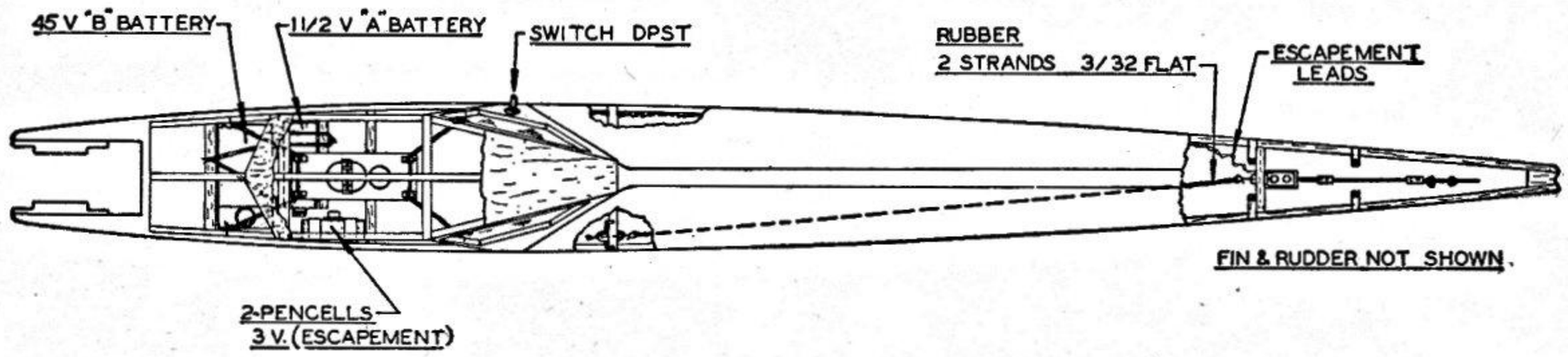
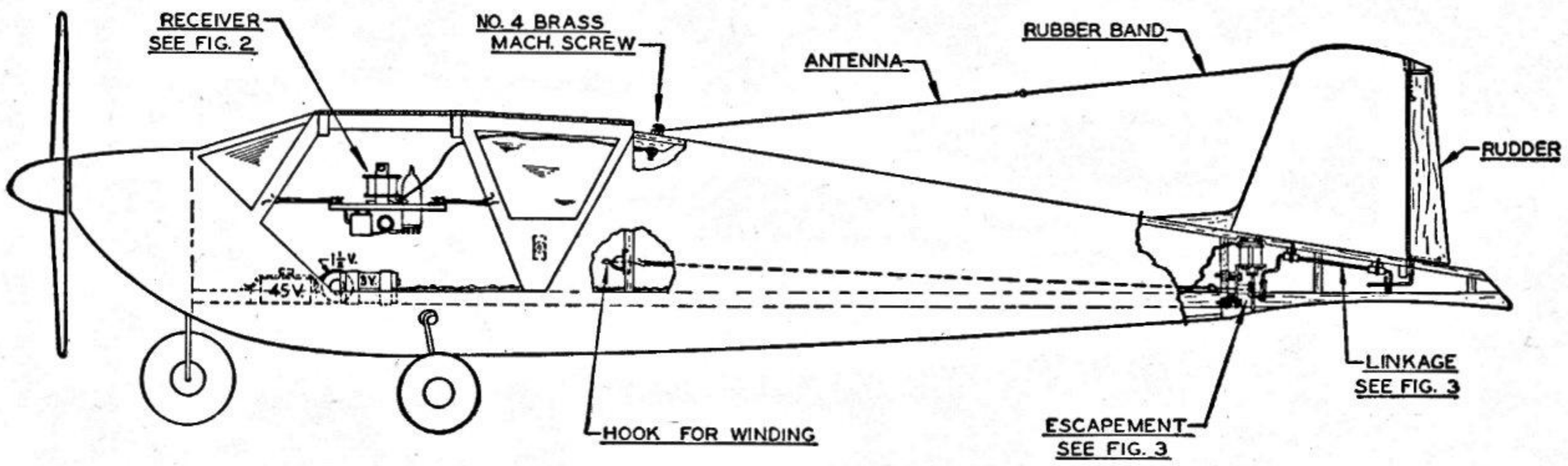


