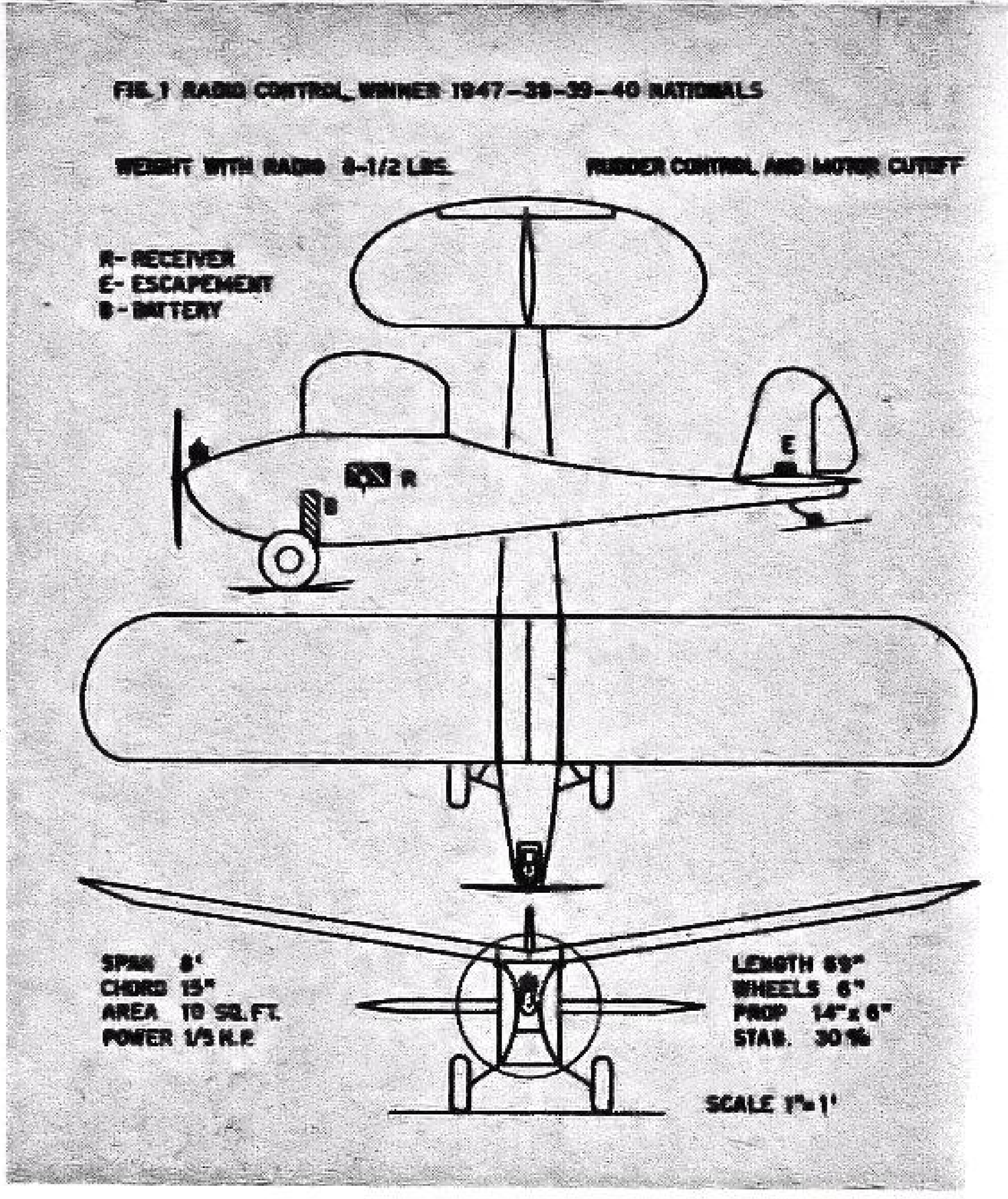
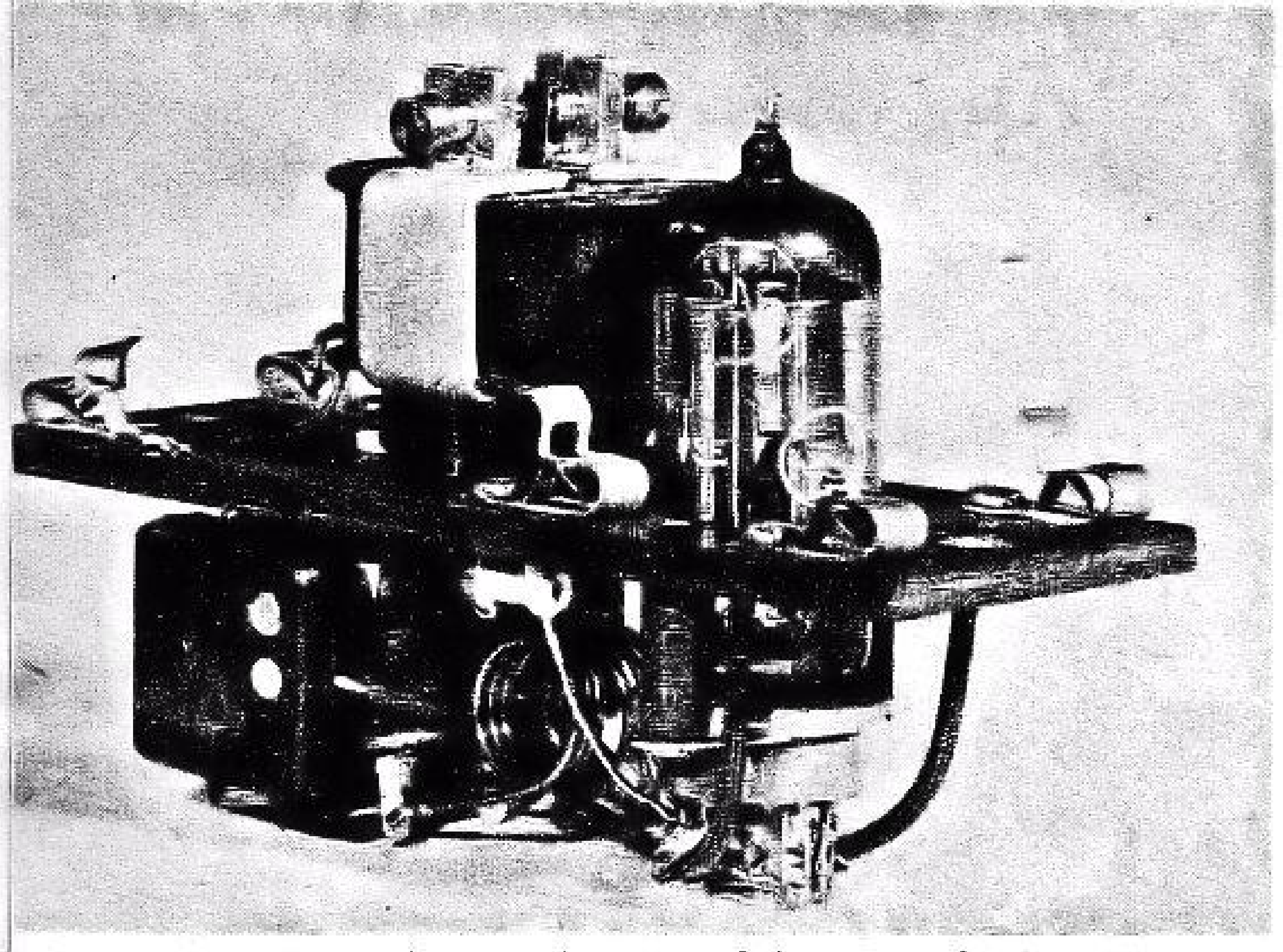
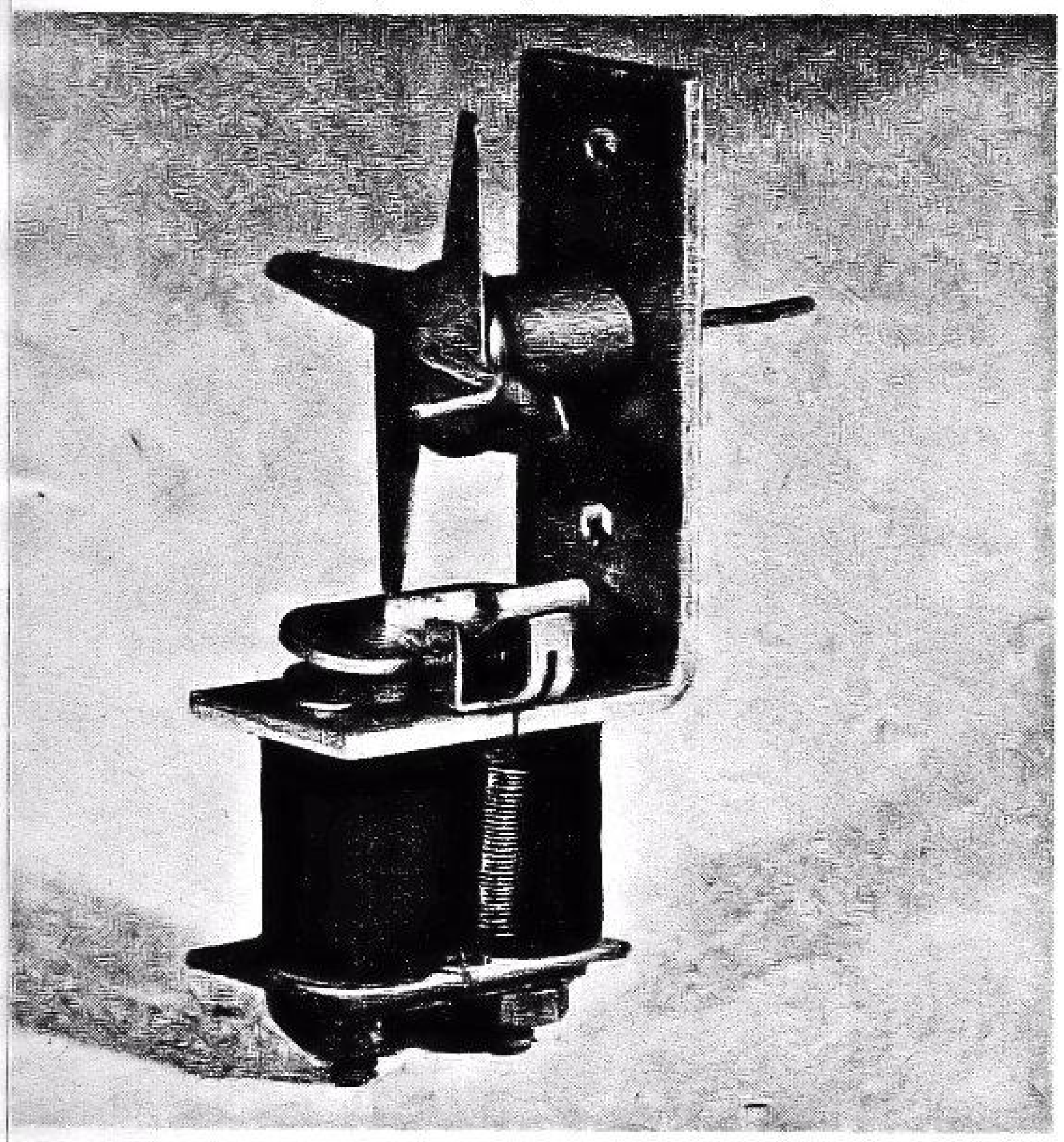
Walter Good helps plane off at '47 Nats. Ship gained extra points by later unassisted takeoffs





