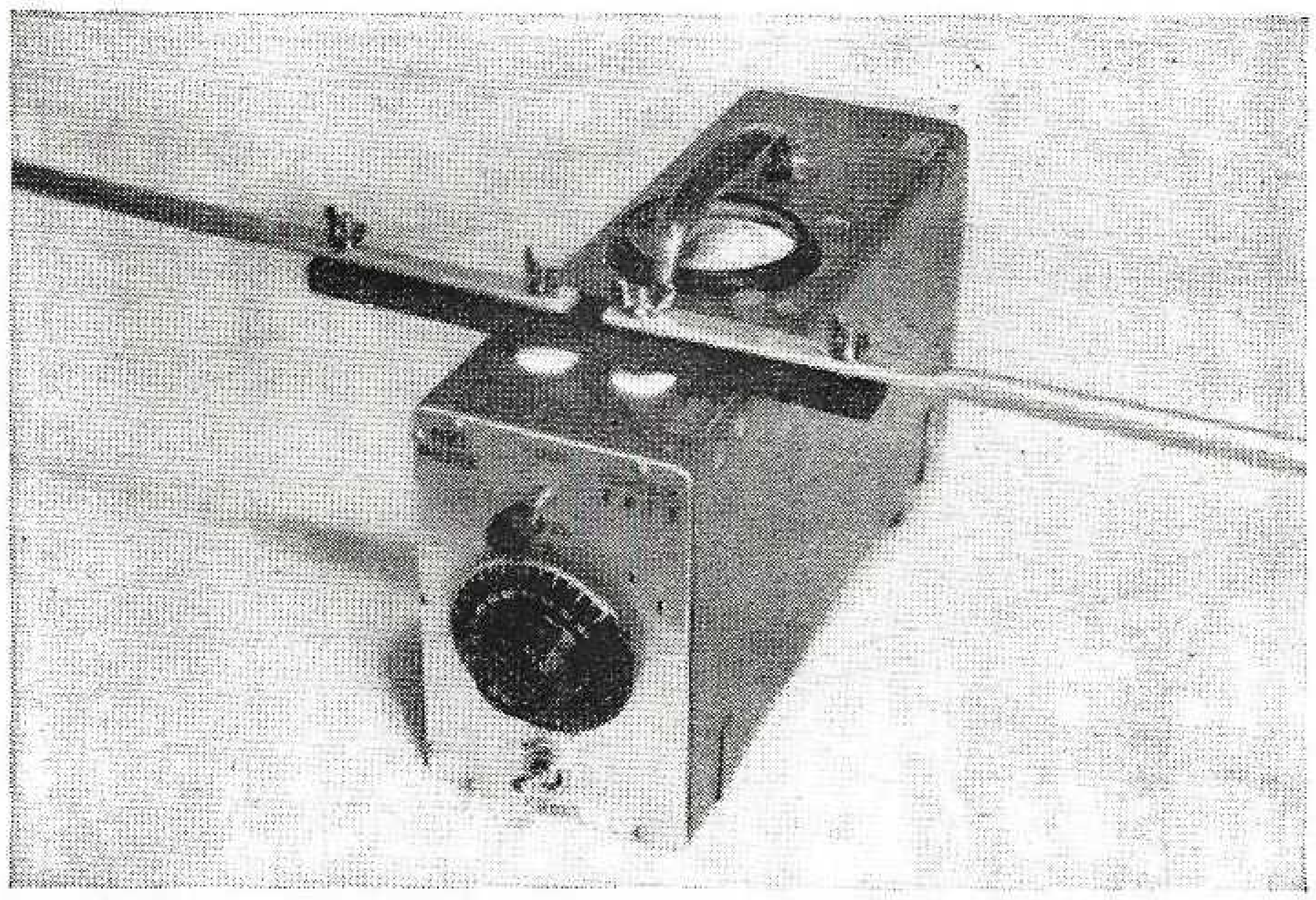

Fig. 4. Extremely compact battery-operated portable control transmitter

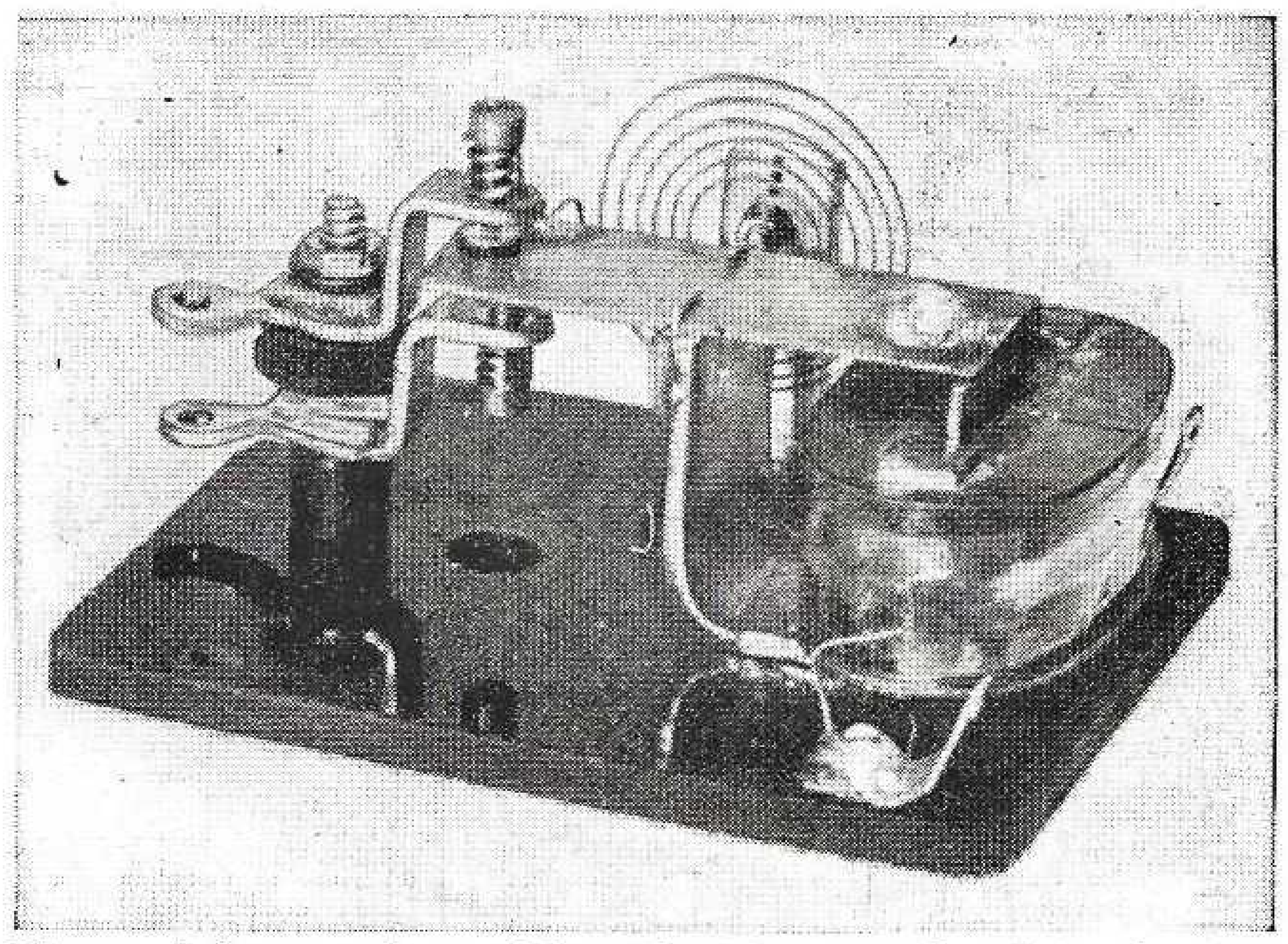

Fig. 2. A homemade sensitive relay constructed mainly of scraps

ELEMENTS OF RADIO CONTROL

By HOWARD McENTEE

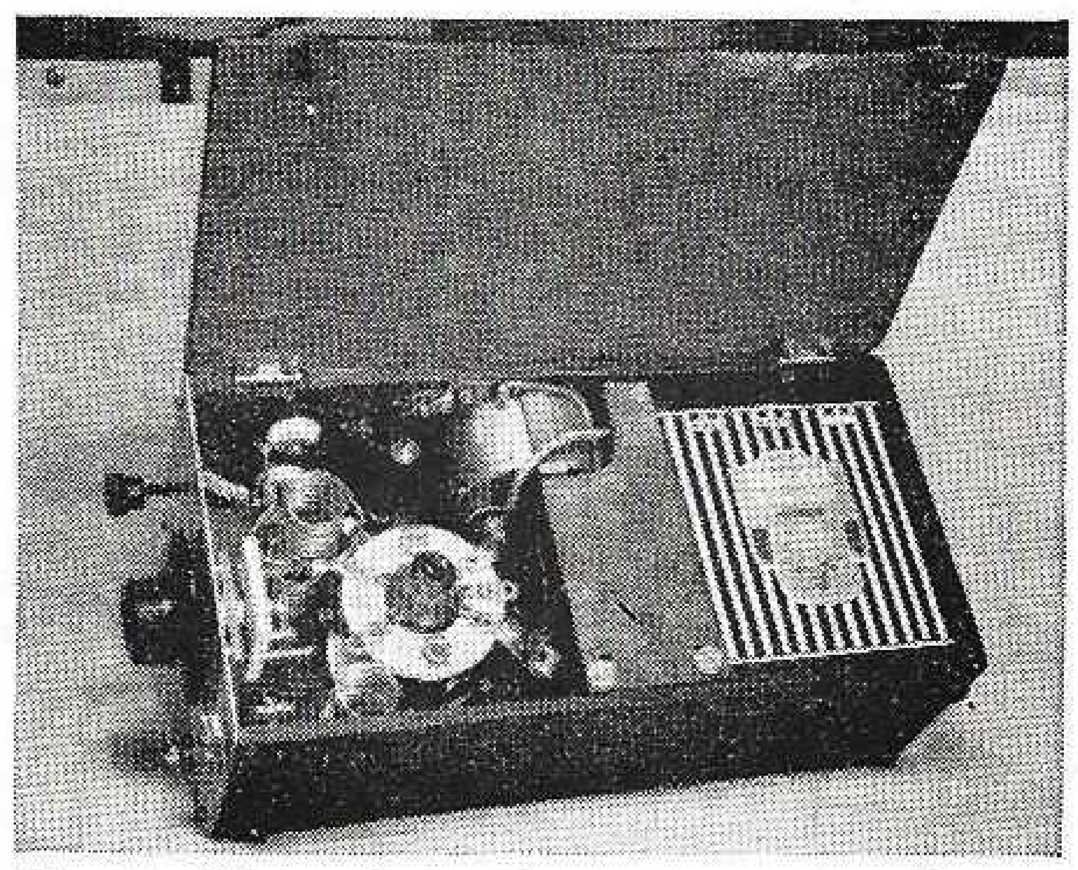

Fig. 5. The tube sockets are mounted one above the other

PART 4

SINCE the last article of this series was written the art of model plane radio control has not changed greatly; no radically new control systems have appeared. Rather, progress has been along the lines of constant refinement, as is the case in so many fields.

One change that may be noted, and it is certainly a change for the better, is the wide variety of equipment now available to the experimenter. When the game first started, makeshifts were the usual thing and all sorts of odd parts were pressed into service in both the radio end and the control surface moving apparatus. Now a great assortment of parts and complete outfits, all engineered for the specific purpose, may be had. There are even companies specializing in the production of this sort of apparatus alone.

Utilization of this new crop of equipment will mean that not as much skill is required in re-building and adapting other equipment for control purposes. Thus, the field will not be so closely limited and should be open to many more builders, particularly since the prices have been lowered because of the larger volume of manufactured materials—and the inevitable competition that has arisen.

A case in point may be taken from

(Continued on page 58)