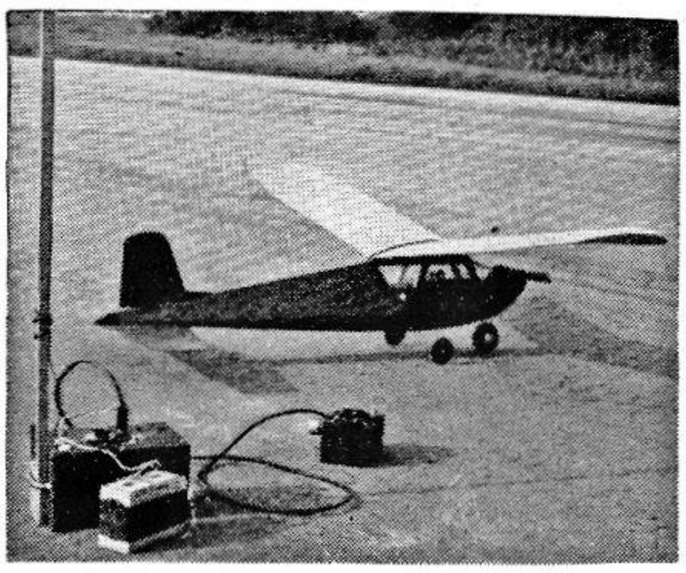


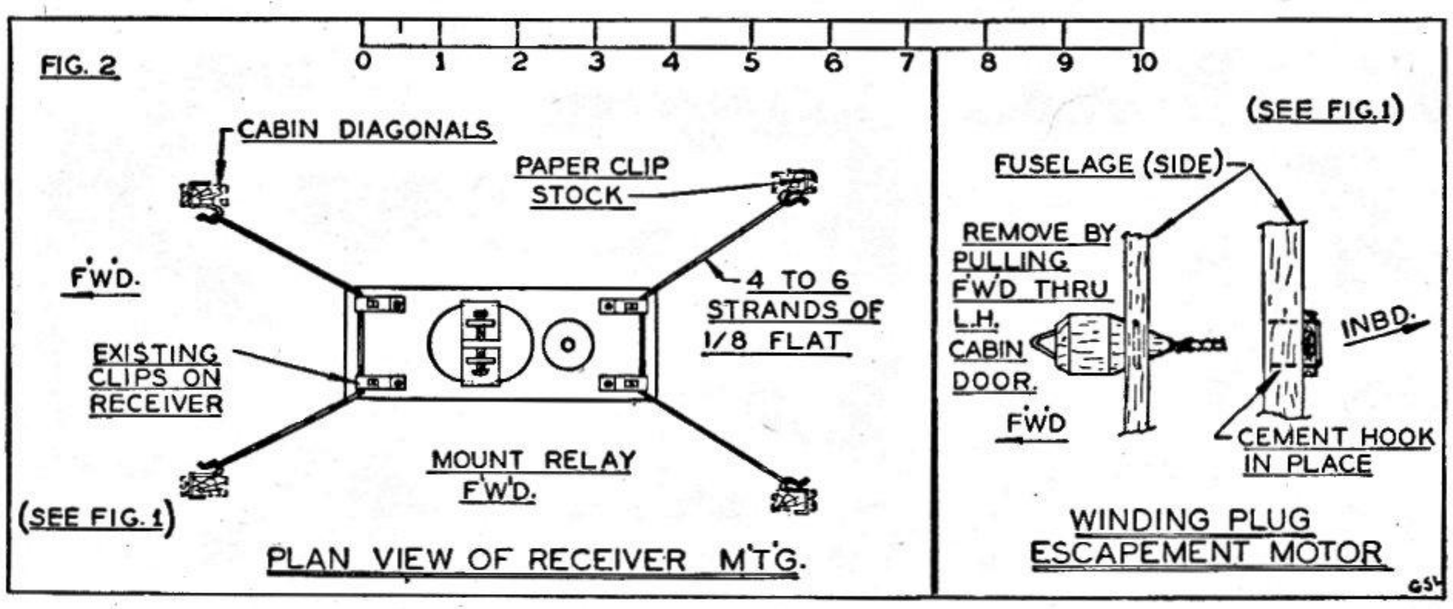
RADIO EQUIPMENT WEIGHTS

RECEIVER	4.5 OZ.
ESCAPEMENT	.7
BATTERIES B	6.2
A	2.6
• ESC'P'M'T	1.0
WIRING & SWITCH	1.0
TOTAL	16.0 OZ

GENERAL ARRANGEMENT
RADIO CONTROL GEAR
"RUDDER BUG"
(FIG. 1.)