The receiver used in the winning plane is shown above, with rudder escapement below



The plane ready to go, at left. Right, Bill holds ship so tiny receiver in large cabin may be seen

Radio Control Can Be Simple

Complication usually causes trouble — study how the Radio Control champs do it the simple way

By BILL and WALTER GOOD

RADIO control flying is fun, especially with simple equipment. Postwar radio gear along with a reliable model and a little practice make possible many fancy maneuvers with just rudder control. Why use more complication if it isn't needed? Simple gear means more time in the air, less time on the ground.

The following material is based on an experience of almost 400 radio-controlled flights. The ship pictured here is the model which won the 1947 Radio Control Event at the Nationals. Previously it also took the 1938, 1939 and 1940 National Events. A description of the model and radio equipment follows, and many maneuvers are detailed so that you yourself may try them.

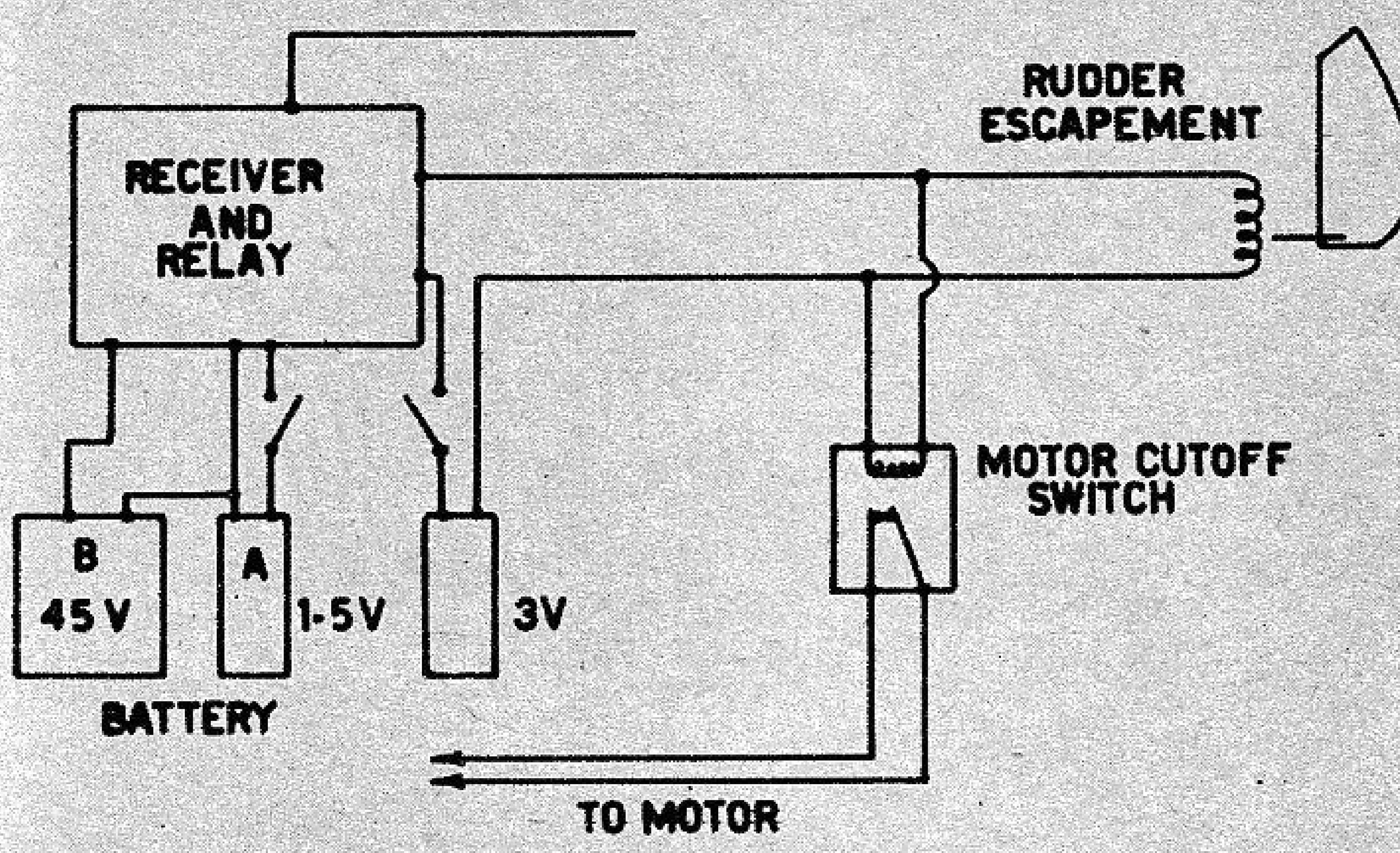
The model is an 8 ft. span, enlarged *Guff* design, weighing 8½ lbs. with radio gear installed. The 10 sq. ft. of wing area using a Grant X Section gives a slow floating flight even with its 13.5 oz. per sq. ft. wing loading.

Fig. 1, a three view drawing, shows the model's proportions and some of the pertinent details. It must be admitted that parts of the model were actually built in 1935, but so many rebuildings have taken place that only a few of the original pieces remain. They are kept well hidden under recent recovering jobs.

During five war years the model rested in an attic, to suffer only the deterioration of its precious six-inch air wheels, which were kindly replaced by Jim Walker.

An *Ohlsson 60* powers the plane with plenty of thrust, and is occasionally throttled back for realistic type flights. Here steep climbs are not desirable. In the past, much of the flying was done with a *Brown Junior* and with a *Dennymite*. The important point is to use a reliable engine which will empty a large tank of gas without a cough or sputter.

