# Basic Radio Control

by E. J. LORENZ

**A simple description of radio control for those with little R. C. knowledge**

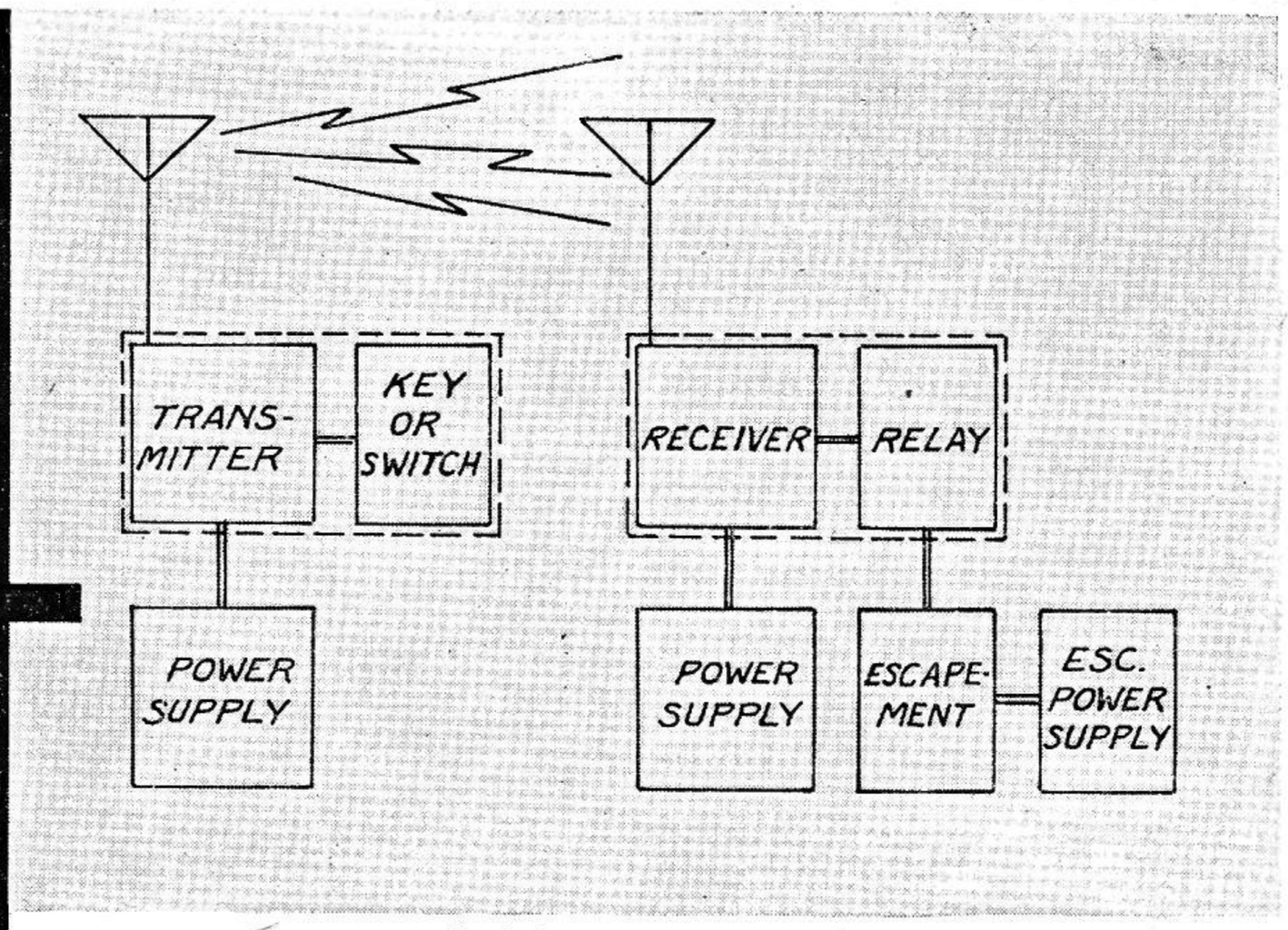


Fig. 1 Basic radio control setup

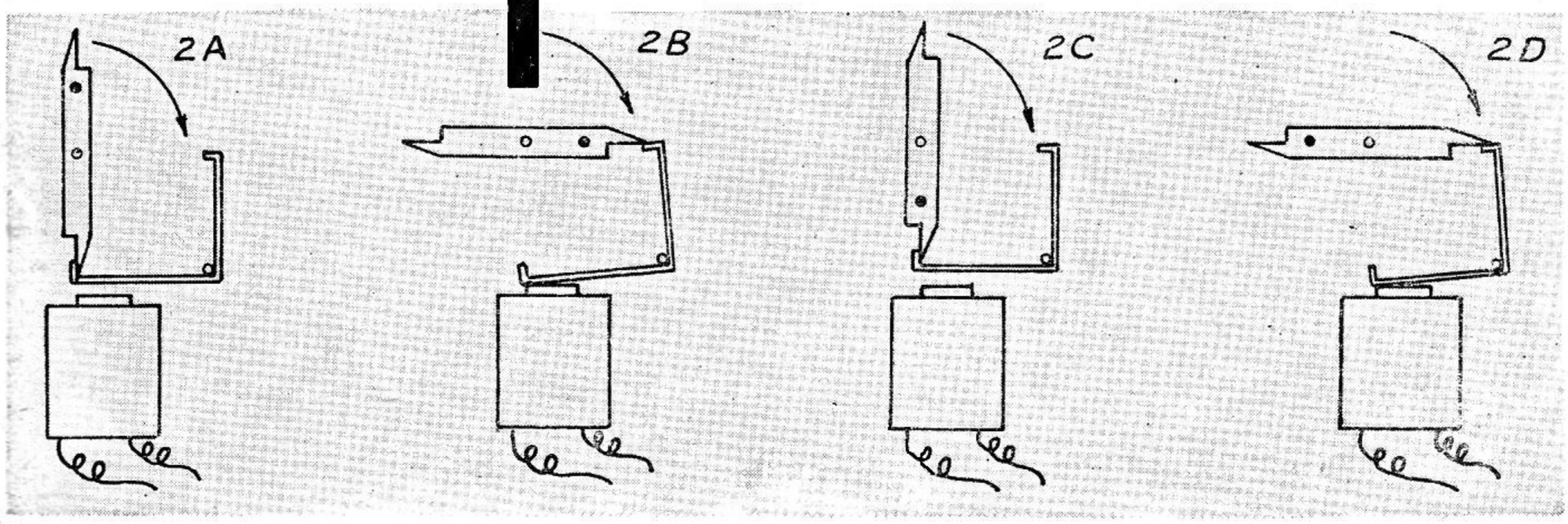


Fig. 2 Escapement sequence. Black dot on rotating arm represents pin that operates rudder arm

THE theory and practice of radio control is not new, dating back to pre-World War I days. The ultimate goal of every model builder is to be able to relax under a beach umbrella and, just by pushing a button, have his model respond to his every wish. This all sounds fine, and someday it will be just as simple as that. However, it is our aim here to point out, in non-technical terms, what can and cannot be done at present . . what kind of plane is needed . . and the answers to those other perplexing questions asked by the person just starting in radio control.

First of all, in any radio work we need a signal generator or transmitter. This is an electrical device for producing the high frequency electrical impulses that are sent out over the transmitting antenna. At present, the most widely used frequency is the 6 meter Amateur band of 50 to 54 megacycles. This means the transmitter is capable of producing a current that alternates 50 to 54 million times a second. The term "carrier frequency" refers to the basic frequency of the transmitted radio signal. The term "channel" as applied to radio control means that ordinarily, as in most commercial units on the market, only one carrier frequency is used. Hence, one transmitter and one receiver would be a single channel unit. For two or three channel operation, two or three transmitter-receiver units would have to be used. The term channel could also apply to one radio frequency carrier, upon which have been superimposed one or more audio frequencies. More will be said about this method later.