SCALE 0 5 10 15 20





Rudder Bug

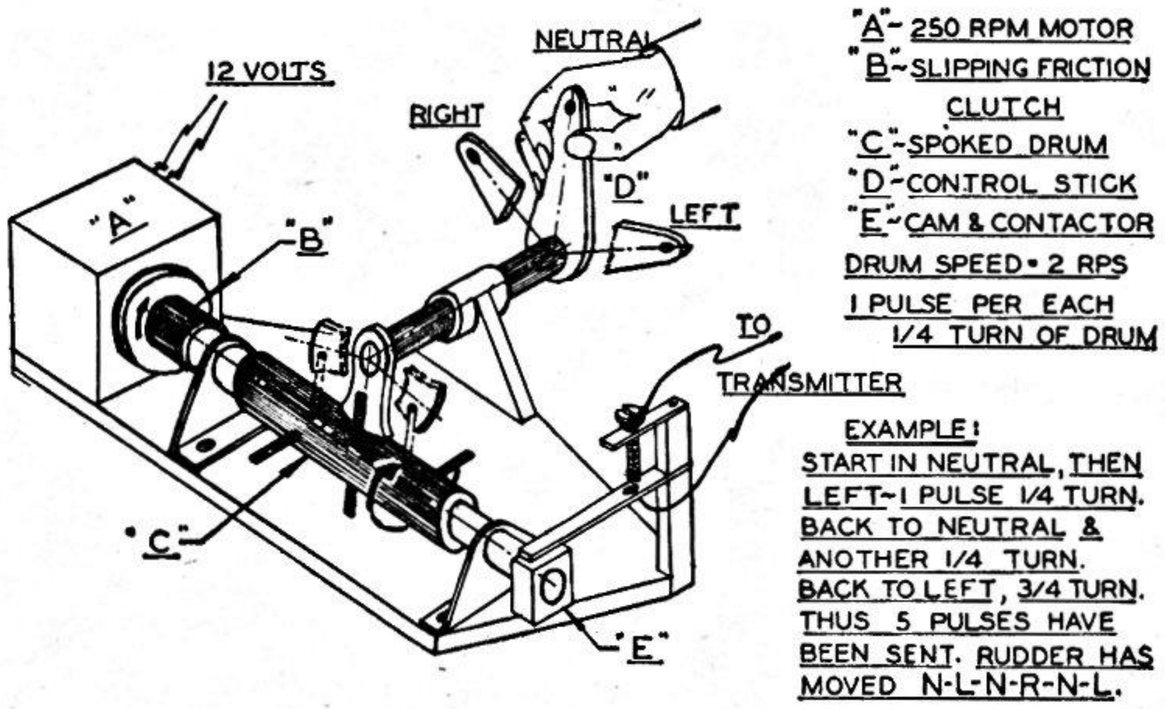
PART TWO

The secret of successful radio control flying is really no secret at all but close adherence to two maxima. One is a thoroughly tested radio control installation; the other is the rigid following of a systematic check-out procedure. It sounds simple but good habits come hard. One reason we feel qualified to give this "advice" is because we have committed most of the radio control mistakes possible and a few horrible ones we dare not admit. (Who was it who launched his radio model after turning the receiver "off" instead of "on"? No answer!!)

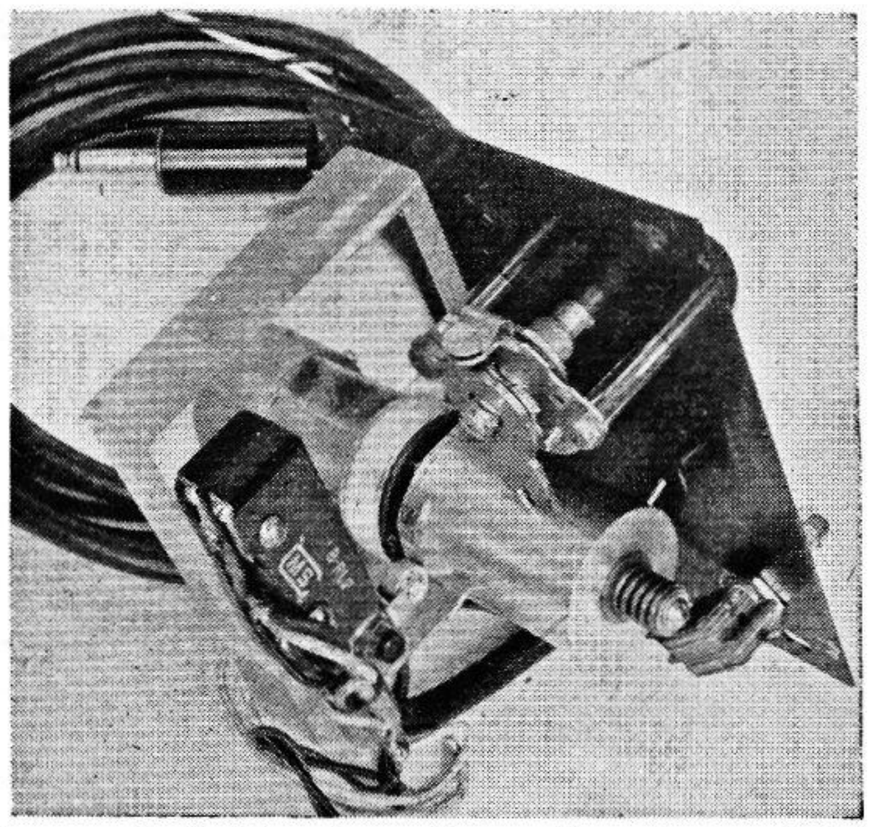
The importance of careful installation and check-out cannot be overemphasized. The consequences are too great—unless you enjoy rebuilding more than you do flying. In a free flight gas job, a loose wire may mean a sputtering motor and a not-so-long flight. In an RC model, a loose radio wire may mean hard-over rudder under full engine power. The result may be a juicy spiral dive followed by thirty days "solitary" in the workshop. With such good reasons, let's be careful.

