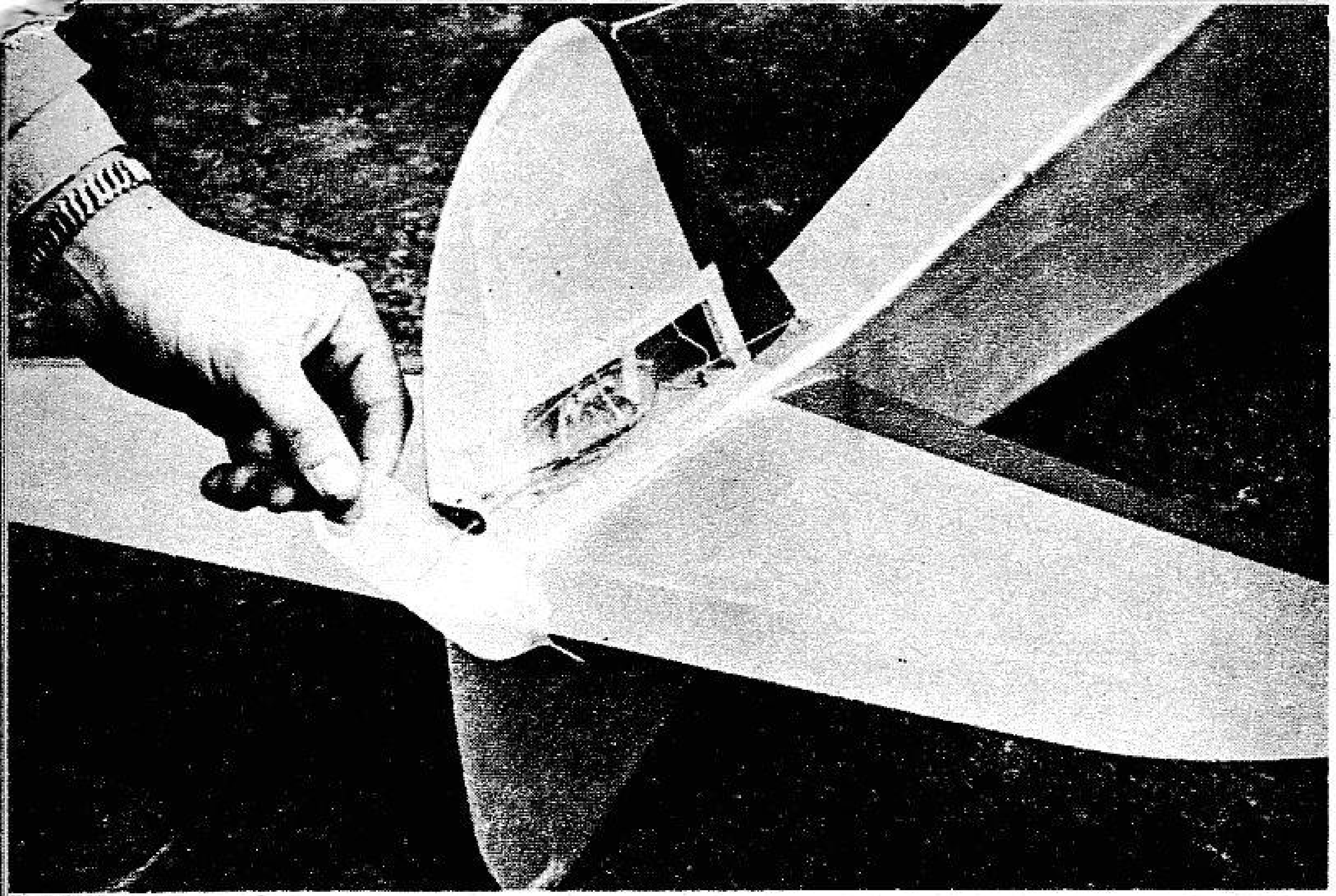