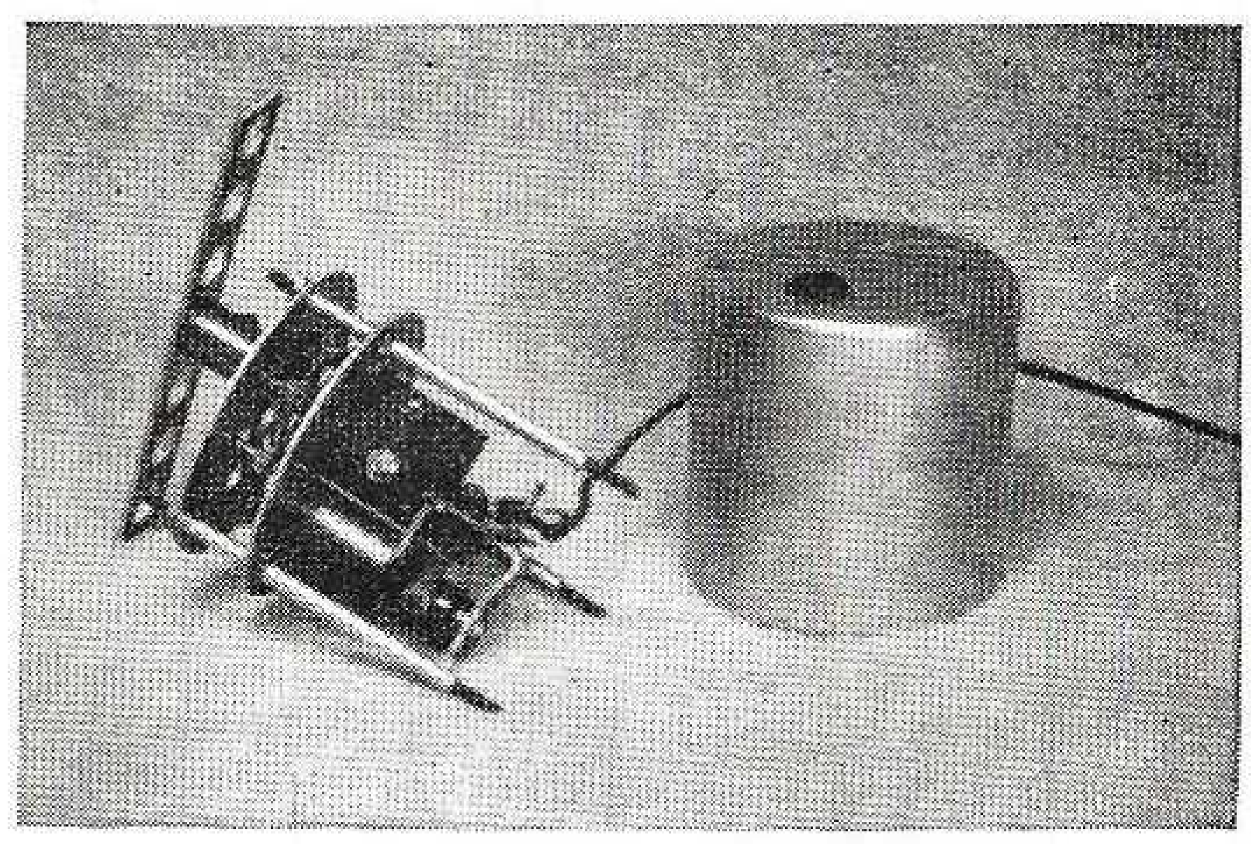

Fig. 1. A very reliable, light, commercial geared-down motor

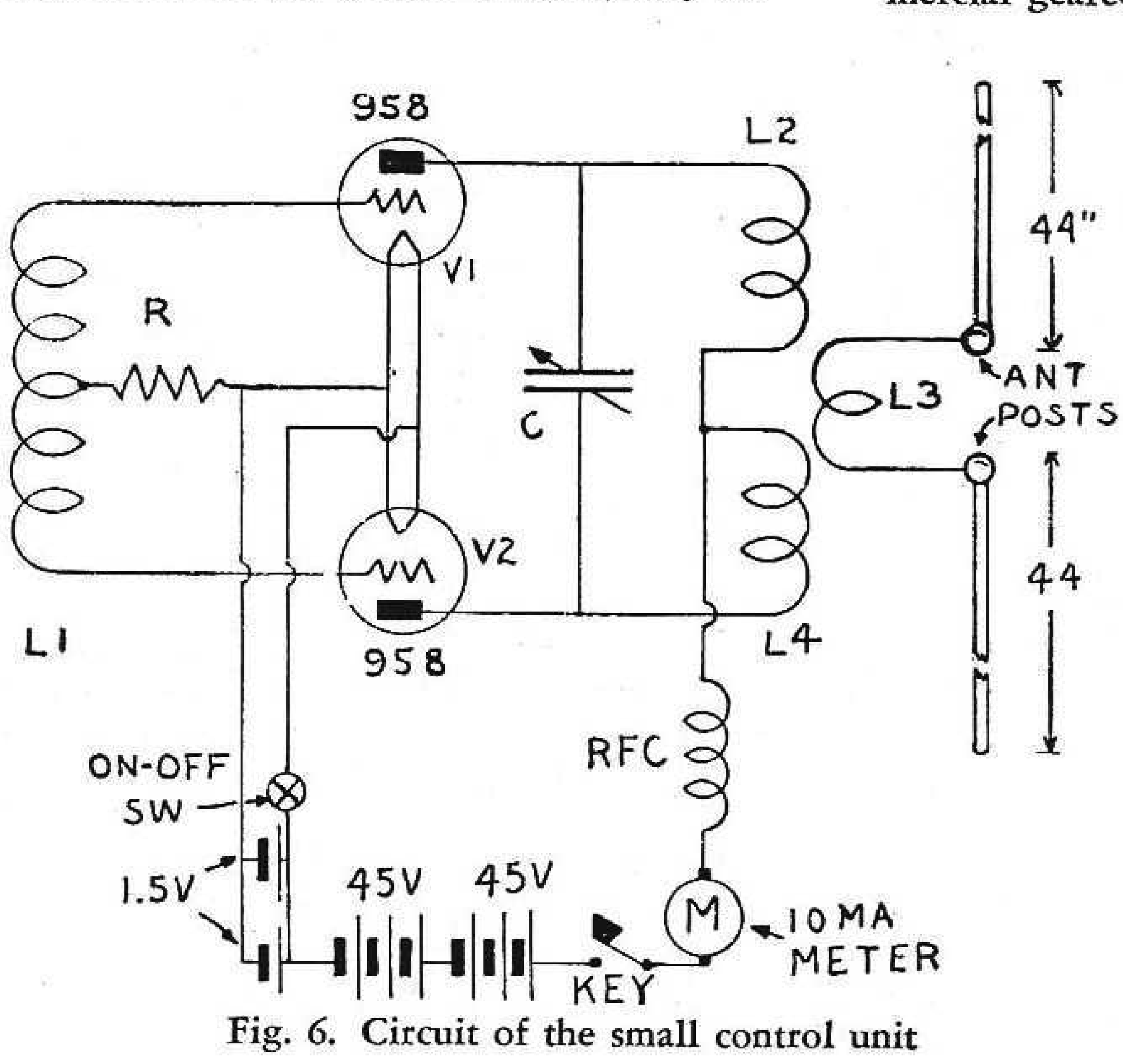

Fig. 6. Circuit of the small control unit

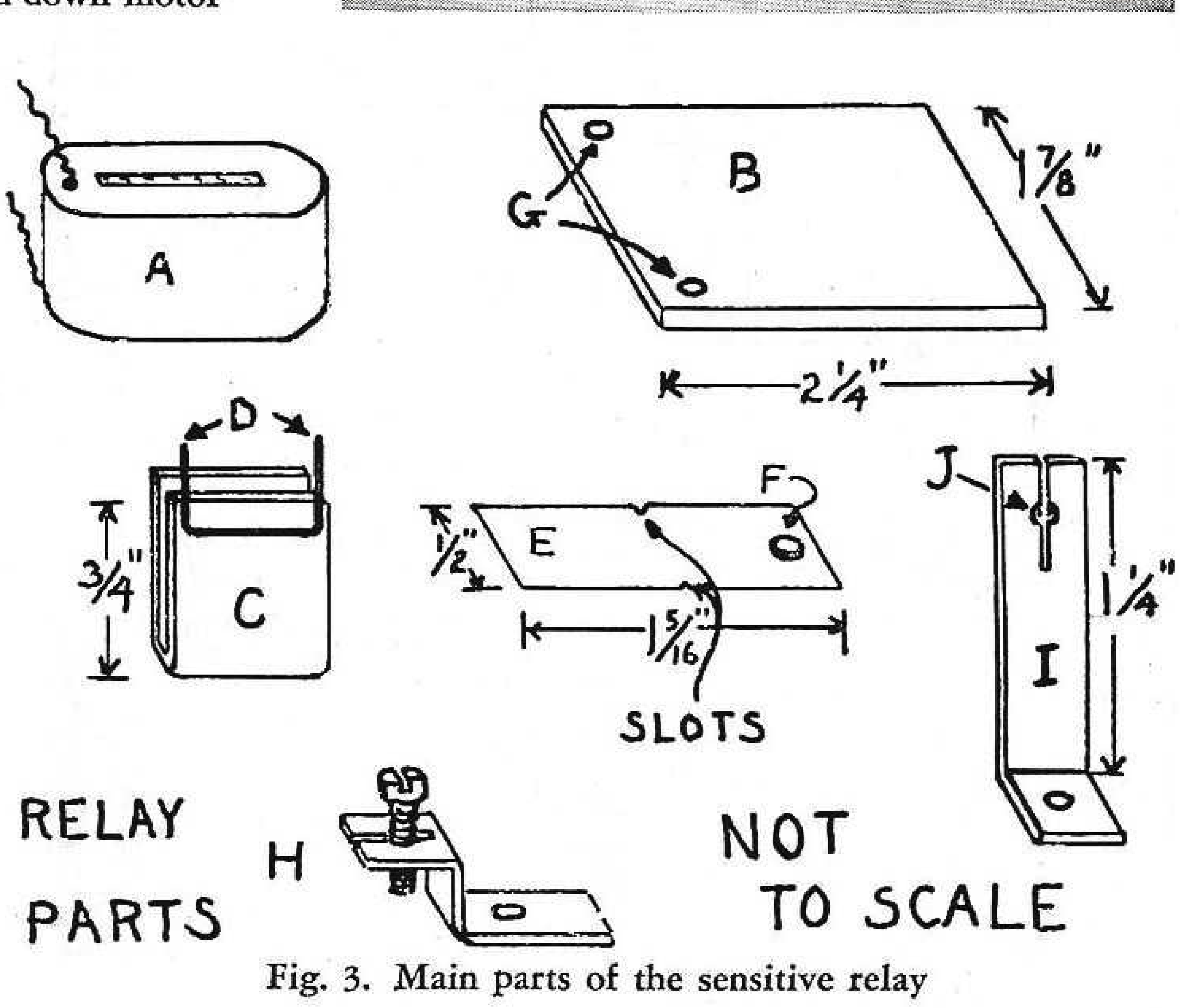

Fig. 3. Main parts of the sensitive relay

Imagine, landing in the airliners of tomorrow while the pilot is sitting in on a game of bridge!

Impossible, you say?

Far from it . . . if these experiments prove successful. If progress maintains its present pace, the fear of fog, rain or sleet won't stop the airliner from settling down to earth no matter what the weather.

That little model is only a target, yet it takes off, flies and lands—utilizing radio control. And soon the new Lockheed will become a guinea pig for the "straight-line" glide experiments.

At last here is the link between "Toy" and Transport.

Elements of Radio Control

(Continued from page 11)

the developments in the battery field. Here the control workers have been helped by a fortunate widespread popularity of portable broadcast receivers. This has forced the battery makers to bring out a large and varied line of small batteries, both A and B, most of which are equipped for plug-in connections, which are a great time-saver, incidentally. Furthermore, the cost of these small units is very reasonable as they are produced in large quantities to meet public demand.

