Summary of

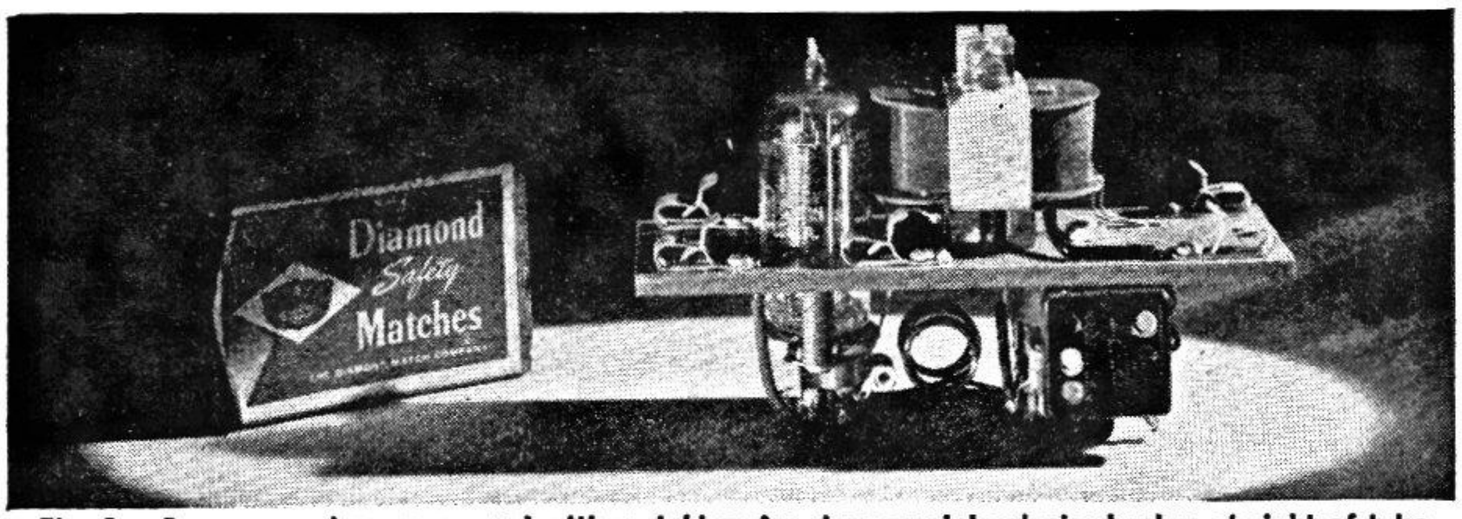


Fig. 1. *Beacon* receiver compared with matchbox for size; special polarized relay at right of tube