The installation pointers given here apply to the Good Brothers' Beacon radio gear and also to other similarly sized sets. The following covers the installation of the receiver, the escapement for rudder control, and the batteries. It is also well to read and follow carefully the instruction book which accompanies the radio equipment. In particular, before you start installing in your plane, set up your radio components on a wooden bench and become very familiar with their operation.

Fig. 1 sketches the general arrangement of the radio department in the *Rudder Bug*. The receiver is shock mounted on rubber bands near the C.G. The batteries are securely fastened to the floor of the cabin. The escapement is mounted in the rear with its rubber band coming forward into the cabin. Total radio weight is 1 lb. Although this is not the lightest installation that can



FLIGHT CONTROLLER SWITCH (FIG. 4)



Control box, developed for greater ease in escapement flying, should prove of interest to every R. C. flier who can't remember where neutral is

by Walter A. Good

be made with the Beacon radio unit, it represents a choice of reliable sized batteries. Smaller batteries result in shorter life and also higher operating cost.

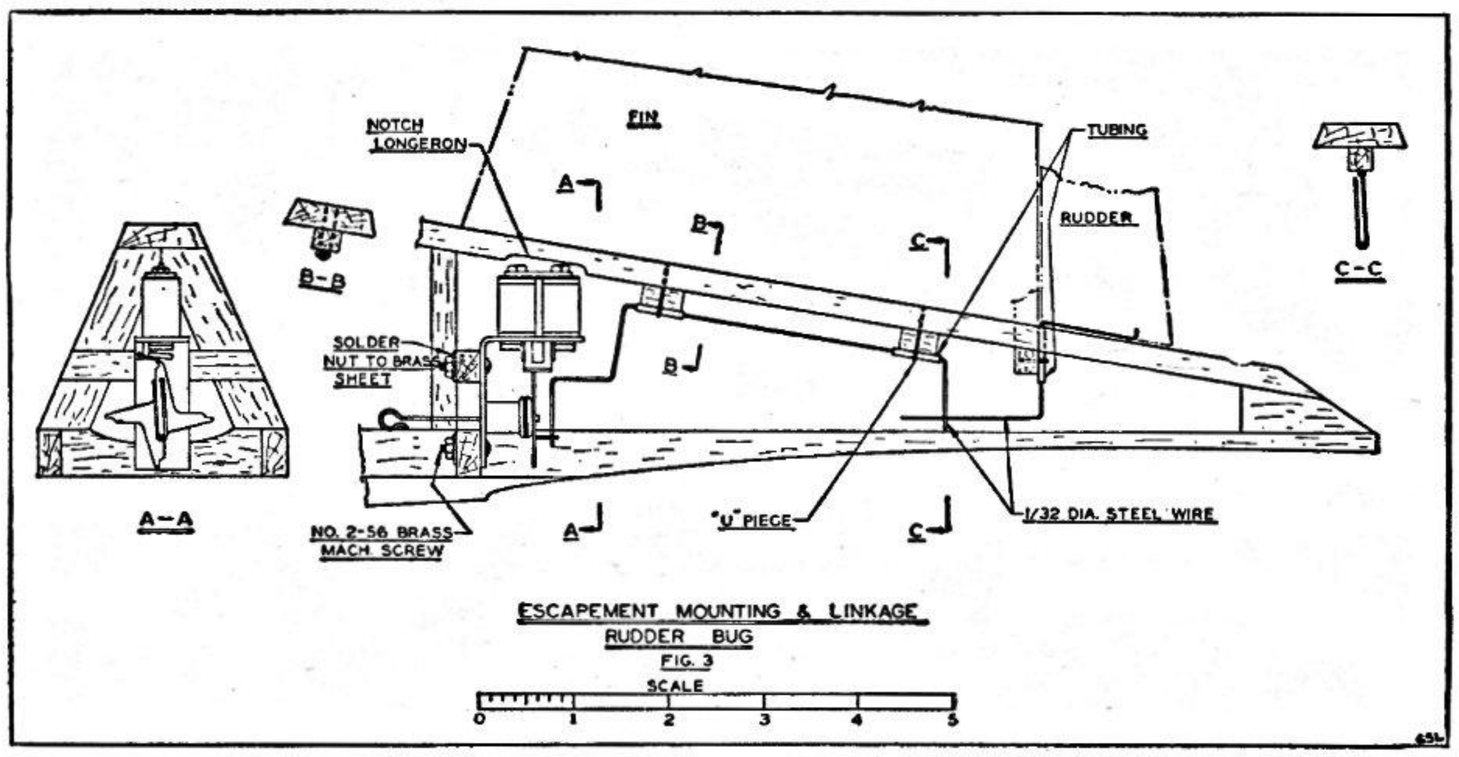
The receiver mounting is shown in Fig. 2 and in the photograph. Anchor the hooks well and cover with fabric for extra strength. Several rubber bands should be used at each end of the receiver; four to six strands of 1/8" flat serve well. If the mounting is too stiff, the motor vibration may bother the relay; if too soft, a hard landing will bounce the receiver from the floor to the ceiling.