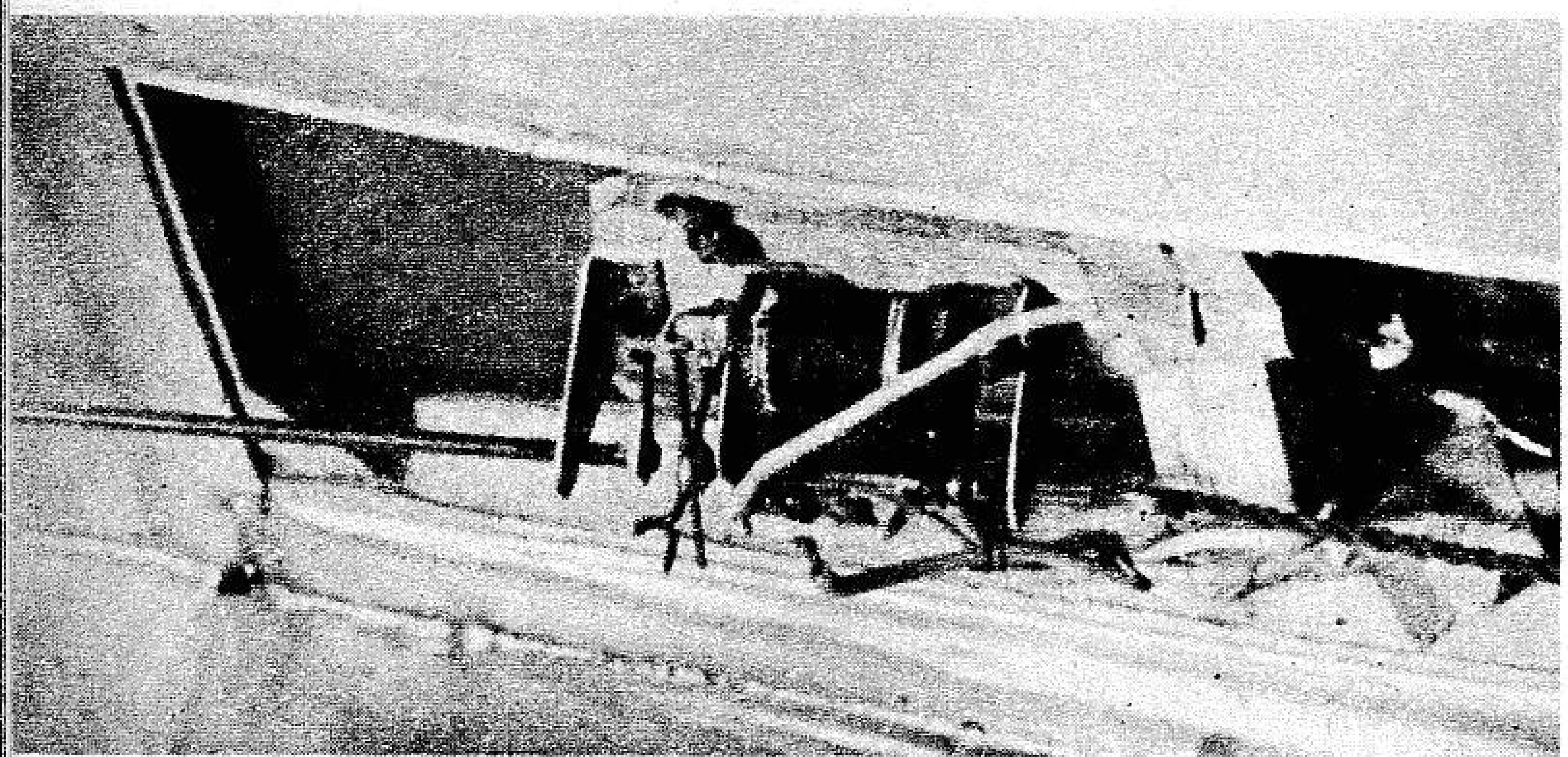
Meet the RUDEVATOR