FIG. 2 WIRING DIAGRAM OF RADIO CONTROL WITH RUDDER AND MOTOR CUTOFF



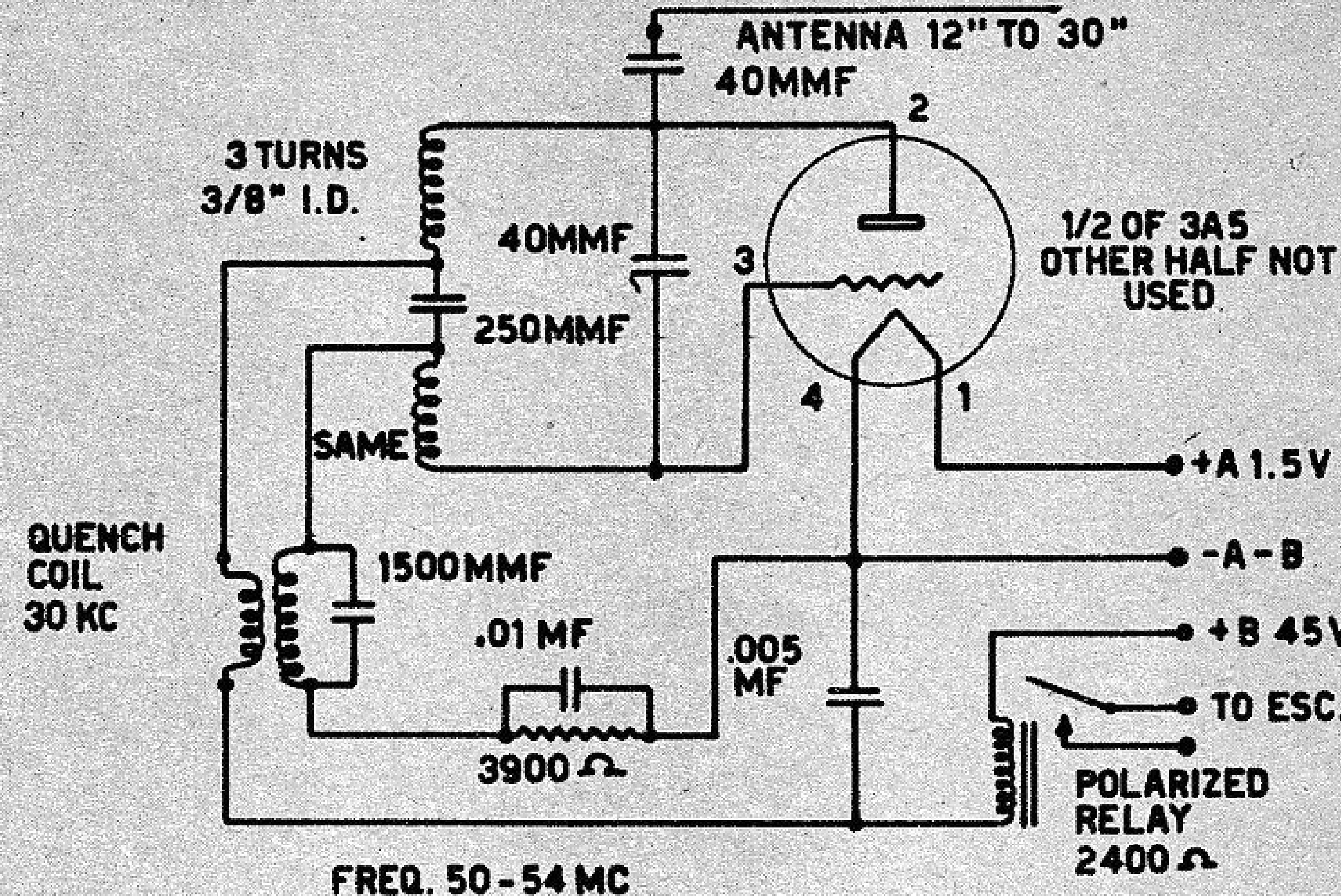


FIG. 3 GOOD BROTHERS RADIO CONTROL RECEIVER

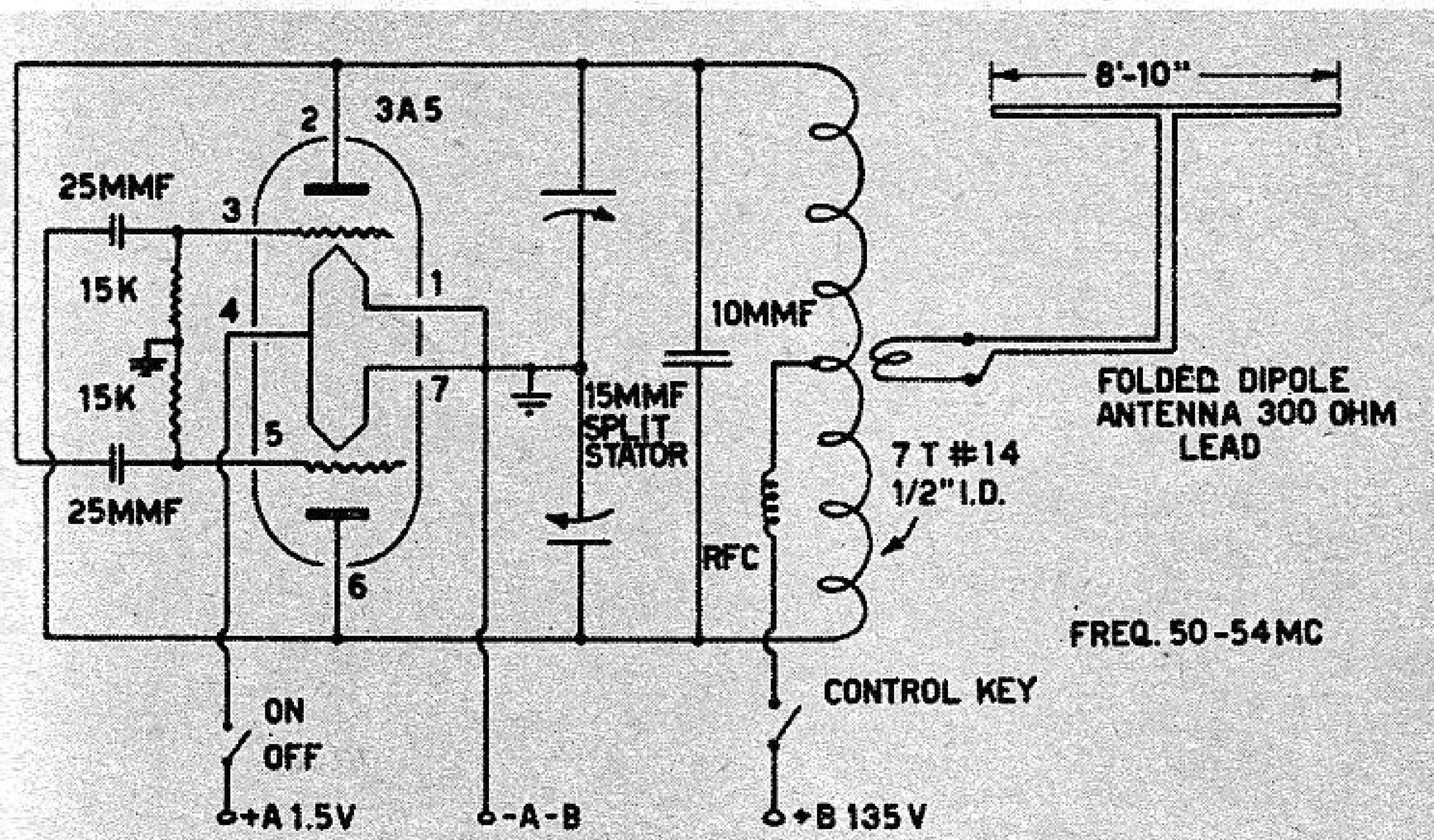


FIG. 4 GOOD BROTHERS RADIO TRANSMITTER

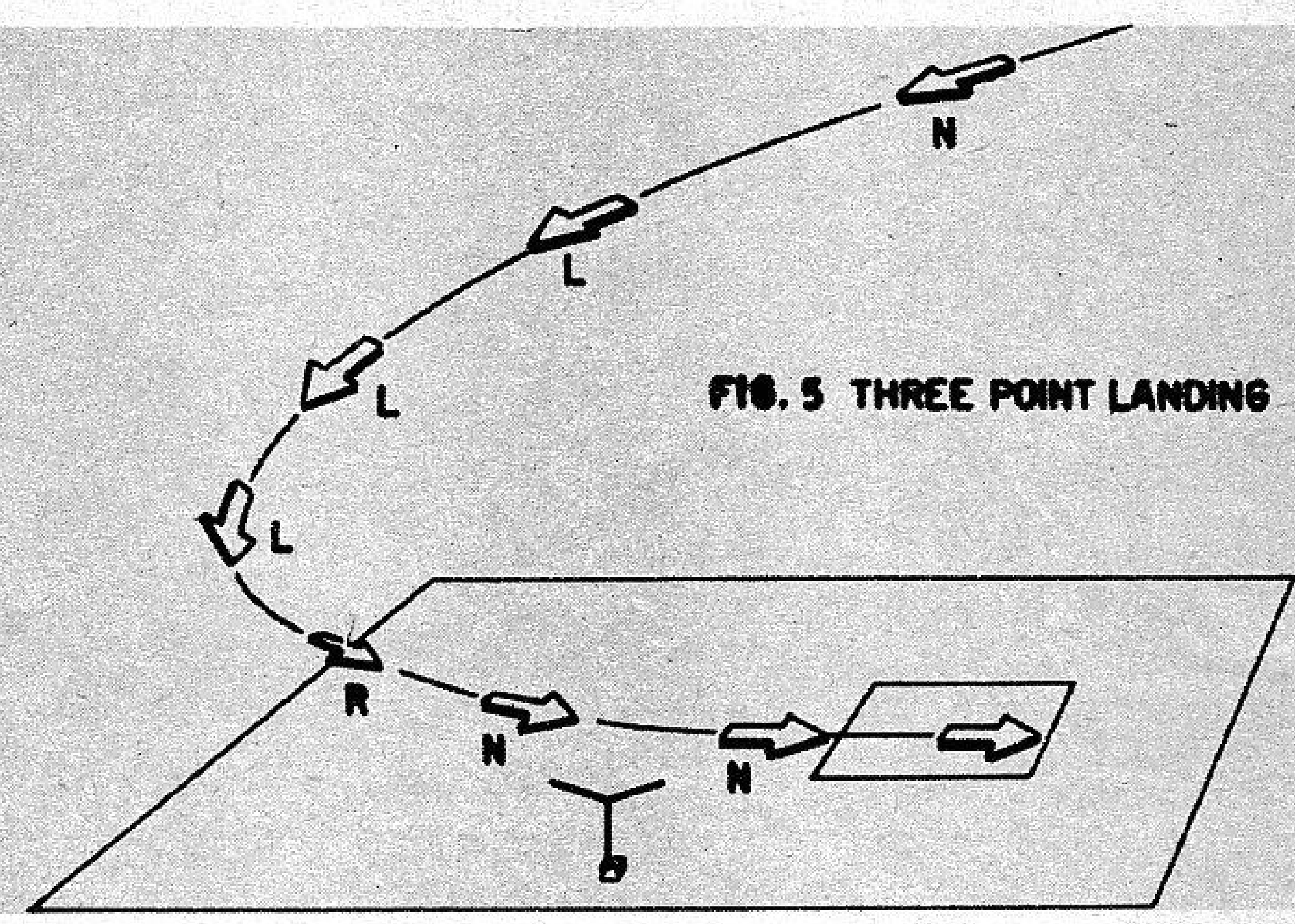


FIG. 5 THREE POINT LANDING

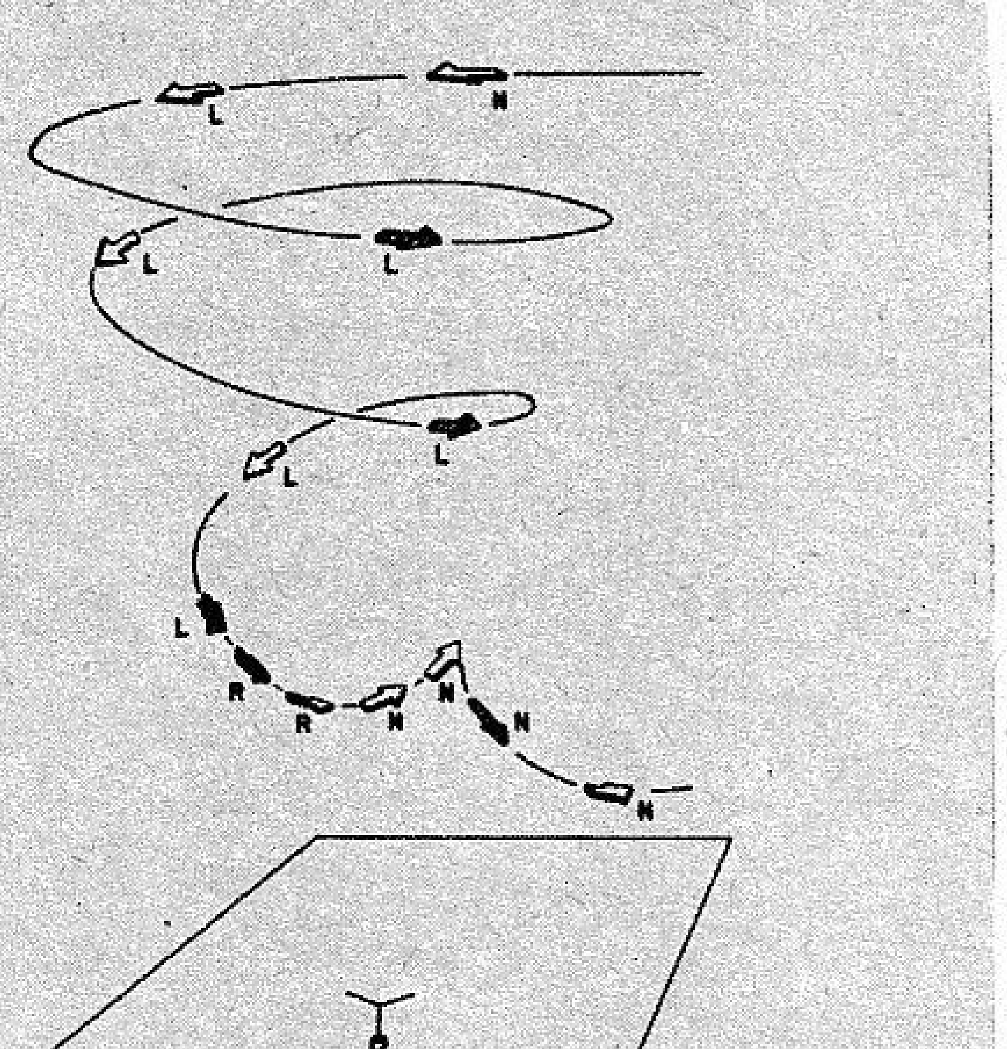


FIG. 7 STALL

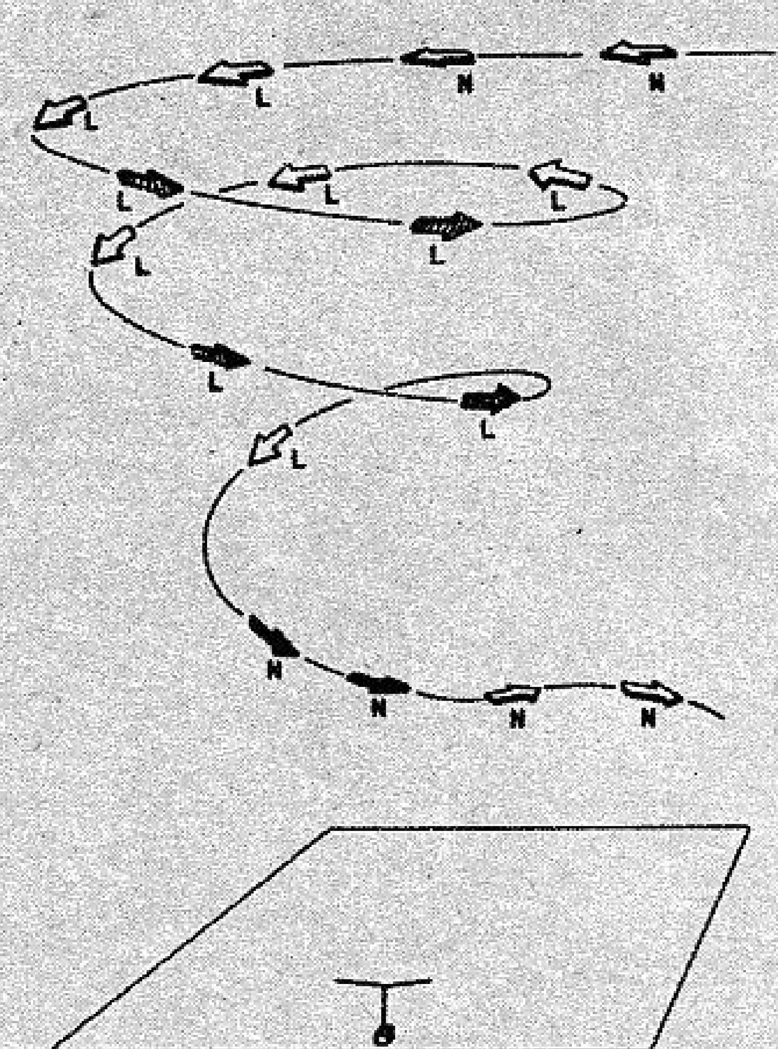


FIG. 6 SPIRAL DIVE

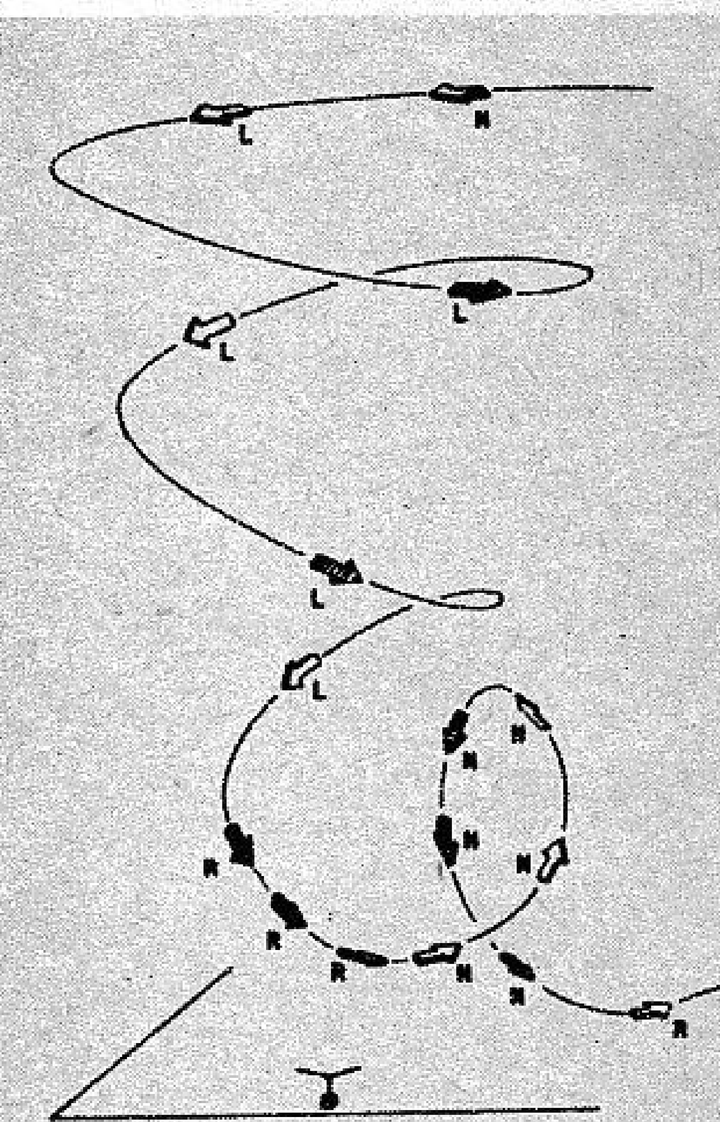


FIG. 8 LOOP

We find a 5 to 7 minute tank just about right. For ignition, two standard D flashlight cells (shades of 1936!) were used to eliminate the booster problem, which simplifies field procedure.

Although this ship is larger than really needed for carrying present day radio gear, it does have several desirable performance features. First, it is very stable—a good quality when you want it to recover quickly from an awkward position. Second, its powered speed and glide speed are about equal. This allows, for a given rudder deflection, the same size of circle whether climbing or gliding. Third, the lack of adverse torque characteristics allows straight flight under power or glide with the same neutral rudder position. These qualities combined with the right amount of spiral stability yields a model which can be "read like a book" when the control practice begins.

Let us see what radio gear is carried by this plane. First, it carries only a *rudder control system*, which looks rather dwarfed in the immense emptiness of the large cabin. A motor cut-off by radio was recently added and will be explained a little later.

What is needed for rudder control? See Fig. 2. Below are listed the necessary items and also their weights:—