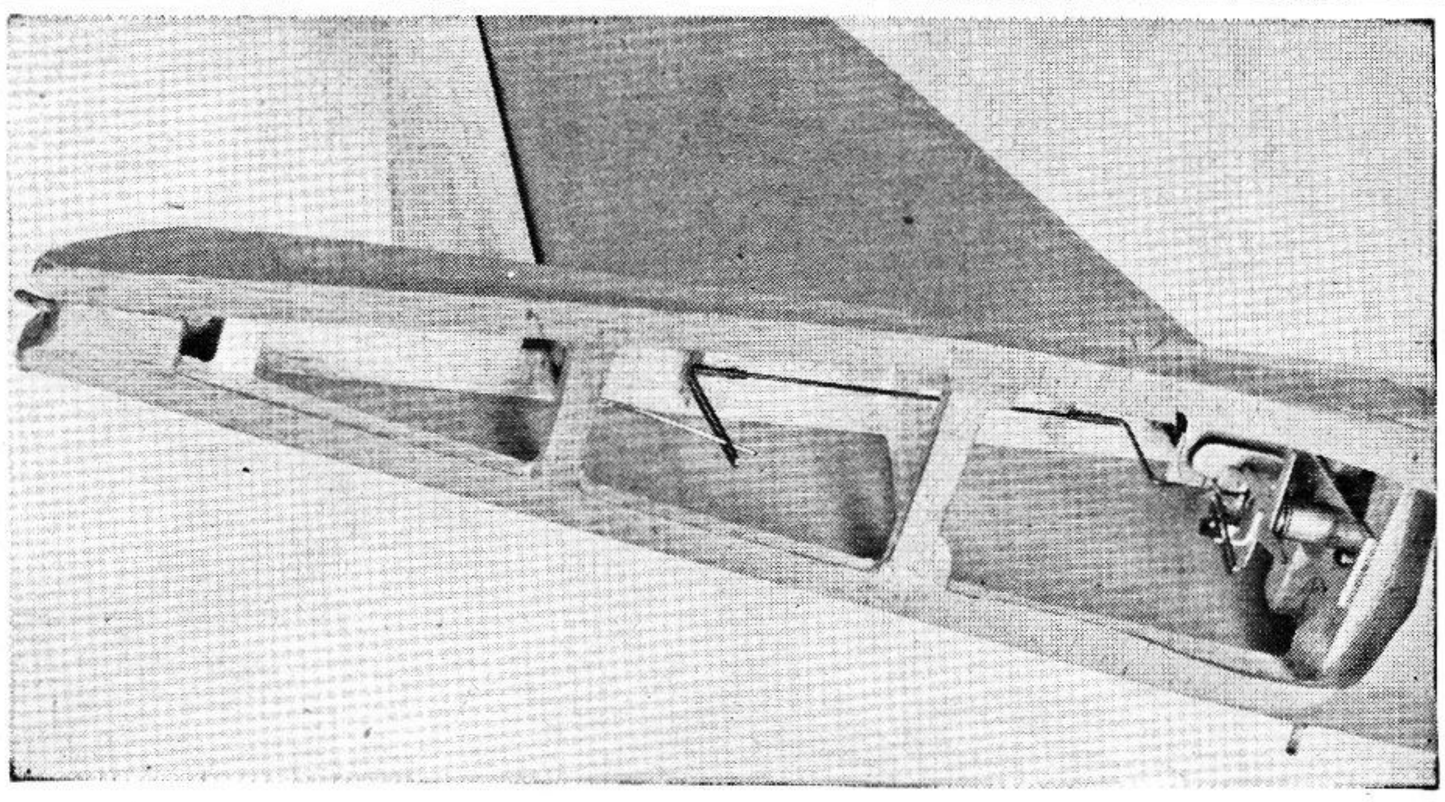
All wiring should be neatly done with insulated flexible wire of about No. 22 gauge. Remember that persistent vibration easily fatigues poorly secured wires. Our log book has a note under the date of October 26, 1947, "Never, never use solid wire again." This followed a flying session in which a broken battery wire made intermittent contact during flight. First, the radio would work, then it wouldn't, then it would work again, and so on during a ten-minute flight. It finally quit altogether in the glide about 100' up, but the ship managed to land safely in a tight right circle—it could have been worse.

Follow the wiring diagram in the instruction book and use a good double pole switch. It is wise to check the switch resistance before mounting. If the resistance measures more than 1/10 ohm, don't use it. One side of the switch opens the filament circuit, while the other side opens the escapement circuit.