Radio Control

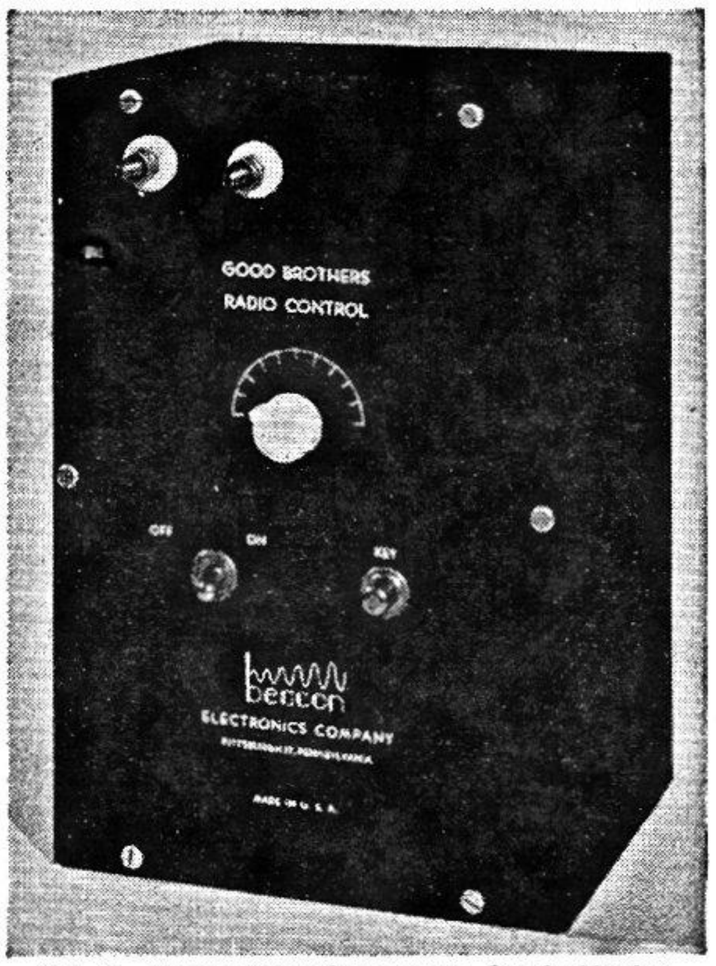


Fig. 2 Transmitter has space for batteries

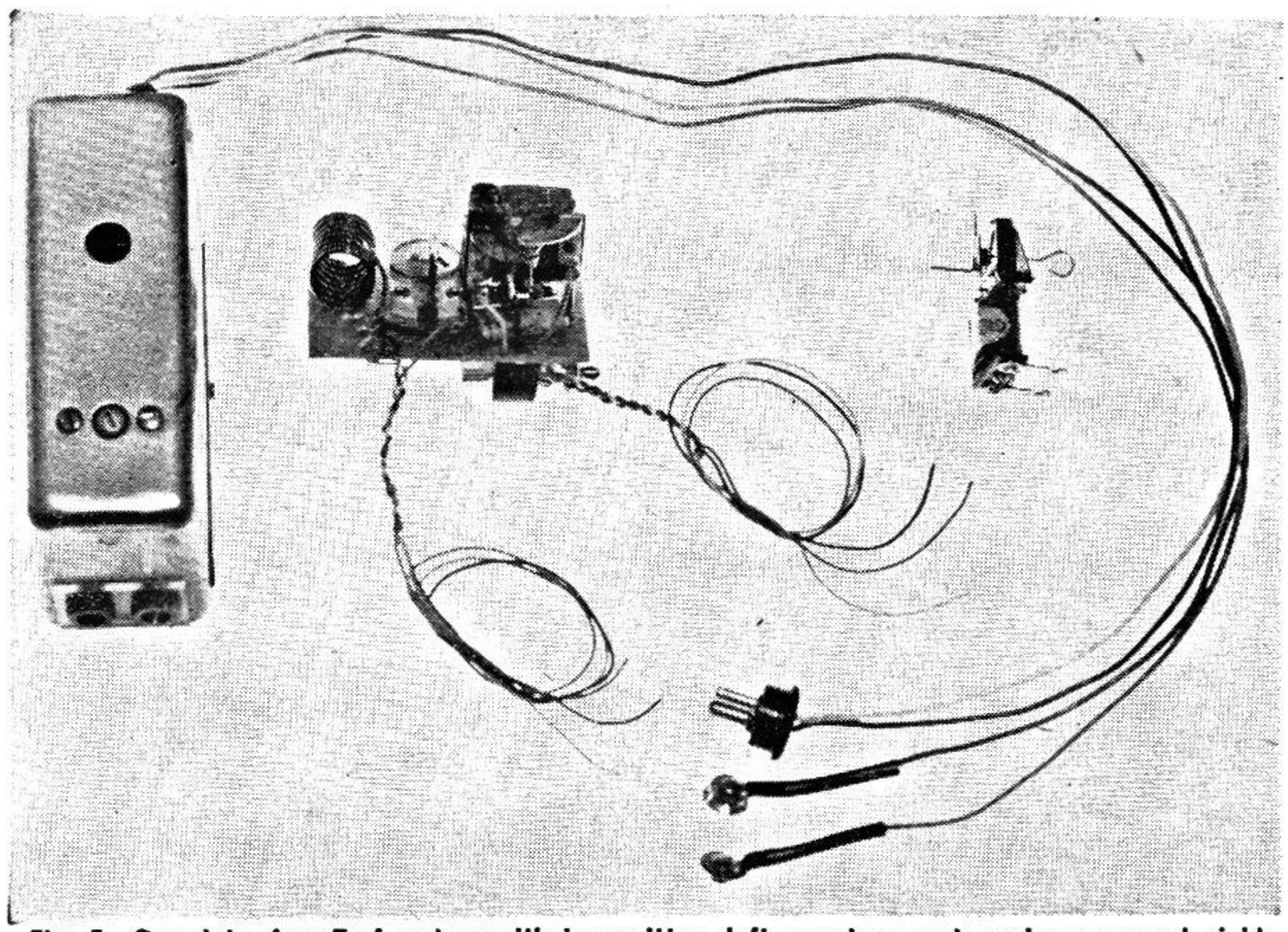


Fig. 5 Complete *Aero-Trol* system with transmitter, left, receiver next, and escapement right

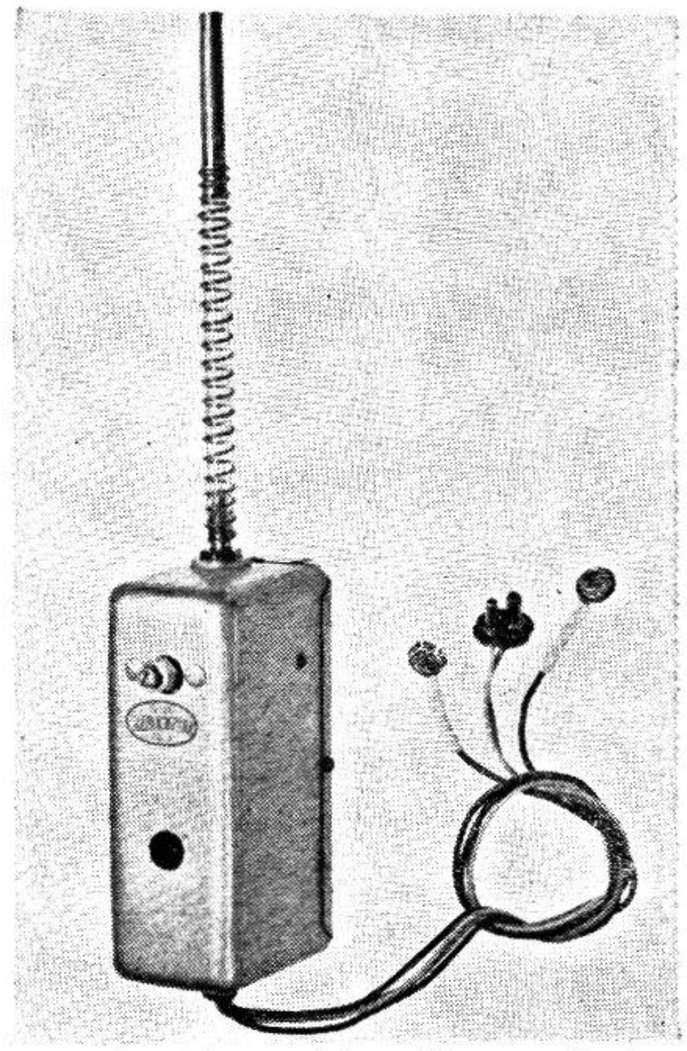


Fig. 6B Special transmitter with compact antenna

by E. J. LORENZ

FREE band!—no license!—multiple channel!—audio control! All these are the goal of the radio control enthusiast. How close are we to them? Perhaps we can give you a fair idea of what is now in use and what we predict for the future.