1. Receiver and Sensitive Relay	4.5 Ounces
2. Rudder Escapement	0.7 Ounce
3. Batteries	
45 V "B" Battery	6.0 Ounces
1.5 V "A" Battery	2.0 Ounces
3 V Escapement Battery	1.0 Ounce
Total Radio Weight =	14.2 Ounces

Thus, the radio gear weighs well under one pound, actually a rather light load for this big plane. To be truthful, the writers used slightly larger batteries than listed above, primarily because the plane could easily carry them. Hence, one set

(*Turn to page 46*)

Radio Control Can Be Simple

(*Continued from page* 13)

of batteries lasted for the entire summer without being replaced. We prefer the plug-in type battery for its convenience and the fact that it does not require a battery box. Plug-in batteries are available in the above sizes from the hearing-aid dealers.

The batteries listed are an "average" set and will give about 20 hours flying time. Smaller batteries may be used but will have less life. If your plane can carry a little extra weight it is wise to use the extra load in batteries. The batteries are held securely against a bulkhead with rubberbands, which are really tight to prevent their slipping.

The receiver is shown in Fig. 3. It is a superregenerative type using one miniature tube on the 50-54 Megacycle Amateur Radio Band. Its sensitivity has been well demonstrated in flight as well as its ability to operate over a wide range of battery voltage. The "B" voltage can be varied from 45 down to 35 volts, and the "A" voltage from 1.5 to 1.1 volts, which means longer battery life and less frequent replacements. The receiver is suspended between two stretched rubberbands which serve to isolate it from motor vibration and hard landing shock.