Since most of the big battery makers have actively entered this field, the selection is remarkably wide, as is the distribution.

The use of plug connections as mentioned above is of great help in testing and field work, as it is a quick and simple matter to remove the units for test. Likewise, it is much easier to substitute large batteries for small when trying out equipment or tuning up in the field.

It is suggested that these plugs be removed from defunct batteries and used for connecting all parts of the control system to provide quick assembly or removal and assure good connections. The weight is negligible in most cases.

The control motors used in this work have been of practically infinite variety, limited only by the ingenuity of the builder. They have also been of many degrees of reliability, unfortunately; a shortcoming probably due in large part to the fact that most of the motors used have been of the model locomotive type designed to run on 8 to 20 volts with considerable power output. We have an entirely different set of requirements for our control work. In the first place, the available voltage is low because of weight limitations. Many locomotive motors, even those of the best design, are not reliable in starting when operating on 3 volts.

A control motor does not need very great power as it is always geared way down for this application. Builders will therefore welcome the Pitman control unit shown in Fig. 1, which weighs only about 3 ounces with cover. It is absolutely reliable in starting on 3 volts and works remarkably well on only 1-1/2 volts. This is an example of equipment built expressly for the purpose versus the makeshifts we have been forced to use in the past.

There are those, of course, who simply haven't the available cash to buy all the best parts. Certain parts, such as the tube, must be bought, but others have to be home-constructed if at all possible. For these, the sensitive relay is often a stumbling block due to its cost and the difficulty of home construction, and it was decided to see what could be done in the way of such amateur equipment. Fig. 2 shows the result. This relay will operate reliably on 1 ma. and weighs only 2 ounces. It does not, of course, compare with the well engineered factory jobs, due in some part to the lack of proper materials, but for those who simply must cut corners on cost, it will do very well for the majority of experiments.