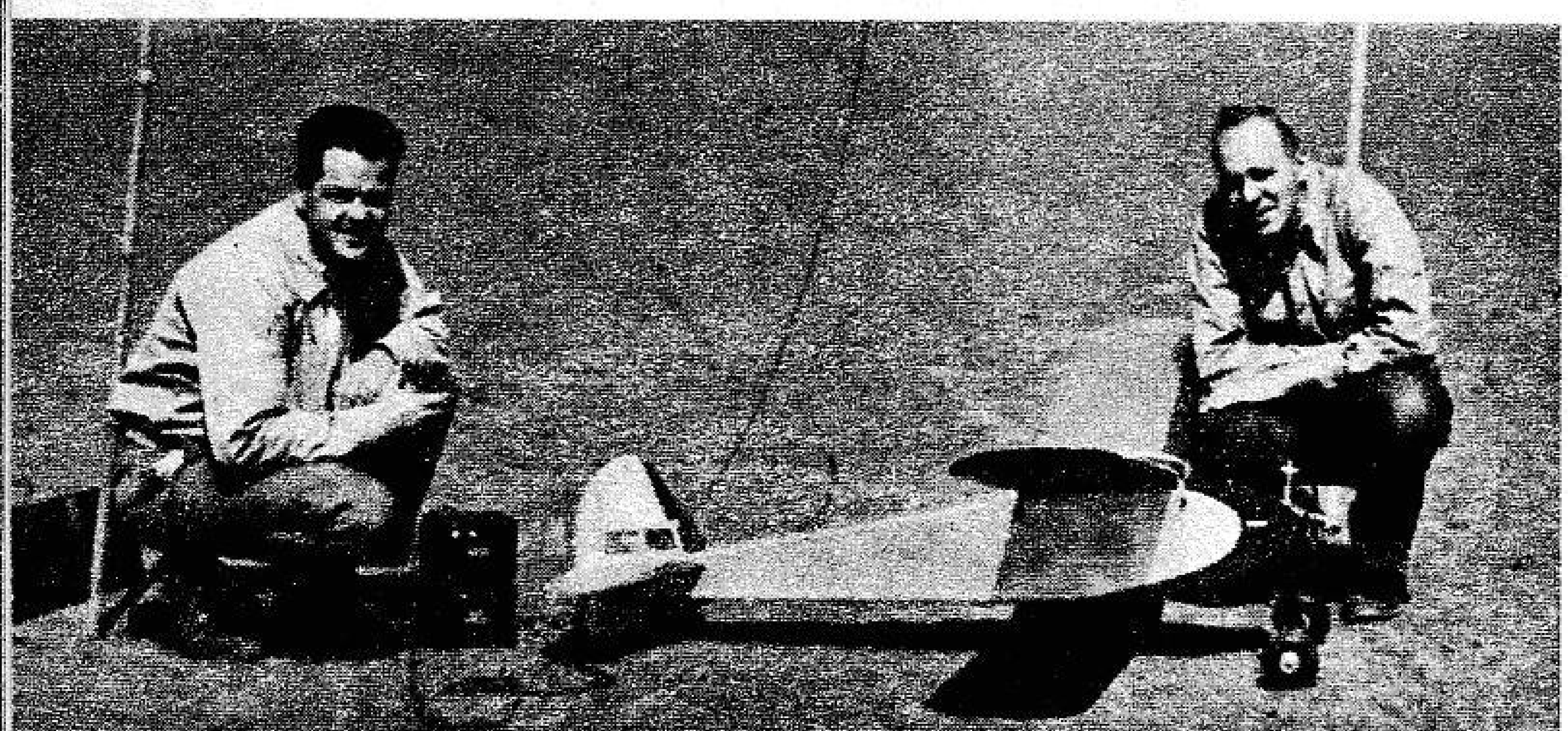
by H. H. Owbridge



General view of *Rudevator* installation on test ship

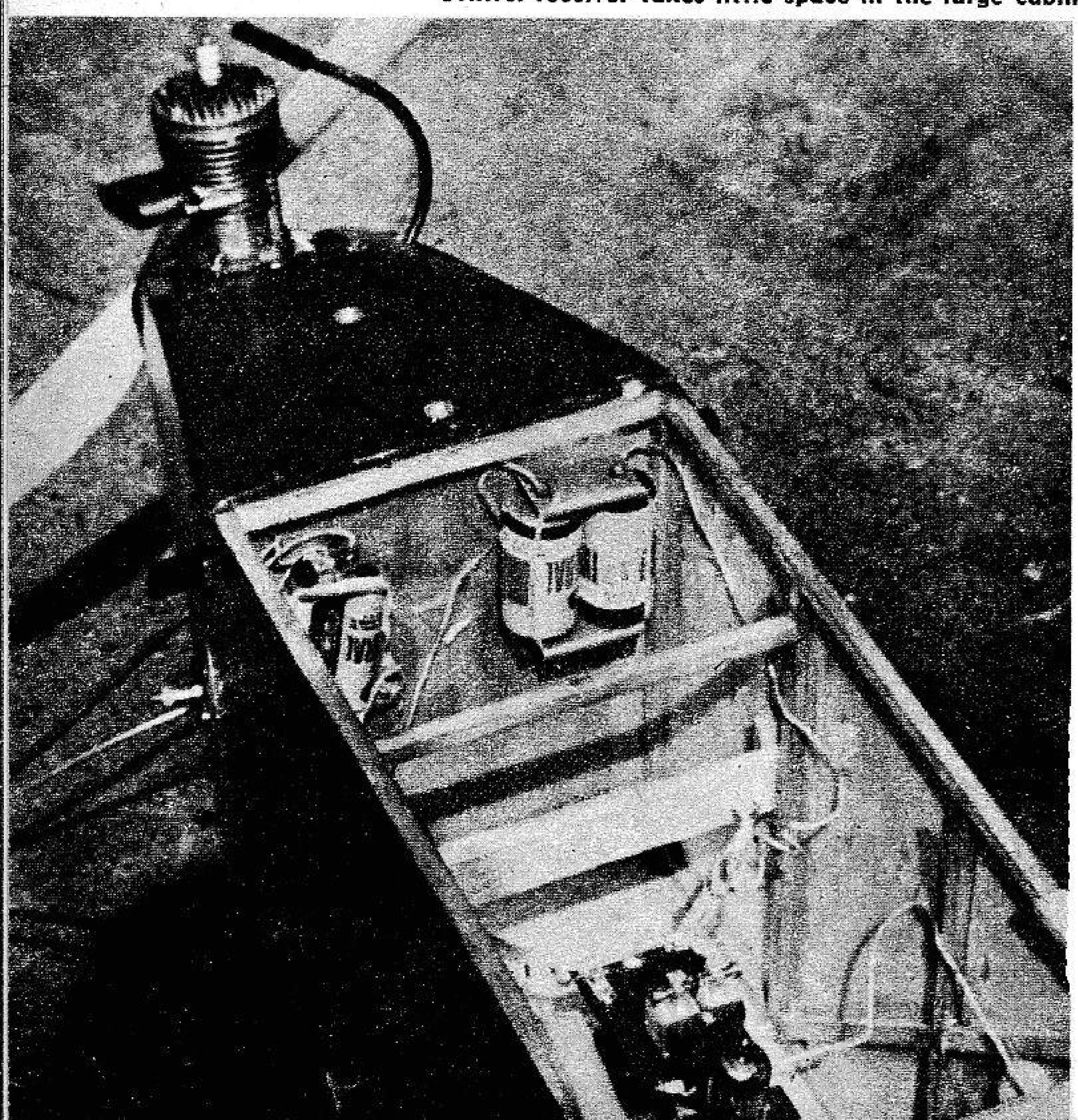


Actuating mechanism is very compact and light



The author (left) and Dick Schumacher ready to fly

Control receiver takes little space in the large cabin



AN article entitled "Simplified Radio Control" by William A. Rhodes in the July 1947 issue of M.A.N. ended my three and a half years of effort to "discover" a really simple control that would advance the art to the stage of mass acceptance. In this article the author stated: "I do not contend that this unit is in its highest state of development, but it has lots of possibilities and I hope that others will conduct further research to improve upon it, keeping in mind however not to let it grow into a nightmare of complication as have some units I've seen."

Well, we both got our wish. Bill Rhodes showed me the really simple control and at the same time he found someone to "conduct further research to improve upon it." Together we believe we can offer our fellow enthusiasts the most control for the least weight on record.

As readers of that article will recall, the control as Rhodes conceived it is really a rotary tab that combines the duties of rudder and elevator. Since it is probably here to stay, let's accept it into the family of model airplane tricks and give it the nickname "Rudevator". Now, with flying time as a measure, the rudevator is very young yet. Bill Rhodes has flown it a little and so have I. But so far as I know, that is all. Like the idea of control line models and the now famous Good Brothers escapement—both of which started out with limited useage—the rudevator will grow in ability with flying time. We feel that its present ability compared to its utter simplicity gives it a good start.

To begin with, the rudevator is completely coordinated with the operator. There is no need for counting or remembering past control positions. Then, too, neutral is automatic when the signal is off. If you get excited, a flick of the switch puts you back in the free flight class where you can wait until your heart stops pounding. Besides rudder and elevator, the rudevator includes an ignition switch. Go off and fly yourself silly until you think you're going to be late for dinner. Then cut the ignition, bring the ship in, pack up and go home.