When we mentioned a year or two ago Class A radio controlled models, and transmitters that could almost be concealed in your hand, there were quite a few raised eyebrows and questioning comments. That was back in the February 1946 issue of M.A.N. Today these things are a reality. This article will describe present equipment and some being developed. And lest the reader assume that radio control is out of his reach in the immediate future because of lack of a license (*any transmitter* — no matter where it is operated, what the frequency or how low the power—*must have a properly licensed operator at the controls*), let us say that free band operation is practically around the corner. But more of that later.

Until this new era in radio control arrives, we shall continue to give you information under the current operating conditions. In this article we'll give a summary of two of the most popular commercial units on the market today, as well as data on the new Eveready 1005E cell, thermal relay cutouts, and various other bits of interest to the radio control fan and builder.

Back in 1945, at the National Hobby Show in Chicago, the announcement and first public showing were made of the Good Brothers' radio control system, produced by Beacon Electronics of Pittsburgh, Pa. This system included a transmitter, receiver, escapement and transmitting antenna. The receiver was a close copy of the ones that brought the Goods fame since they first popularized this interesting phase of modeling, some of the differences being in the type tube used and in the receiver's being a fixed frequency affair. The change in tubes was brought about by tube developments during the war. The fixed frequency receiver, first of its kind to reach the market was settled upon because it made for a more compact and lighter unit, there being no bulky variable tuning condenser. The war also brought into general use the now widely used midget ceramic condensers which cut size to a minimum. The Good Brothers' receiver (Fig. 1.) employs a superregenerative circuit with a quench-frequency coil, thus enabling use of an inexpensive high-vacuum tube. Original models used types 30 and RK-42 tubes, while the commercial version uses a 3A5 twin triode, of which only one section is used in the receiver.

Perhaps the greatest advantage of this circuit is its ability to function well over a wide range of battery voltages. The receiver, operating from the A battery of 1½ volts (220 ma. drain), performs well from a new battery voltage of 1.5 down to 1.1 volts. The B supply of 45 volts (approximately 5 ma. drain) gives satisfactory service even when the voltage falls to around 34 to 36 volts. A critical point of this receiver is the sensitivity of the antenna. Care must be taken not to get too close to the receiver antenna while tuning

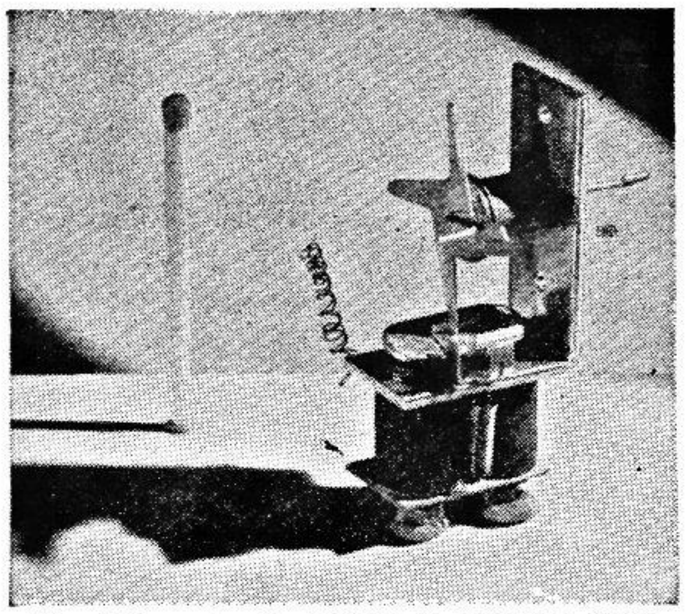


Fig. 3 *Beacon* escapement is four-arm type

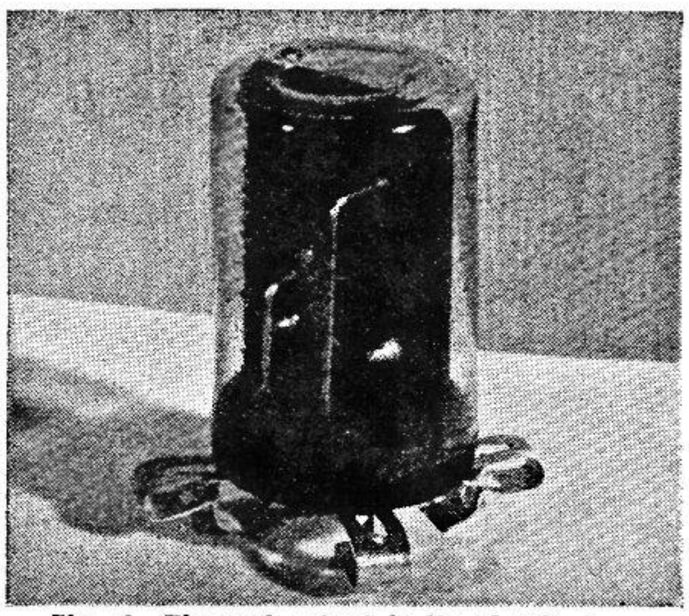


Fig. 4 Thermal cutout in its plastic case

from the transmitter because of "body effect" which detunes the receiver. A little care in placing the antenna in the plane, and in not placing your hand too close to it while tuning, will erase this minor problem. The circuit of the Good Brothers' receiver is given in Fig. 1A. Value of the components are given at the end of this article. This receiver measures 1-7/16" x 2-3/4" x 4" overall and weighs 5 oz. less batteries. The relay was developed by Bill and Walt Good, and because of its polarized design assures very good contact pressure even when set for greatest sensitivity. This relay can be adjusted to operate on a change of plate current of as little as 200 microamps, or .0002 amp.