The escapement device in the photograph is mounted in the fin of this model. It is driven by the wound rubberband whose energy is released by the electromagnet. The pin on the spoked wheel engages a slotted arm from the rudder flap and thus positions the flap. There are three main flap positions—right, left, and neutral; and two intermediate positions—half-right and half-left. The fact that the rudder must follow a definite sequence has been found not a severe handicap because of the inherent high

(*Continued on page* 49)

(Continued from page 46)

speed of the system. For instance, the rudder can go from full-left to full-right in 1/10 second! An 8 in. loop of rubber provides more turns than required for several ten minute flights. When installing the escapement it is important to be sure that all parts are "free" and that no binding occurs.

At the 1947 Nationals an engine cut-off device was used in addition to the rudder control to garner extra points. It added less than one ounce of weight and allowed stoppage of the motor at any time. Use of the thermal delay principle accounts for its simplicity. Four connections are made to the cut-off switch as shown in Fig. 2. Two of the connections take the same voltage as the escapement and lead to a heater element inside the delay switch. The other two are in series with the engine ignition circuit and lead to a pair of normally closed contacts inside the switch.

The contacts are mounted on heat-sensitive bimetal arms. Thus, energizing the heater for three seconds, or longer, causes the contacts to separate, opening the ignition circuit and the engine stops. In flight it is only necessary to hold the transmitter "on" (half-rudder