The rudevator will fit any free flight model that will lift a receiver. And receiver installations complete with batteries are getting down below 8 oz. these days. The rudevator answers to a normal carrier wave and a simple pulse at that—no audio tone or timed signal length is necessary. The rudevator is simple to install. You know that old free flight job that never could get high enough on a 10 second motor run to win anything? Well, don't burn it. Give it a new lease on life with radio control. You don't have to rework the tail to hinged surfaces or install control rods either, for the rudevator does all that. As for that old engine that's low on compression, quit trying to sell it for more than it's worth; it's ideal for radio control. Unless however you intend to use your radio controlled model to go off hunting thermals in a free flight contest.

First let's review the rotary tab itself. It too has improved a little. As seen in Fig. 1, it is made of 0.020 celluloid sheet and the control area is the large area between the two protruding tips. This area can be adjusted at any angle on the shaft from 10 to 50 degrees depending on how fast you wish the ship to respond. Even two airplanes the same size may need a slightly different angle or area because one may be more stable than the other. A general rule is: 1 sq. in. for each foot of wingspan, and set at 30° or 40° to the shaft as a start. It's not too important however since the control can be turned on and off quicker than a water faucet. Just pick a calm day and have an engine timer aboard for that first flight. The small tabs at the tips of the rudevator are set at an angle over a teakettle so they will propel the main surface around in the slipstream. Ours turns about 100 rpm which is plenty. Since the shaft is clamped to the center of the rotary tab, no balancing is required. Check it out in a car before you fly. If it starts rotating at 10 mph, it's all right. Our tab has a control area 1-1/2" x 4" with the cor-