The transmitter of the Beacon commercial version, Fig. 2, differs from the Good Brothers' original units in that it is of lower power output and is more readily adapted to portable battery operation. It is a one tube push-pull circuit, using a 3A5 tube, the same type tube used in the receiver. This circuit (Fig. 2A) gives an output of 1¼ to 2 watts, depending on the individual tube (the author has noted quite a bit of difference in the power output of 3A5 tubes even when used in the same circuit). The power requirements are 1½ volts of A supply at 220 ma. and 135 volts of B supply, with a key-down drain of approximately 30 ma. The antenna used is a folded dipole of 300 ohm twin-lead wire. This antenna may be stretched out straight or formed into a Y for a slightly better all-around radiation coverage. The present transmitter measures 5" x 6" x 9" and weighs about 8 lbs. with the enclosed batteries.

The control surface actuating device is a reliable lightweight escapement, which operates on from 3 to 4½ volts. This unit measures 1" x 1⅛" x 2¼" and weighs ¾ oz. On 3 volts this escapement (Fig. 3) draws about 300 ma., and such a drain can be furnished by two pencells. While a 300 ma. drain from pencells may seem a bit high for this application, it will be noted from Fig. 3A, that only one short impulse from the transmitter is necessary to place the control in the desired left or right position, or back to neutral. When the control is held at any of the one-half positions, the coils are energized for the length of time it is desired to hold the position. The big advantage of this four-arm type escapement is that no power is used when the control is in a left or right position.

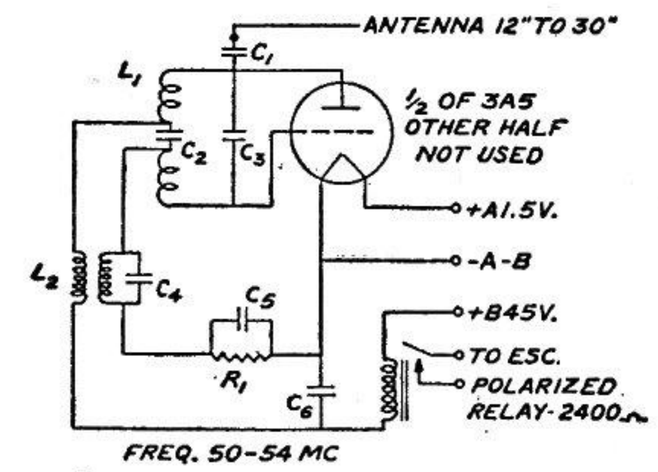
One other big advantage, as used by the Good Brothers at the 1947 Nationals, is the inclusion of a thermal delay ignition switch (Fig. 4). This switch has the heating element connected across the coils of the escapement, and under normal pulsing conditions will not heat sufficiently to cause the bimetal strip to open the contacts. When it is desired to cut the engine (or operate other devices for a short time), it is only necessary to hold the transmitter key down for the length of time needed to actuate the relay. This thermal switch, as produced by Beacon from Walt Good's design, was scheduled to hit the market very early this year. It measures 1-1/16" in diameter, 1-5/8" high, and weighs 1/2 oz. The time delay action is preset for 4 seconds, when used with 3 volts. Since it is actuated when the key is held down, the escapement is on a one-half position and there should be no danger of too severe a turn with a properly designed ship. Information on another thermal switch will be given later in this article.

All in all, the Beacon radio control unit has contributed considerably toward raising radio control to the high interest level it holds today.

The latest radio control unit to reach the model world is the Aero-Trol set which has been available for over a year. The first circuit diagrams that have been printed on this set are shown in Figs. 5A and 6A. The Aero-Trol receiver (Fig. 5) employs a self-quenched super-regenerative circuit, using the Raytheon RK-61 tube. By using this special tube, and other miniature components, it was possible to bring the weight down to about 2 oz.

As with most other radio control units in use today, both commercial and home-made, it operates in the six meter amateur band and covers 50-54 megacycles. The receiver is of the fixed frequency type, but the frequency may be varied a slight amount by varying the spacing between turns in the tank coil. It has a variable antenna condenser to compensate for length when using a short antenna (about 28 to 30 inches is normal). The presence of hand or body near the Aero-Trol receiver antenna has very little effect on the set's operation. The variable resistor in the B-plus lead compensates for battery voltage and variations in RK-61 tubes. By using the variable resistor and condenser in the Aero-Trol receiver circuit, utmost sensitivity can be obtained. This was proven in tests, while developing the set, when we had reliable operation at a distance of almost ten miles.

This compact unit measures 1-7/16" x 1-3/4" x 2-3/8" and the weight, less batteries, is 2 oz. Because of compactness and lightweight, it is possible to use several receivers in the same plane in order to operate several controls. The fact that the RK-61 tube is used in this receiver causes an occasional comment as to its life and general practicability. However, this tube is used faithfully by "ye olde master", Jim Walker, and in practically all of a certain type of Government R. C. unit. The tube itself is of the sub-miniature type and has life of 4 to 10 hours,