position) for over three seconds to stop the motor. A safety advantage appears here in that if an interfering transmitter should "jam" your frequency, the motor will cut after three seconds and the model will glide down in a large safe circle rather than climb off into the distant blue.

Well, that is all that goes in the ship; receiver, escapement and batteries. A switch and a little wiring finishes the installation. The wiring between units is accomplished with a good grade of insulated *flexible* wire. Never, never use solid connecting wire unless you also want to "sweat out" as we did, a flight in which a broken but touching solid wire intermittently allowed operation. Luckily, the plane was landed back on the edge of a 600 acre field! Do a really good job of installation if you want reliable results. A poorly soldered joint or half-broken wire will soon catch up with you—after the ship is in the air. The above describes the airborne gear. What about the ground equipment?

It should be heartening to know that transmitter equipment has greatly improved since the war. Field experiments have shown that low-power transmitters are quite effective. Fig. 4 is a Schematic Diagram of the transmitter. Its self-contained batteries give four watts input to the miniature push-pull oscillator. Using the transmitter as a base, it supports the antenna pole which quickly slips in place, so but a few seconds are required at the field to put the transmitter in operation. A control switch at the end of a 7 ft. cable completes the ground equipment. This simplicity is a far cry from the old days which required storage batteries, high voltage genemotors, and many long minutes of "set-up" time.

