pound Lord mount or suitable equivalent. Lord shock mounts may be purchased at various stores and occasionally through radio supply shops. Mounting a relay in this manner is shown in Figure 6.

When tuning the receiver, especially when a condenser is used for the purpose, an insulated tuning wand made of plastic or phenolic fibre should be used. Such an item may be obtained from any radio supply store. If a metal screwdriver is used, the frequency will change when it is removed due to a decrease in capacitance caused by body capacity being removed. This change in frequency may not be noticeable near the transmitter but will become apparent when the plane flies a short distance away. Do not use long leads on your meter when checking plate current dip since they may add inductance and capacitance to the circuit while they are plugged in. When the meter is removed, this inductance and capacitance also is removed, thus detuning the receiver. In order to help eliminate this problem, place an .01mf ceramic condenser across the plug jack terminals as shown in Figure 7.

Too much stress cannot be put on keeping wiring neat and on eliminating extra lengths of wire. Rosin core solder should be used at all times. NEVER USE ACID CORE SOLDER. Even though the acid may appear to have been wiped off after soldering, it gets into small crevices and into pockets in the solder and eventually will cause failure of the joint by corrosion. ERSIN, an English solder, has been found to be an excellent solder for electrical work.

With a receiver using a thyraton tube (RK-61 or XFG-1) one of the problems that arises is what to do as the tube grows older and performance becomes less stable. Generally, after five to ten hours use, it is apparent that operation is not as it was at the end of (*Continued on page* 49)

R. C. Receivers

(*Continued from page* 25)

one hour's use. Therefore, from time to time, the receiver must be readjusted. When a tube is new, the antenna trimmer should be set at about minimum capacity. This will apply at both 27 Mc. and 52 Mc. The antenna should be about 20" long for 52 Mc and about 30" long for 27 Mc. The plate rheostat then should be set to give a plate current reading of 1.5ma. As the operating time on the tube increases, the rheóstat may be turned towards minimum resistance to maintain the plate current at 1.5ma. The antenna trimmer also may be used to increase plate current. However, increasing the capacity of the antenna trimmer will tend to decrease the sensitivity of the receiver. As the tube continues to be used, the antenna coupling will have to be increased in order to maintain the no-signal plate current of 1.3 to 1.5ma. At a certain point in the tube's life, current will fail to rise when the antenna coupling is increased, or perhaps the receiver will show a lack of sensitivity. When this happens, the length of the antenna may have to be increased 30 per cent or more. The coupling then can be decreased by the antenna trimmer's being turned toward minimum capacity, thus increasing the sensitivity and at the same time maintaining the proper plate current.

When a new RK-61 seems to lack sensitivity, we suggest setting the rheostat to get a reading of 2.5 to 3ma. The tube is left to idle at this current for 15 to 20 minutes. Check occasionally during this period by reducing the current to 1.5 ma and noting the sensitivity. This forced aging of the tube will enable it to perform properly.

Some modelers have rejuvenated old tubes by heating them in an oven for about half an hour at 200 to 250 degrees F. The merits of this procedure are not fully established yet but, as long as the experiment is conducted only with old tubes showing lack of sensitivity and low plate current, there is little to lose in any case.

A general understanding of receiver operation may help you gain peak performance

from your set. Figure X shows a standard receiver circuit using the RK-61 tube and we shall refer to it in our explanation. In this type, which is known as a superregenerative receiver, we have a no-signal plate current of about 1.5 milliamperes. The area within the plate of the tube glows a bright purple and a hissing noise can be heard if earphones are inserted at point "x." With no signal coming into the receiver, there is a frequency circulating in the tank circuit, grid resistor/condenser, and tube. This frequency is governed by the grid resistor/condenser combination and it tends to place a voltage at the grid of the tube so that electrons can flow freely from the filament, past the grid and to the plate. This produces a flow of plate current. The amount of plate current is governed by the amount of resistance in the external circuit, the relay and rheostat. The more resistance, the lower the plate current. Thus we set the idling, or no-signal, plate current by varying the resistance of the rheostat. This current flowing in the plate circuit flows through the relay and the magnetic flux set up in the coil of the relay attracts the armature and thus the relay is closed.

Upon receipt of a signal having been imposed upon the antenna, the signal frequency is tuned to resonate in the tank circuit. This is done by varying the variable condenser. When the circuit is tuned to the incoming frequency, the radio frequency circulates through the grid resistor/condenser and a negative voltage is impressed upon the grid. Since the grid is in the electron stream between the filament and plate, a negative voltage acts to repel the electrons back toward the filament, thus decreasing the stream toward the plate. This results in the plate current's decreasing. Thus an incoming signal results in a decrease in plate current, causing the relay to open. The purple glow in the tube decreases or disappears as the signal is received. Also the amount of plate current decrease depends on the strength of the incoming signal.

This is a very elemental explanation since the operation of a superregenerative receiver is complex enough to require a textbook to explain all of its functioning and characteristics. Any kit you purchase or any set you build from plans has been thoroughly checked and will operate properly if instructions have been followed carefully.