The antenna in Fig. 1 was copied from Owbridge and Schumacher. It consists of a slack wire from the receiver terminal to a No. 4 brass machine screw aft of the cabin. Outside the body a very flexible bare antenna wire is fastened and then wrapped a number of times around the extended screw. The end of the antenna wire is attached to a short length of rubber band which is secured to the tip of the fin. This allows easy alteration of the length of the antenna merely by wrapping or unwrapping it around the screw.

Test the escapement operation with a wound rubber band on the bench, before installing. It should work on less than 2 volts with a fully wound band. Thus, 3 volts gives considerable safety factor. Mount on the two firm cross members as shown in Fig. 3 and the photograph. The linkage idea was borrowed from Ed Lorenz and has worked quite well. Note



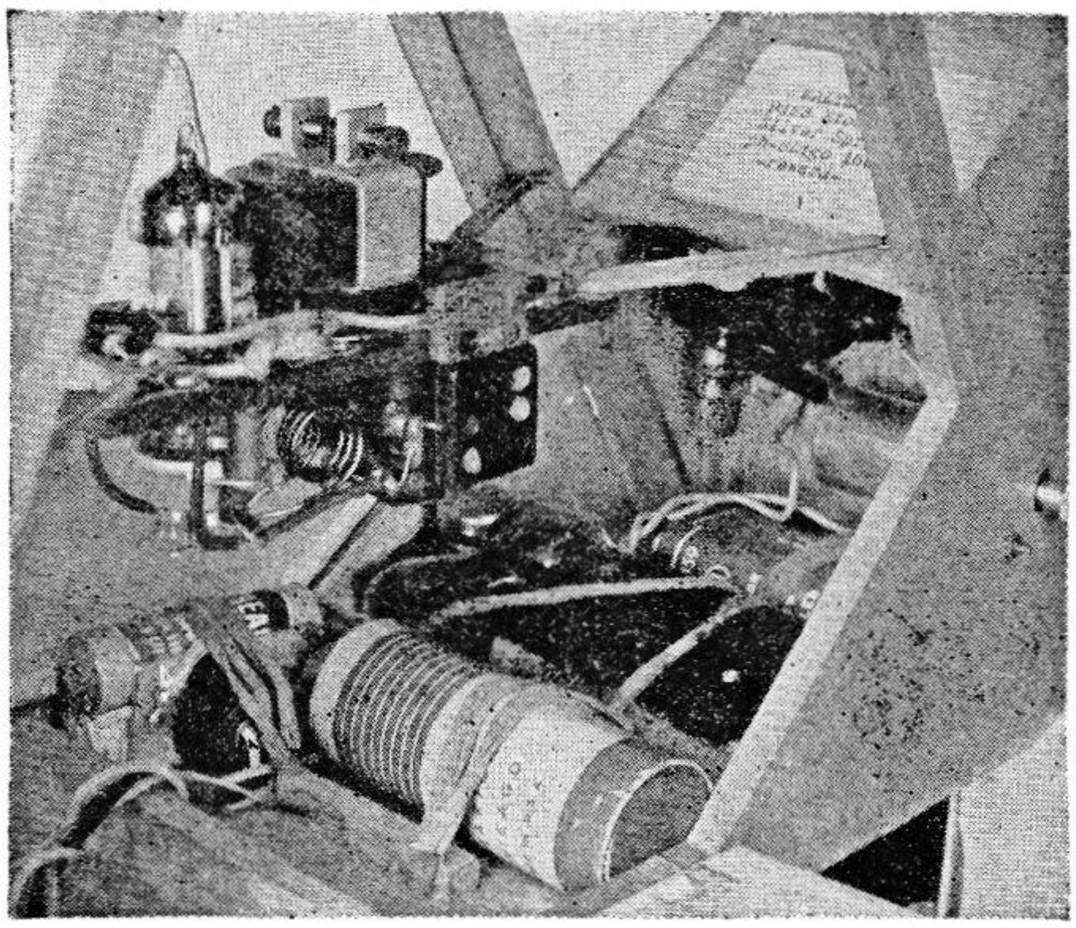


Removal of stabilizer shows escapement mounting and adjustable linkage to rudder

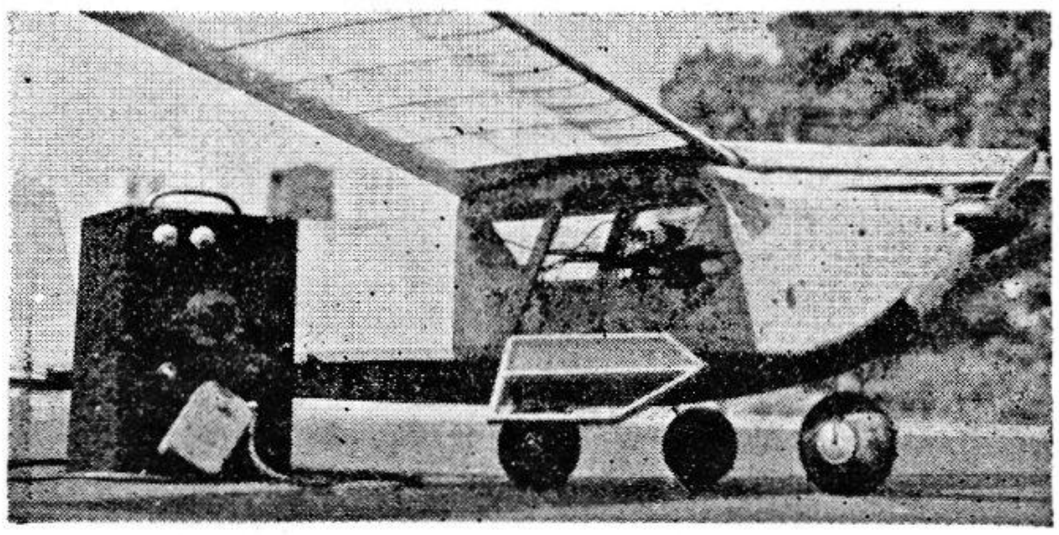
how arm A from the rudder may be bent up or down to quickly change the amount of rudder motion. Bending toward the ground increases the motion. It is best to start with less than 1/8" rudder motion each way, measured at the trailing edge of the flap. Left or right bending of the same arm allows trimming of the "neutral" rudder position to give a straight glide path. Since the linkage is made from 1/32" piano wire, the rudder merely springs over and back if accidentally bumped. The linkage and rudder must not bind in their travel but should be very free with just a "hair" of play in the "U-shaped" wires. Only a few winds in the rubber should cause the system to work.

Two strands (one loop) of 3/32" flat rubber is recommended for this model. It has been flown with two strands of 1/16" flat which had adequate torque. The escapement can handle two strands of 1/8" flat when needed, so the 3/32" represents a very safe compromise. The forward end of the rubber is reached through the cabin door and is wound with a hand drill to show a double row of knots, or about 400 turns. This is adequate for several days of flying.

The two escapement wires are twisted together and tacked to the inside of the body along one of the crutch sides. They are not run near the top of the body because this would place them too close



Large door allows access to receiver, ignition equipment, and batteries



Transmitter with nonautomatic control switch, alongside the plane

to the antenna with possibility of undesirable interaction.

The batteries needed are the 45 volt B, the 1.5 volt A, and the 3 volt escapement battery. Below are listed typical sizes which may be used:—

B—45 volts—Zenith No. Z-30R Plug-In Hearing Aid..6 oz.
A—1.5 volts—Otarion No. GP-2 Plug-In Hearing Aid..3 oz.
Escapement—3 volts—2 pen cells.....1 oz.