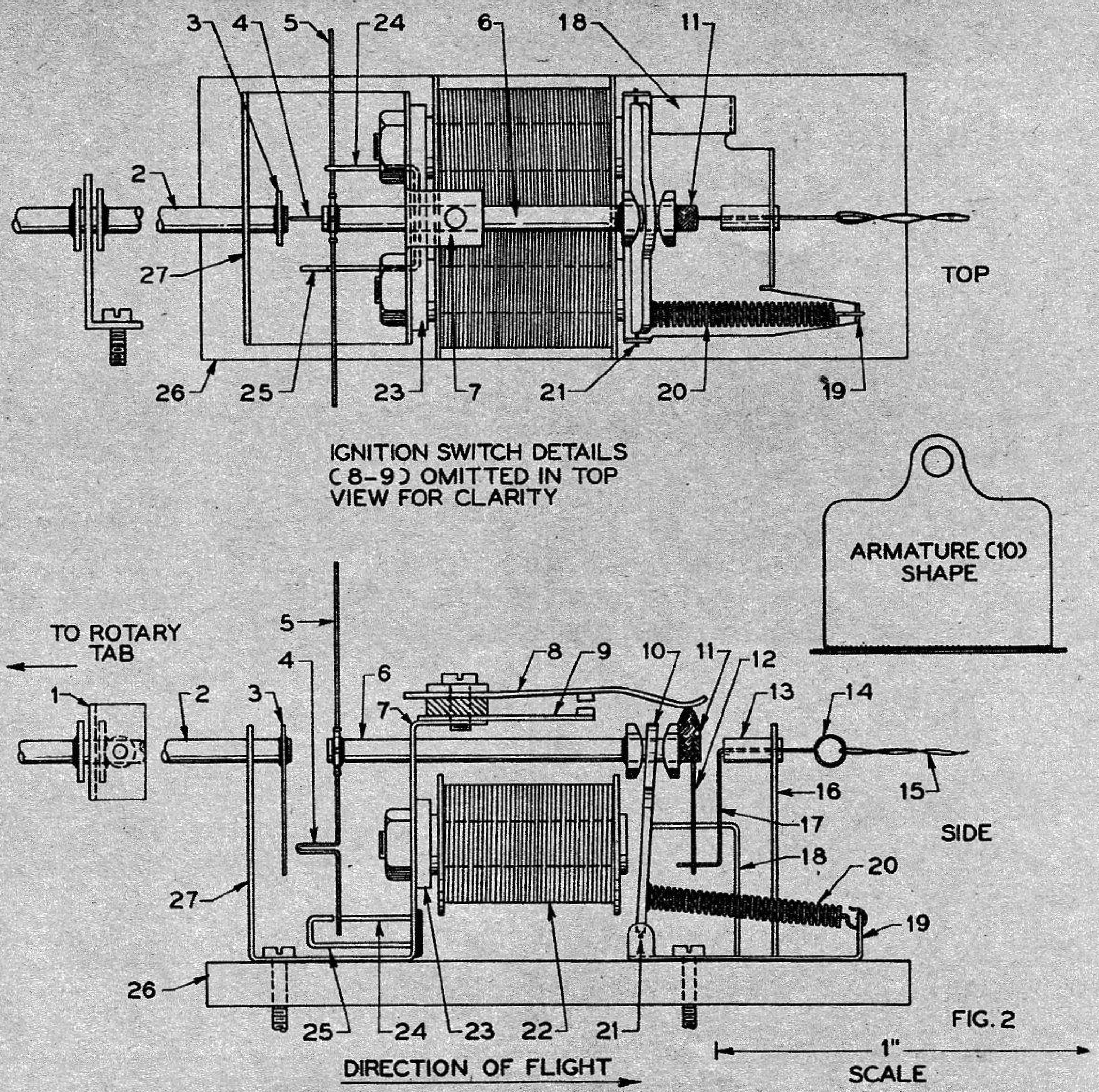


FIG. 2

ners rounded off. The propelling tabs are 3/4" long by 3/8" wide. For a 7 ft. span model this area is a little on the small side, but then we are beginners, too.

Let us assume we all understand that when the rudevator is turning free it is in neutral. And for those who think the model will show the effects of any aerodynamic vibration, let them try it sometime. The mass of the model and the stabilizing effect of the fixed tail surfaces just won't let the ship respond while the rudevator is rotating. Now, to produce rudder or elevator control, all that is necessary is to stop this rotary tab in any one of four positions. Let's forget about the other four intermediate positions since this is a step control rather than a proportional control, and the amount of turn or dive you get depends upon how long you hold the control on. Let's not worry about climbing turns either, since with only two engine speeds (go and no go) the model would only stall anyway and we can do that with the elevator. Diving turns yes; any model with a single control will dive if the rudder is held long enough, especially if the turn is with the engine torque.

Fig. 2 shows the brain behind the control. To assure coordination with the ground operator, the rudevator uses a form of escapement. It is really a stop that is positioned by an escapement. The fact that the stop has two directions of motion (rotary and transilatory) does the trick. Four spokes (#5) protrude from the short escapement shaft. The shaft is connected to the armature of the double coil electromagnet by means of a bearing (#10) which will allow rotation of the shaft. Torque to rotate the escapement shaft is provided by the loop of 1/32" square rubberband (#15). Tension in the rubber motor is isolated from the escapement shaft by a small music wire crank (#17). Now, motion of the armature (when energized by the receiver sensitive relay) will step the four spoke wheel around one-quarter turn at a time through the labyrinth escapement stops (#24, 25). However, one spoke has a stop protruding from it (#4). When the electro-magnet is energized, this stop engages