FREQ. 50-54 MC

FIG. No. 1A
GOOD BROS. RECEIVER

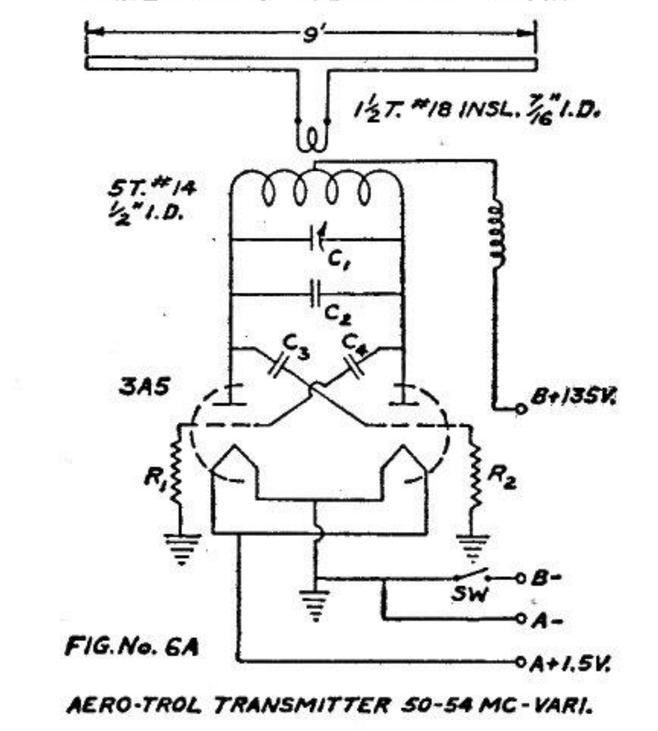


FIG. No. 6A

AERO-TROL TRANSMITTER 50-54 MC-VARI.

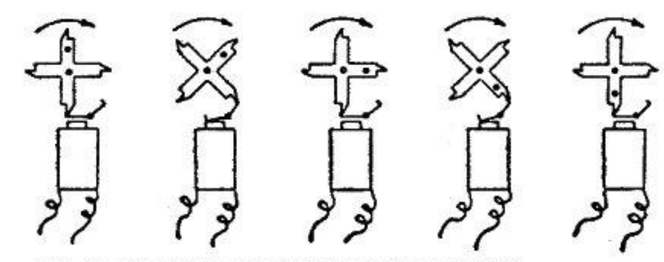


FIG. No. 3A FOUR-ARM TYPE ESCAPEMENT
BLACK DOT REPRESENTS PIN THAT
OPERATES CONTROL ARM.

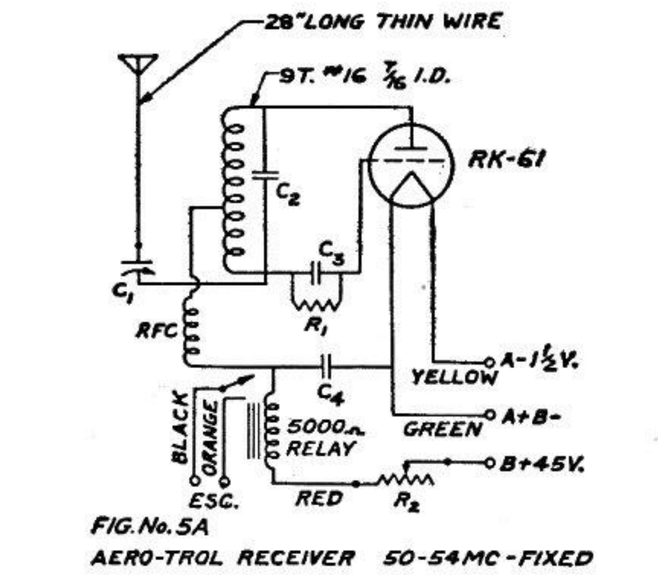


FIG. No. 5A

AERO-TROL RECEIVER 50-54 MC-FIXED

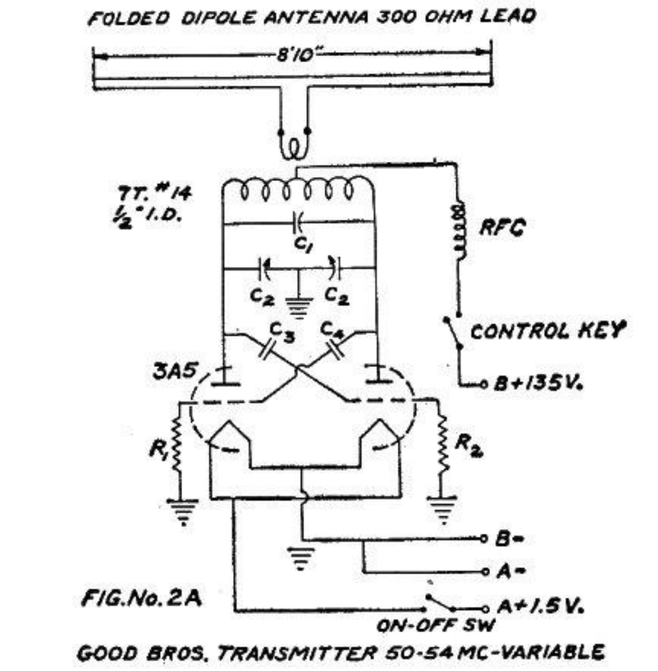


FIG. No. 2A

GOOD BROS. TRANSMITTER 50-54 MC-VARIABLE

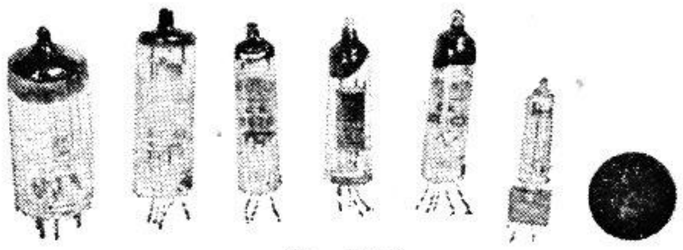


Fig. 16B
Miniature tubes compared to penny (black circle at right)