We prefer the plug-in type because they are rugged and reliable and eliminate the battery box problem. If you can carry heavier batteries than those listed, it will be found more economical. Soldering up your own batteries can be done but usually leads to more trouble than the plug-in type. After selecting your batteries, distribute them along the floor of the model until the C.G. matches the position (about 36 per cent) found correct in the free flight tests. Make sure a bulkhead is in front of each battery by adding extra cross pieces if necessary. Then cement heavy wire hooks to the crosspieces and fasten the batteries in place with several rubber bands across each battery. "Flying" batteries on hard landings can cause real damage, so strap them down securely.

Little has been said about preparing the transmitter for the field. Construction of a simple antenna support for the transmitter is well repaid by the saving in set-up time at the field. The addition of a flight controller switch at the end of a 7′ cable eases flight operation. The switch may be a simple push button type or an automatic one, as shown in the photograph and Fig. 4. This motor-driven switch automatically sends the right number of pulses and will always maintain synchronization between the rudder and the control stick.

The heaviest criticism of the escapement-type control has always been leveled at the possibility of forgetting which rudder position comes next after resting awhile in Neutral. Experience has shown that practice soon "conditions" the operator so he knows what comes next, except when he becomes flustered or confused, and this does happen occasionally! Thus, it was decided to build a laboratory model of an idea which would make the switch automatic, thereby "remembering" for the operator. A surplus 250 rpm motor (A) operated on 12 volts, instead of its rated 27 volts, is the driving power. Running continually, it applies torque through a slipping friction clutch (B) to a spoked drum (C). Drum rotation is prevented when the control stick (D) blocks passage of one of the spokes. Motion of the control stick from Right to Neutral allows the drum to rotate one-quarter turn, very similar to the escapement. Note how the cam and contactor (E) at the end of the drum sends one pulse for each quarter turn. Returning the stick to the Right allows drum motion of three-quarters of a turn and sends out three pulses, just the right number to step the escapement to Left, to Neutral, and to Right. This all happens in the short time interval of less than one-half second as the drum speed is set for about 2 rps. In use, the control stick may be wiggled crazily through any series of motions and the escapement always ends in the same position as the control. The original switch was constructed by Loran Wenrich, at the Johns Hopkins Applied Physics Laboratory, after considerable hours of labor. It worked so nicely in the workshop that we quickly clapped it in a box and took it to the field. Many flights, including radio control take-offs, have been executed by this switch, with the effect of allowing more freedom on the part of the operator. Even a rectangular landing approach pattern consisting of four consecutive right turns offers no mental hazards. A secondary advantage appears in that loss of synchronization between the control and rudder immediately indicates trouble and not a poor memory.