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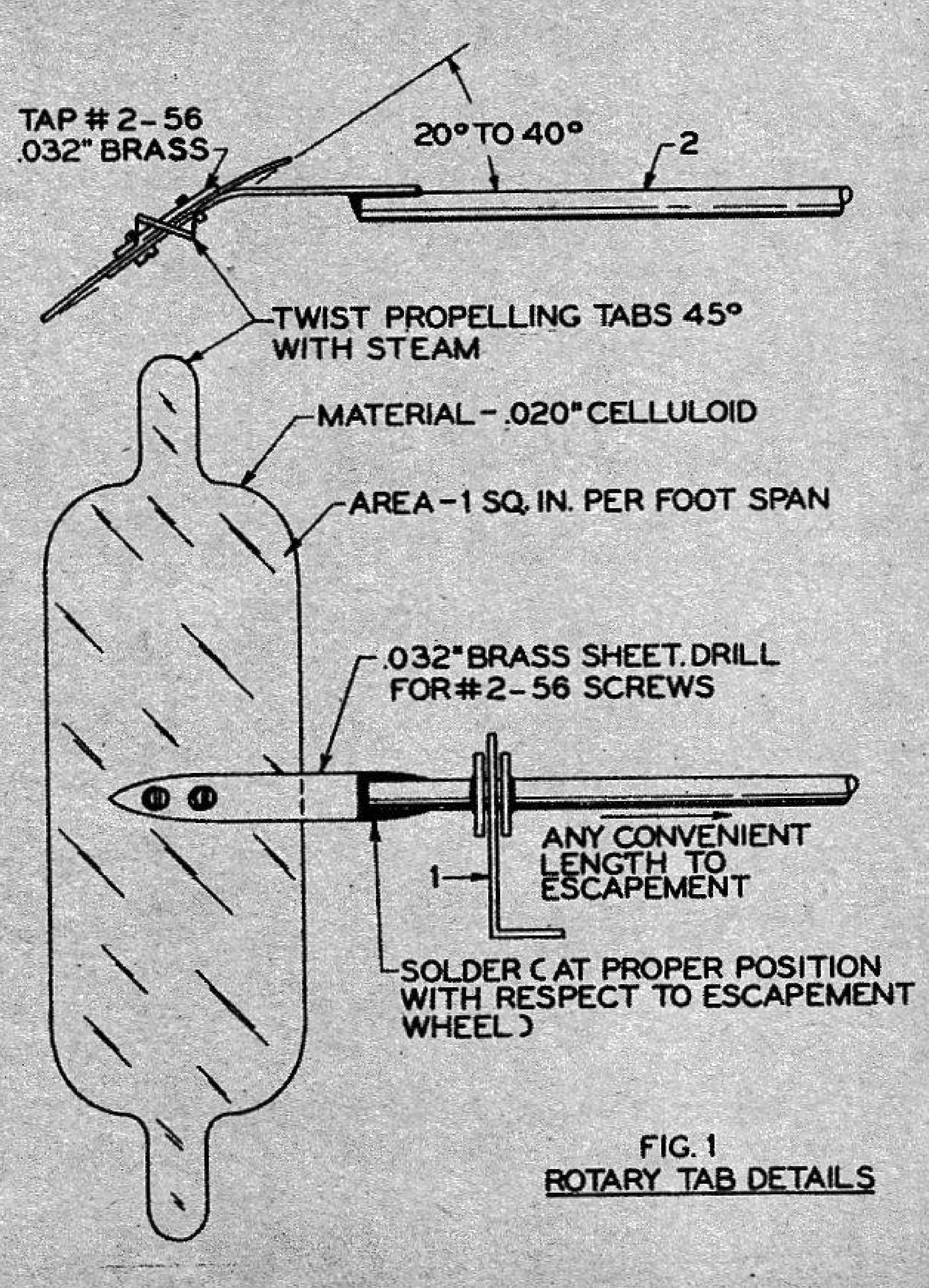

FIG. 1
ROTARY TAB DETAILS

Meet the Rudevator

(*Continued from page* 29)

the arm (#3) on the rotary tab shaft (#2) and stops the tab in that position. When the armature relaxes, the tab shaft resumes rotation. Almost no power is required of the rubber motor since it only drives the escapement shaft. The rubber motor never drives the rotary tab or vice-versa. The rubber is good to the last twist, and since it will hold so many turns we find that winding once a day is sufficient. Actually the control could be designed without a rubber motor; the rotary tab could be used to operate the escapement, but a time lag would be involved and the overall response to signals would not be as fast.

There are four neutral positions on this type of escapement. This is more than we need; so we use one of them for stopping the airplane motor. The small switch (#8, 9) is normally closed and we wire it in series with the plus side of the ignition batteries. In one neutral position when the electro-magnet is relaxed a small drop of glue (#11) on the escapement shaft hits and opens this switch. We make this occur on the neutral position after down. One must remember not to dwell on this neutral position but to use any one of the other three unless he is ready to stop the engine. For this reason it is best to leave this switch disconnected and rely on an engine timer for the first few flights. The escapement opens this switch every time around, but it goes by so fast that the engine merely burps.

Now for the control head. This is nothing but a simple four point selector switch. We use a typical 12 point rotary selector switch with 4 of the detents flattened out. This leaves 8 detents, 4 of which are sloppy loose and 4 are normal tight and alternated with the sloppy loose ones. We use the loose ones for neutral so there is an extra feel for neutral without having to look at the position of the crank. The 4 tight detent positions are connected into the transmitter B battery. With the control in the left hand and the crank side of the box facing the operator, up is up, down is down, left is left and (you guessed it) right is right. Neutral is when the crank points to any corner of the box.