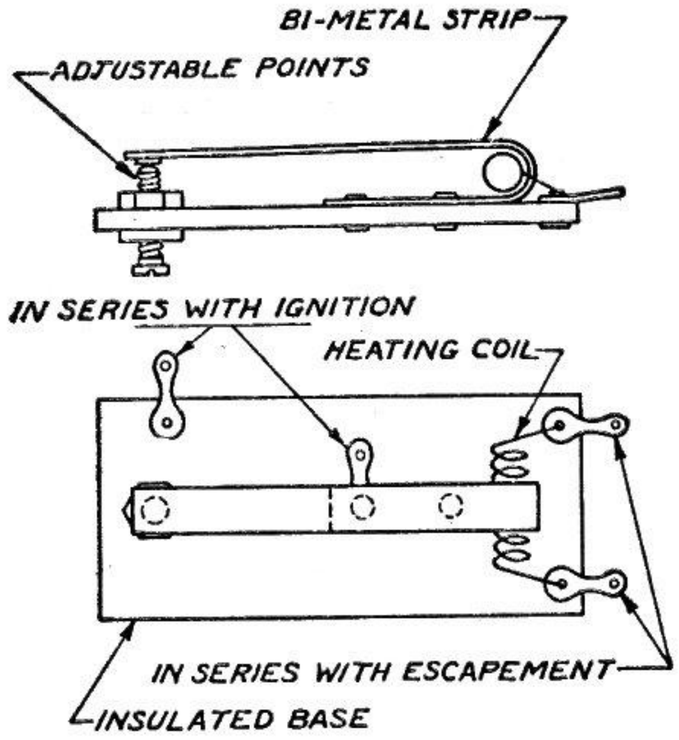


FIG. No. 9
THERMAL CUTOUT

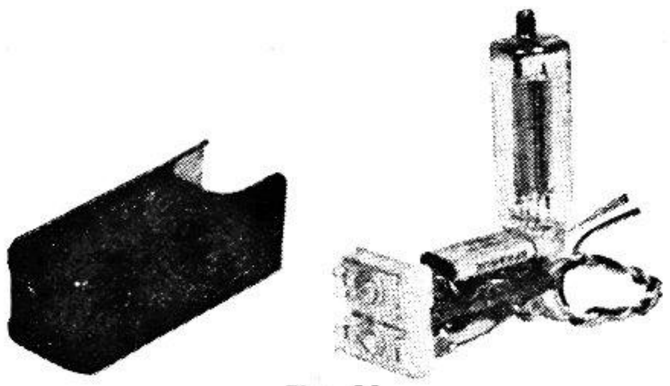


Fig. 10
A tiny receiver, less the relay

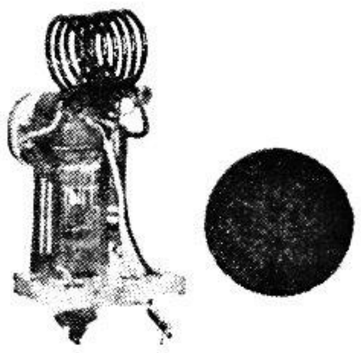


Fig. 11
Vest pocket transmitter (for comparative size note circle of half dollar at right)

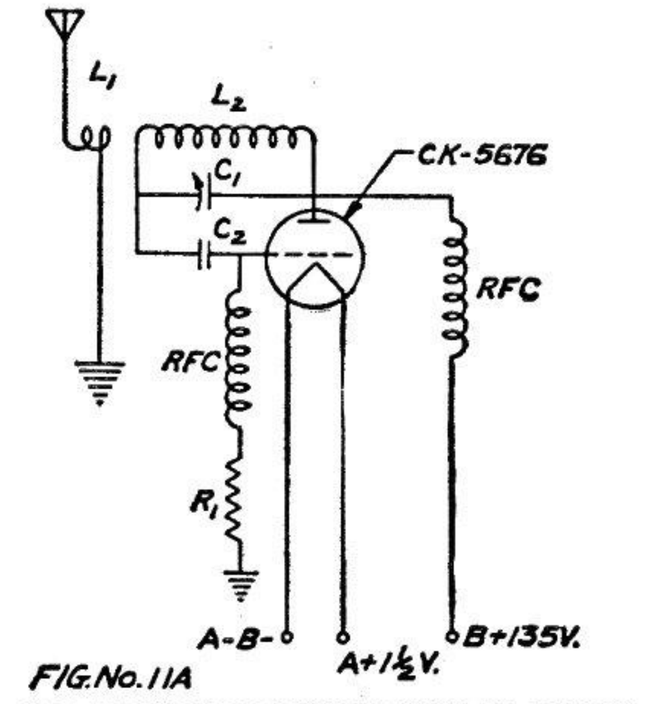


FIG. No. 11A
SUB-MINIATURE TRANSMITTER 50-54 VARI.

depending on the maximum plate current used. Since the RK-61 draws but 1.5 to 2 ma, with no signal, battery life is greatly prolonged and the smallest batteries may be used to save weight and space.

The transmitter (Fig. 6) is similar to the Beacon unit except for circuit values and layout. The 3A5 tube gives an output of 1-1/4 to 2 watts with a power input of 135 volts at 30 ma. The main feature of this transmitter is its small size of 1-1/2" x 2" x 4-1/4". The weight is 4-1/2 oz. and batteries are carried separately. Fig. 6B shows one of the original Aero-Trol transmitters with the portable antenna as described in "Hints and Kinks on Radio Control" in Sept. 1948 issue of M.A.N.