The automatic switch as here presented is not intended as a constructional feature but to show the embodiment of an idea which most probably can be duplicated by a variety of methods.

Now for those all important check-out procedures to be made on the completed installation. The philosophy is to adjust the system so completely at home that it could be flown out of your back yard with no further checks. Thus, the field checks are only to see if it has remained in adjustment. For preliminary tests in the workshop, set the fuselage away from any large metal objects. With the Beacon Receiver, the plate current meter should have very short leads (less than 1 in.) for best results. Long meter leads act like antennas and may alter the settings when the meter is removed from the circuit. Adjust the antenna length according to the instructions to obtain optimum sensitivity. Keying the antennaless transmitter should cause the receiver's 6 ma. idling current to drop to about 3.5 ma. Be sure to use fresh batteries and check them under load with a voltmeter. The B battery should measure between 45 and 36 volts and the A between 1.5 and 1.1 volts. The escapement battery under load should read between 3.0 and 2.4 volts. After recording the two plate current values noted above, it is easiest to set the relay contacts by Gene Foxworthy's method. Insert a 10,000 ohm variable resistor in series with the meter and adjust it to obtain the plate current values desired for the relay setting. Setting "in" 1 ma. from each edge is a convenient rule. Thus, for the above currents, the relay should close at 4.5 ma. and open at 5 ma. Now remove the meter and resistor and observe the over-all operation while keying the transmitter. This completes the indoor tests and we adjourn to the backyard.

Sometimes with too long a receiver antenna the set "loads" when the model is placed on the ground. The result is poor sensitivity or no operation. Try this with the antennaless transmitter. With a helper on each wing tip, lift the model up to 5′ above the ground, all the time keying the transmitter. This may "unload" the set if the receiver antenna is too short and cause the relay not to restore from the contact position. Thus, we have two quick checks on the antenna length.

Next, with the model again on the ground, run the engine at different speeds and while keying observe for proper rudder operation. Look for skipping rudder positions when not keying. Although not common, if skipping should occur, it is easy to localize the trouble—turn off the receiver switch and see if the escapement continues to skip. If it does, chances are propeller unbalance may be responsible because of excessive vibration. If skipping does not continue, then the trouble is probably at the contacts of the sensitive relay, indicating that the receiver mounting rubbers are too stiff, or that the relay contact is set too close to the idling current. In any event, don't take a step toward the field until the skip is completely eliminated; a steadily skipping rudder can give a long straight flight.

If space is available, also make the distance check at home. With the help of a "ham", set up your transmitter with its antenna in a clear area. Have a helper wheel the model away and while keying the transmitter determine the operational limits of the frequency setting knob on the transmitter up to a distance of 500′. Set the knob half-way between your limit marks. Now pack the car, you're ready for the field!

At the field set up the transmitter near the up-wind end of the field. Too much wind is not desirable, but a light breeze will not be harmful. Check the motor for proper operation. Repeat the "unload" test and also the distance check. Now you are ready to fly. Set flight timer for 30 to 60 sec. Turn on the radio gear, run through several positions, and leave in Right rudder. Start the motor and adjust (*Turn to page* 59)

Rudder Bug

(*Continued from page* 16)

for 3/4 speed. While the launcher holds the model ready for hand launching, the operator runs the rudder to Neutral to Left to Neutral. This leaves the rudder in Neutral going Right. O.K., let 'er go! Restrain that temptation and get altitude, at least 50'. Give short Right followed by Neutral. Then short Left and again Neutral. The purpose is to "feel out" the control sensitivity. Be cautious! Use the early flights to trim the rudder for straight flight in the glide, then trim for straight flight under power and finally for equal sized circles. Don't adjust the rudder for tight circles until you have a little practice under your belt. At first you may find it difficult to land into the wind and at a designated spot simultaneously, so concentrate on keeping it into the wind and someplace on the field, it's safer. Spot landings come with practice; a square approach pattern may help. ROG flights can be made when you have a good "feel" of the controls. Use full engine power and be ready to quickly correct any deviation. True running wheels are a necessity. The rudder becomes effective about 20' from release and 50' to 100' are required for take-off. Maneuvering near the ground is risky but fun—get plenty of practice before you try it.

When using tighter circles, the model will spiral down quite rapidly so go easy at first. To get a 360° turn requires rudder for about 270°, then neutralize—the model will coast the other 90°. This action is symmetrical either to the left or right. The glide circles will be larger than the power ones and the ship will enter the turn rather slowly, so allow for this when flying.

So happy spot landings and remember there is no substitute for plenty of flying practice!

(Note: Readers interested in RC should study the article by Walter and Bill Good in the March '48 issue of MAN for further information on flying and stunting a model with only rudder control.—Editor)