Synchronization with the rudevator is simple. With the transmitter and receiver on, your assistant starts the engine. The slipstream starts the rudevator rotating. Put the crank in any signal on position.

The rudevator will stop in some position, say up. Turn the control box in your hand so the crank is pointing up. You are in sync. If you make a mistake and get out of sync in flight, do the same thing. Our rudevator escapement goes up, right, down, left or clockwise as viewed from the rear. So remember to turn the crank clockwise to stay in sync. We prefer it this way, but if you must operate like a pilot, turn the control box flat with the crank on top. Then forward is down and back is up and rudder remains the same. But you must crank counter-clockwise to stay in sync.

There is one case where you can move the crank back and forth in both directions and still remain in sync. This is when you are using rapid alternate left and right rudder alone to jockey the ship in for a spot landing, or when using elevator alone to do loops. Actually, the escapement goes through down while the crank goes through up, but who cares if you are only interested in the one control at the time. The crank can be turned as fast or slow as desired. As a check, we twirl the crank and listen to the rudevator escapement rattle in response.

Our ship was designed and built by Dick Schumacher of Burbank at a time when we expected to have to carry about 3 lbs. of radio apparatus. The present rudevator installation weighs 1 lb. complete and gross weight is 5 lbs. 10 oz. The 7 ft. wing gives it a glide almost like a sailplane. We fly it trimmed straightaway, of course, and plenty of downthrust is used to hold the nose down under power. Turns of 360° can be made under power before the nose drops dangerously. Power off turns are gentle and can be held to the landing. Elevator down will not cause an outside loop but merely an increase in speed until the large stabilizer balances out. At this point up elevator produces a loop. Simple maneuvers like this are enough to keep one busy at first. The simple formula for our next job will be less airplane and more rudevator.

RUDEVATOR PARTS LIST

No.

1. Rear steady bearing—.032″ Alum.—Washers soldered to shaft prevent fore & aft motion.
2. Rotary tab shaft—1/16″ brass rod.
3. Rotary tab shaft crank—.020″ brass sheet.
4. Rotary tab shaft stop—.032″ music wire—one spoke of four-spoke escapement wheel is bent to form this stop.
5. Escapement wheel—.032″ music wire—has three plain straight spokes and one stop spoke (4). All spokes are soldered into drilled holes in a #0-80 brass nut—then unit is soldered to shaft.
6. Escapement shaft—1/16″ brass rod.
7. Ignition switch platform—part of (27).
8. Ignition switch movable contact—insulated—0.006″ brass sheet—contacts, coin silver.
9. Ignition switch stationary contact—.006″ brass.
10. Armature—1/16″ iron. (Hole for shaft oversize to prevent binding—#0-80 nuts soldered to shaft.)
11. Ignition switch cam—model airplane cement built up to required height on escapement shaft. Switch shown open (it is normally closed).
12. Escapement shaft crank—.020″ music wire.
13. Rubber motor crank bearing—1/16″ brass tube.
14. Rubber motor hook—.020″ music wire.
15. Rubber motor—2 strands 1/32″ or 1/16″ square—any practical length.
16. Forward Bearing Bracket—.020″ brass sheet.
17. Rubber motor crank—.020″ music wire.
18. Armature stop—part of (16).
19. Armature return spring support—part of (16).

20. Armature return spring — ⅛″ dia. — solder to armature.
21. Armature bearing—.032″ music wire soldered to bottom of armature.
22. Coil—2 required—4 to 6 ohms total when connected in series; these were from a code practice buzzer.
23. Magnet back plate—1/16″ iron.
24. Escapement wheel 2d stop—.032″ music wire. This is a labyrinth stop—rotation of escapement wheel is clockwise as viewed from rear—(up, right, down, left)—as each spoke leaves first stop (25), it is caught by 2d stop.
25. Escapement wheel first stop — .032″ music wire. Must clear spokes of wheel. Both stops are soldered to (27).
26. Base plate—⅛″ hard balsa.
27. Rear bearing bracket—.020″ brass sheet. Both bearing brackets are held by #2-56 machine screws which bolt thru base plate & airplane structure. Assembly is checked for alignment after installation.