The escapement (Fig. 7) is of the two-arm type and features self-neutralization (see January 1949 issue M.A.N.) Operating on 3 to 4-1/2 volts, it has a drain of about 800 ma at 3 volts. When no radio impulse is received the escapement is in a neutral position. To obtain either right or left position, the transmitter key must be held down for the length of time the control is to be actuated. Upon releasing the transmitter key, the arm returns to neutral and is ready for the next operation. This escapement measures 3/4" x 1" x 2" and weighs 1/2 oz.

This covers our outline of the radio units now on the market. Radio Control Headquarters and Bell Sound Systems each have a unit on the market, but unfortunately we were not able to obtain full details on them. R. C. Headquarters was the first with a commercial radio control unit and at present they also put kits for receivers, transmitters, etc. The Bell Sound Systems unit is a two-channel set employing three tubes each in the receiver and transmitter. The receiver measures 3" x 5" x 7" and weighs about 2 lbs. It is therefore best suited for large planes or boats.

Perhaps one of the outstanding uses of the Bell radio control unit was illustrated when Charles Mooney, owner of Hobby Harbor in Columbus, Ohio gave a demonstration down one of the main streets of the city. Mr. Mooney controlled a 3 ft. car, weighing 25 lbs. along the sidewalks of the busy street, turning corners and even completing tight circles. The race-car type vehicle was propelled by electric motors at a speed of about 5 mph.

And now for a few words on the various photographs. Fig. 8 shows the tubes now generally in use in radio control sets, also several other tubes which can be used in the new 465 mc. band. From left to right they are: 3A5, RK-61, CK5676 (sub-miniature triode by Raytheon), 6K4 (UHF triode by Sylvania), CK608 (UHF triode by Raytheon), and a very sub-miniature triode which has not yet been released to the public. All tubes are shown in comparison to a one cent piece at the right.

The 6K4 and CK608 have a cathode emitter and use 6.3 volts, which more or less prohibits their use in receivers due to the extra weight of batteries needed. The balance of the tubes have filament emitters and use 1.5 volts for heating.

Fig. 9 shows the thermal relay mentioned earlier in this article. The author's original model measured 3/8" x 5/8" x 1-1/2", weighed less than 1/4 oz. and featured a device for holding the points open after they had been actuated. This completely opens the ignition circuit, thus saving batteries and coil. The contacts may be reset by releasing a small spring. This unit is pictured in center of Fig. 15.

Figs. 10, 11 and 12 give an example of

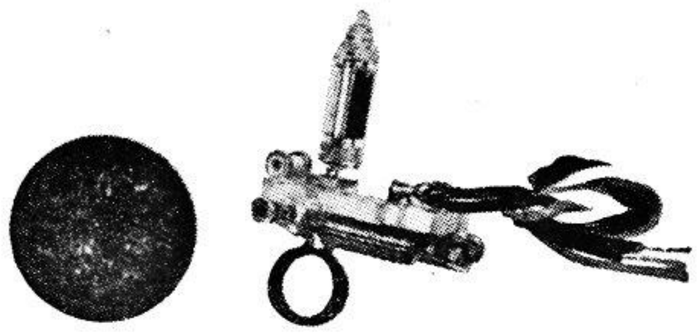


Fig. 12
This tiny transmitter (compared to size of half dollar at left) operates on 165 mc.

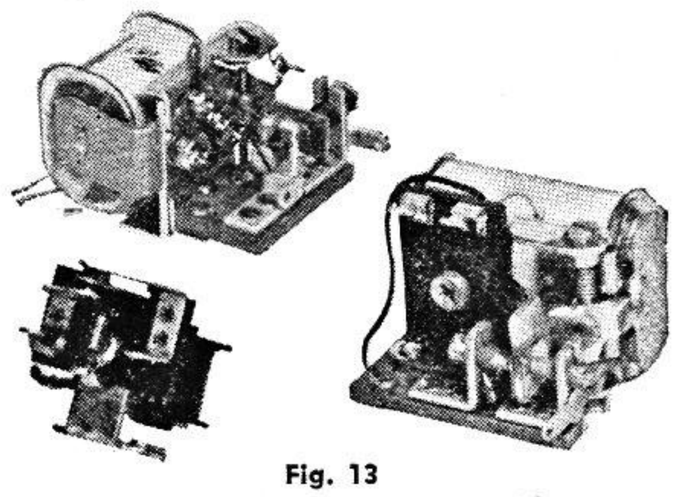


Fig. 13
Various commercial sensitive relays

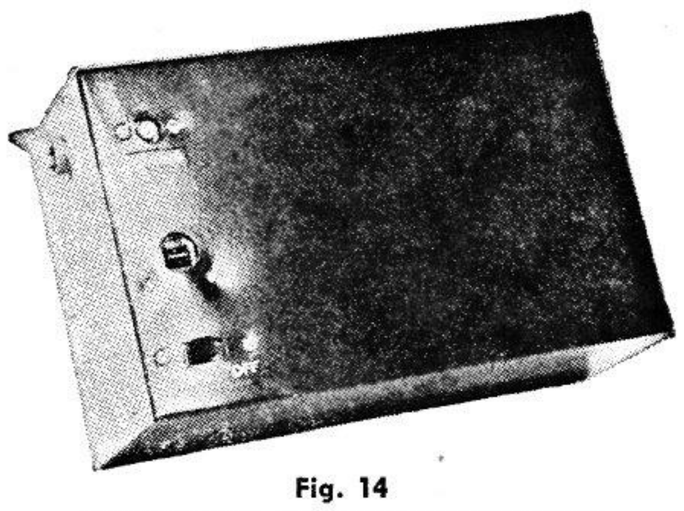


Fig. 14
Experimental "freeband" transmitter

Fig. 15
Some weight-saving R.C. components (for comparative size note circle of ten cent piece at extreme right)

what can be done in building miniature transmitters and receivers. Fig. 10 is a six-meter receiver using an RK-61 and measuring 3/4" x 3/4" x 1-7/8", exclusive of the tube. Weight with relay is 1-1/2 oz. Fig. 11 is a six-meter transmitter with a range of 3/4 to 1 mile. It uses the circuit given in Fig. 11A. Fig. 12 was just an experimental model of a transmitter operating at 165 mc. Sizes are shown as compared to a half-dollar.