A balanced armature is employed, since this is least susceptible to change in operating position and to vibration. The relay shown was built on a scrap of Bakelite 2-1/4" x 1-7/8" x 1/8" thick, but weight may be saved by building it right on the base of the receiver, if such base is of sufficiently substantial material. Balsa wood, of course, is not strong enough for this purpose.

The heart of the relay is the magnet coil and the best source of such coils ready-made is in the old "Baldwin Type C" headphones and loudspeaker units. These were made in huge quantities and practically every radio service shop has one or more lying around. The coils of other magnetic speakers may also be used. The resistance of these bobbins runs from 500 to 2000 ohms or over, and the highest possible value should be picked. The coil shown came from a Baldwin speaker unit and had the highest resistance of quite a few tested, about 1800 ohms. It is naturally possible to use two such coils in series by enlarging the core piece. When this is done, be sure to connect the coils so that they aid each other, or the resultant magnetic pull will be practically zero.

If you buy the speaker in a junk shop, be sure the coil is tested for continuity. Using a Baldwin unit as an example, proceed to dismantle it completely. Nothing is used but the magnet coil, which must be removed carefully to avoid injury to the fine wire windings.

The armature, a piece of thin iron pivoted in the center of the bobbin, must be removed; it is held by two slender wires and they may be broken by moving it sideways in the slot with a pair of pliers. Work back and forth carefully till both wires part; do not yank the armature out, as damage may be done to the winding.

The "U" shaped iron core piece, C, comes next, and is of soft iron. This must be filed or ground down until one end fits through the magnet slot. This piece should be about 2 1/4" x 9/16" x 1/16" before bending. It is formed to the proper "U" shape, the two arms of which are just 3/4" long. Two holes for 4-36 screws are made in the center section to enable fastening to the base.

The armature, E, is a piece of core metal taken from a disassembled audio transformer. This material has properties valuable for our purpose and is much better than ordinary sheet iron. The piece is 1/2" x 1 5/16" x 1/64" thick, though it may be thicker than this.

The armature is held to the core by piece D, which is simply a short length of No. 24 bare copper wire soldered to the core end. Before bending this piece, file two small notches in the edges of E so

that it may be held on the pole piece by D. Bend the latter until the vertical arms fit snugly in the notches, then solder D to C.

The core and magnet may now be fastened permanently to base A, with the two wires from A fastened to the terminal posts G.

Before E is fastened in place, solder F, two bits of silver, to the end for contacts. These may be obtained from various sources such as defunct relays, spark coil vibrator parts, and so on. Most auto supply stores carry Ford "Model T" coil vibrator parts for about 10c, from which good contacts may be taken.

Place the armature on the pole piece end and bend the vertical projecting ends of D tightly over the top. Then wiggle E up and down slightly to loosen it enough for about 1/16" free movement. The armature must move as freely as possible, but must not wobble.

The stationary contacts, H, are now made. Those shown in the photo came from a discarded cheap relay and are held by a single screw to the base with insulating washers to separate and space them. The contact screws should have silver or other suitable tips and are set to meet the contact points soldered on the armature.

There are many different methods of making the contact arms; the points to keep in mind are that they must be adjustable through a vertical range of about 1/8" and they must be reasonably rigid. Extra weight should be avoided, of course.

The next part to be made is the support, I, that holds the hairspring. A piece of brass, 1 1/4" x 1/4" x 1/16" thick, bent at right angles 3/8" from one end, will do. Drill a hole, J, for a 6-32 screw at the exact height of the armature from the base; this distance is 3/4" on the relay shown. Tap the hole, then slot the brass down the center for 3/8", and squeeze the ends slightly. Now, when a screw is run in the hole, it will be held tightly, but may be moved for adjustment.

The last item required is a hairspring from an alarm clock. The one used in this case is of brass with an outside diameter of 3/4" and has seven turns. It is soldered in a slot in the adjusting screw. Then the outer end is bent over and soldered to F, near the contact end. It must of course, first be fastened to the base in line with D before the last soldering operation takes place.