Probably the best insurance for consistent successful radio flights is careful pre-flight testing at home. Tests in the workshop, then out on the ground and with the motor running are all worthwhile. In fact, every test you can think of, short of actual flight, should be tried at home close to your tools and hot soldering iron. This may be equivalent to suggesting that a new gas modeler run his engine before appearing at the field for expectant flights, and we all know what happens to those who don't.

Don't be discouraged by a few unsuccessful "shake-down" flights. It always seems to take a few of these at the start of the season to get everything tied down. Once they are out of the way you are ready for some real controlling. We have found that 10 to 20 flights are required to give the operator a good "feel" for the control. This apparently sharpens his judgment of the model's flight characteristics and also "educates" his timing.

After arriving at the field, the transmitting antenna is connected to the transmitter and the plane is assembled. Everything is ready for a flight except for a few routine checks. If the equipment has not been operated for some time, the battery voltages are checked and perhaps a distance check is made to adjust the transmitter tuning. If these tests have been made recently, then it is just a matter of turning on the transmitter and testing for satisfactory control. This is done before the motor is started. Now the motor is started and *one final check is made*. This check is *never* omitted any more! It consists of running the rudder through several positions just before takeoff. If *perfect* operation does not result, the plane is not launched. On several occasions imperfect operation was ignored, hoping it would "work all right" in the air—it didn't!

To avoid any misunderstanding between the person launching the plane and the operator at the transmitter, it is well to adopt a standard test procedure. One that has worked out well in practice is to set the rudder, by radio, to right rudder just before the motor is started. After the motor is running satisfactorily the launcher raises his hand and watches the rudder. Then the radio man sends three dots or moves the control key to cause the rudder to go to "neutral," then "left," then back to "neutral." This leaves the rudder in "neutral" with the next position "right" rudder, which is the most likely needed control position if there is any trouble on takeoff. If the rudder goes faithfully through these three positions the plane is launched. This is done either by hand, by running a wingtip, or by unassisted R.O.G. after a little flying experience has been gained. The plane is allowed to climb to a height of 40 ft. or more before any control is given—just another safety measure—a radio controlled plane is not of much use if it consists of a pile of sticks at your feet!

If the plane has been trimmed for a smooth climb and glide and the right and left circles are about the same size, then it is time to consider doing some fancy maneuvers! The maneuvers to be listed and described are a few of those that can be done and *have* been done with *rudder control alone*. This is to point out that it is possible to perform a large number of stunts or maneuvers with a small amount of equipment and a simple radio control system.

The following descriptions by no means imply that this is the only way in which these stunts can be done; however, they are the result of actually doing them with the particular plane we have been flying.

First, an approximation can be made to a three point landing by keeping the plane in a full-right or left turn while it is losing its last 10 to 15 ft. of altitude. The plane in Fig. 5 is in its gliding turn, the motor is off. When the ship has about two feet of altitude left, it is suddenly brought out of the turn by quickly applying opposite rudder and then neutral. The effect is to give an extremely flat glide due to the excess speed picked up in the turn. If properly executed the ship will make a beautiful landing with hardly a bounce. Needless to say, a calm day is preferred and the over-controlling must be carefully done to provide a fast but smooth "straightening out." The same effect may be had by merely neutralizing out of the main turn, but the flattening effect is not so pronounced and the control may not "take" sufficiently fast to make a good landing. When the over-control technique is used, it is best to neutralize the controls just at the instant that the ship noticeably "takes" the opposite rudder control. Thus, by the time the plane responds to the neutral position it will be well straightened out. It is the time of response of the plane to the controlled surface that has to be considered, as the motion of the control surface is practically instantaneous with this system.

The next three maneuvers: the spiral dive, the stall, and the loop, are all based on the correct performance of the spiral dive, so it will be described first. See Fig. 6. It is well to have plenty of altitude for this stunt, just in case the "earth-bound pilot" gets a little nervous and does not pull it out fast enough. 500 to 1000 ft. should suffice, and the ship should be upwind and a little off to one side so that the "pilot" can get a good perspective of what is going on. The ship should be given either "right" or "left" rudder, whichever produces the tighter circle. If they are both the same, give it "left" rudder and *wait!* The motor should be running good and fast. The first circle will be a standard 360° turn, and maybe part of the second circle will be too, but watch the bank—it's getting steeper and the nose is starting to drop. The motor is "reving" up now that the plane is flying faster, and by the time that third or fourth circle occurs the ship is heading almost straight down and making the most beautiful spiral dive you have ever seen! What if the radio doesn't work? It just can't quit now! Give it neutral rudder and see what happens. There, it is straightening out and even gaining altitude from its excess speed.

Now that we're back on the ground let's gas it up and try for another spiral, this time ending up with a stall, as in Fig. 7. A little altitude, please! There's "left" rudder—one circle—two circles—she's banking pretty steep—three circles—the motor is screaming now—four circles—quick, give it opposite rudder, then neutralize. Did you see that ship straighten out? There goes the nose, up, up, up. Oh, now she's falling out of the stall! Not bad though, even if it does leave you kind of weak!

How's your constitution? Is that wing fastened on real tight? Let's try the loop! See Fig. 8. Did the ship really come down fast on that last spiral, or do you think it could have gone a little faster? It will need every ounce of speed it can get if it's going to go on over into a loop, because you are going to operate the controls exactly as you did for the stall. Let's put in a little down trim on that elevator just to speed things up a bit. Also, let's have a good thousand feet on this trip. Now, give it "left" rudder again and wait—wait until you just don't dare wait any longer—five circles—six circles—it's coming down faster this time—quick, opposite rudder—neutralize—there she goes, up, up, up—she's over! Boy, what a sight! Give a little right rudder just before she hits the bottom of the loop, that will pull her around and keep her from stalling out. Now, neutralize after the turn is well established and let her work off this excess speed in a gradual manner. Ready to try it again or do you need smelling salts first!