Fig. 13 shows three of the sensitive type relays used in radio control receivers today. Above: Sigma type 4F; lower left: Kurman type 13C44; right: Sigma type 5F. The last mentioned is perhaps one of the most sensitive commercially used relays on the market, having a sensitivity of 5. milliwatts.

In Fig. 14 we have an exclusive photo of one of the new "free band" transmitters. This was an experimental unit and therefore shows a tuning adjustment; the production model will not have this. The complete transmitter and all batteries are carried in the case, which measures 2-

(*Turn to page* 51)

Summary of Radio Control

(*Continued from page 26*)

7/8" x 4-1/2" x 7-1/2". The name of the concern doing work on this unit cannot be given at this time, but in addition to their regular electronic product designing they are well versed in the needs of the radio control fan.

Some small components used in present day R. C. equipment are shown in Fig. 15, compared with a dime. At the left is an *Electrotor*, a new design of electric motor, useful for operating control surfaces, motor throttle, etc. through a gear train. This tiny P. M. motor operates on 3-6 volts and weighs 7/8 oz. Next is a tiny variable condenser, and following this, the thermal cutout diagrammed in Fig. 9. The heating coil can be discerned at the lower end of the unit; this coil is placed within the bend of the thermal strip. Lastly come two hearing-aid carbon potentiometers, one with and one without a knob.

And now for the latest word from the FCC. At present there is only one band on which equipment approval for manufacturers can be given. This is the much discussed Citizens' Radio Service Band of 462-468 megacycles. As mentioned in previous articles, tube difficulties (on the receiver end) are holding up the marketing of a unit for this band. Apparently this is being overcome, and we may see something really new in the very near future. There is available an experimental frequency of 27.255 megacycles, but no equipment approval is ready at this time. Input to the final stage, on this latter frequency, is limited to 5 watts (as compared to a class A-B station on 465 megacycles of 10 watts), and frequency tolerance must be maintained within .01% on the 27 megacycle band (within .04% is allowed on 465 megacycles). Pulse, audio, or frequency modulation will probably be allowed in both bands.

A bit of good news is contained in the fact that there is a company coming out with a complete line of radio control kits, information bulletins, and those hard-to-get parts, heretofore available only through manufacturers. Word has it that in addition to the catalog of hard-to-get parts, there will be plans and hints on radio control units and devices, to be issued at least once a month.

New developments of note are a self-neutralizing selector, being developed by R. V. Bentley, designer of the widely used English Tekni-Flow prop. There is also an electronic pulser, so small it will fit in the palm of the hand. This item will make for faster development of proportional control. As this article goes to press we understand the new improved *Rudevator* has been announced by its developers, H. Owbridge and R. Schumacher of Burbank, Cal.

The coming year should show great strides toward multiple channel, multiple selector type controls, and more simple and foolproof receivers. Future sets will be able to take the most severe abuse, short of breaking the tube, and still be in good operating condition. Batteries such as the new Eveready 1005-E hearing aid A cell promise longer life when used in receivers. This new "air breathing" cell is approximately the weight and size of two pencells, placed side by side. Preliminary tests by the author showed this cell to have a no load voltage of 1.32 volts, and when connected to one RK-61 tube this voltage falls to 1.25. After *23-1/2 hours of continuous use* the voltage fell to a safe endpoint of 1.1 volts. This is a drop of but .15 volts in almost 24 hours. With two RK-61 tubes in parallel, the initial voltage was 1.22 volts. This fell to 1.1 volts in 9-1/2 hours. Although this is not a high drain cell, it does offer excellent service when confined to furnishing filament power to one or two RK-61 tubes.

In a coming issue we hope to bring you information on the first free band radio control unit—an English model. Also, information will be given on one of the most famous radio control planes and

units in this country. Let's make 1949 the biggest year yet for radio control!

Component Values for Circuits Given

FIG. 1A

C1 40 mmfd.
C2 250 mmfd.
C3 40 mmfd.
C4 1500 mmfd.
C5 .01 mfd.
C6 .005 mfd.
R1 3900 ohms
Antenna 12" to 30" long
L1 3 turns 3/8" I.D. both sides.
L2 30 Kc quench coil.

FIG. 2A

C1 10 mmfd.
C2 15 mmfd. split stator
C3 25 mmfd.
C4 25 mmfd.
R1 15,000 ohms
R2 15,000 ohms
RFC 1/8" dia form 1/2" long wound full #36 en. wire.

FIG. 5A

C1 5-25 mmfd. var.
C2 15 mmfd.
C3 100 mmfd.
C4 .05 mfd.
R1 3.9 megohms
R2 6000 ohm pot.
RFC 3/16" dia. form, 3/4" long, wound full #34 en. wire.

FIG 6A

C1 5-20 mmfd. var.
C2 18 mmfd.
C3 100 mmfd.
C4 100 mmfd.
R1 16,000 ohms.
R2 16,000 ohms.
RFC 1/8" dia. form 1/2" long wound full #34 en. wire.

FIG. 11A

C1 5-35 mmfd. var.
C2 100 mmfd.
R1 22,000 ohms.
L1 1-1/2 turns #16 wire, 7/16" dia.
L2 8 turns #16 wire, 7/16" dia.
RFC 3/16" dia. form 3/4" long, wound full #34 en. wire.