The relay is now complete. The upper contact should be turned to allow the armature to come very close to, *but not to touch*, the magnet end of the core. Then set the lower contact to allow 1/64" or less of movement. The hairspring is adjusted last and should be set for as much pressure as possible for the given operating current. The instrument illustrated will release on about two-thirds of the operating current, which is considered good for a job made of scraps. For example, it will operate on 1.5 ma. and release on 1 ma.; its lowest operating current is about .6 ma.

Experimental work in the shop and short range work under actual operating conditions have proved the convenience of the tiny transmitter illustrated in Figs. 4 and 5. This apparatus is entirely self-contained. The power input is about 1/2W. under full load, and is sufficient, when working with sensitive receivers, to work up to about 25 feet with no aerial at either receiver or transmitter; and operation has been carried out over a distance of 800 feet with an antenna on the transmitter only.

Two RCA-958 acorn tubes are used in a so-called T.N.T. circuit, which is extremely simple, as may be seen in Fig. 6. (The RCA-957 tubes may also be used, but must be operated at lower input current.) This consists of an untuned, center-tapped grid inductance and a tuned plate coil, also center-tapped. The key is simply two strips of brass, operated by the button near the forward edge of the meter in Fig. 4.

The case is of tempered pressdwood, though ordinary wood could be used as well, and measures 8 1/2" x 4" x 2 5/8" deep inside. At the rear of the container are two Burgess type W30FL batteries and just forward of them are two No. 2 flashlight cells. The latter are connected in parallel by means of contact strips on the side of the case and on a removable strip that holds the cells firmly in place. A pressdwood partition in front of the cells serves further to anchor them securely.

Next to the front come the two tube sockets mounted one above the other and spaced with bushings so that the tubes do not touch the case sides nor each other.

The coils are soldered directly to the socket prongs. L3 is a coupling coil which fits in between L2 and L4. The transmitter shown has a knob on the front panel to vary the coupling without opening the case, but this is not entirely necessary. The knob is on a threaded shaft and turning this moves L3 through a range of about 3/8", which is quite sufficient for the purpose.

C mounts on the front panel, but must be insulated from it. An insulated shaft was fitted to this condenser, as hand capacity was found to be annoying. The shaft was cut off short and a 4-36 flat head screw soldered to it. A 1/2" length of Bakelite rod was then drilled, tapped and threaded on the screw; the dial was fastened over this.

The meter is placed beneath the handle for protection and also because this location fitted in better with the other parts.

The panel is an aluminum plate, 4 3/8" x 2 7/8" x 1/16" thick and the labels for the various controls were printed on it with indelible ink, using a 10c store printing set. A coat of clear lacquer completes the panel and protects the printing.

After carefully wiring the set, turn on the power and observe the meter reading. It should be close to 3 ma.; if it is much higher, squeeze or compress the turns of L1, which should reduce it. The turns should be altered until the reading is as low as possible, and changing the length of this coil is the only means of tuning it. The output of the transmitter should be checked to be sure it comes within the 5 meter amateur band, and the dial accurately calibrated for the purpose.

The antenna consists of two halves as seen in Fig. 6; each half may be made up of two or more telescoping tubes so that the whole thing can be collapsed to reasonable dimensions. The rods fasten on a sturdy strip of Bakelite 8" long, which in turn is held by the antenna posts on the transmitter. The whole thing is held by wing nuts so that it may be quickly and easily disassembled.

Set the tuning dial to 58 mc. and with the antenna in place, slide the tubes in or out until maximum plate current is flowing. The rods should be adjusted equally from both ends so that when highest current shows on the meter each side is of the same length. They will probably come to about 44" each. Do not allow the plate current to go over 6 ma.; reduce coupling if it rises above this value while adjusting the antenna.

This little transmitter will be found extremely useful for both experimental and actual flying work. It will be found to impress an audience much more than will a bulky and cumbersome transmitter when giving demonstrations.

PARTS LIST

V1, V2, RCA-958 tubes; R, I.R.C. 1/2 Watt 50,000 ohm resistor; C, Hammarlund HF15 variable condenser; sockets, Hammarlund No. S900; M, Triplett model 223 meter O-10 ma.; "A" battery, 2 Burgess No. 2 cells; "B" battery, 2 Burgess No. W30FL 45 Volt batteries; L1, 17 1/2 T No. 14 bare, 11/16" diameter, 2 1/8" long; L2, L4 each 7T same wire 11/16" dia., 7/8" long, separated 1/2" at center; L3, 3T same wire and dia., 3/8" long, adjustable; RFC, Bud high frequency choke, No. CH925.