In order to pick up or detect this carrier frequency that is sent out over the transmitter antenna as the key or button is pressed, a receiver is needed. Whenever a receiver is tuned to a particular transmitting frequency, certain things happen in the receiver which change the amount of current flowing in the plate circuit of the receiver tube. Since this change is only a thousandth part of an ampere, a very sensitive relay is needed which will respond to this very small change in current. The relay acts as a switch between the receiver proper and the actuating device. In order to make a sensitive relay, many many turns of very fine wire are used to wind the coil. It is primarily the amount of work needed to wind this fine wire that increases the cost of this type relay.

Our prime purpose so far has been to transmit a signal, pick it up with a receiver and then actuate a relay on the receiver in synchronization with the keying of the transmitter. (Fig. 1). After the relay points make contact, due to the radio signals being received, our control becomes a mechanical and electrical problem.

The majority of control systems in use today employ an escapement for moving the control, whether it be the rudder, elevator, engine control or other device. An escapement is perhaps the lightest and simplest device and requires the minimum amount of batteries. The action of such an escapement is shown in Fig. 2. This particular type is self-neutralizing; which means that as the operator's finger is removed from the keying switch, the control automatically returns to neutral. A four arm escapement is also used but requires an extra impulse to make the change from left or right, back to neutral. Fig. 2A shows the escapement in a neutral position, with no current flowing through the coil.

When a signal is sent out into space and picked up by the receiver, the points of the relay close, thereby completing the circuit between the escapement coil and its batteries. This pulls the armature down and allows the arm to move to position 2B. A rubberband supplies the torsion power to the arm. The pin on the arm thus moves from neutral to right. When the transmitter goes off the air, the signal is gone and the relay points open, thereby cutting the current off the escapement coil. The arm now swings around to neutral again as shown in 2C. The next time a signal is received, the

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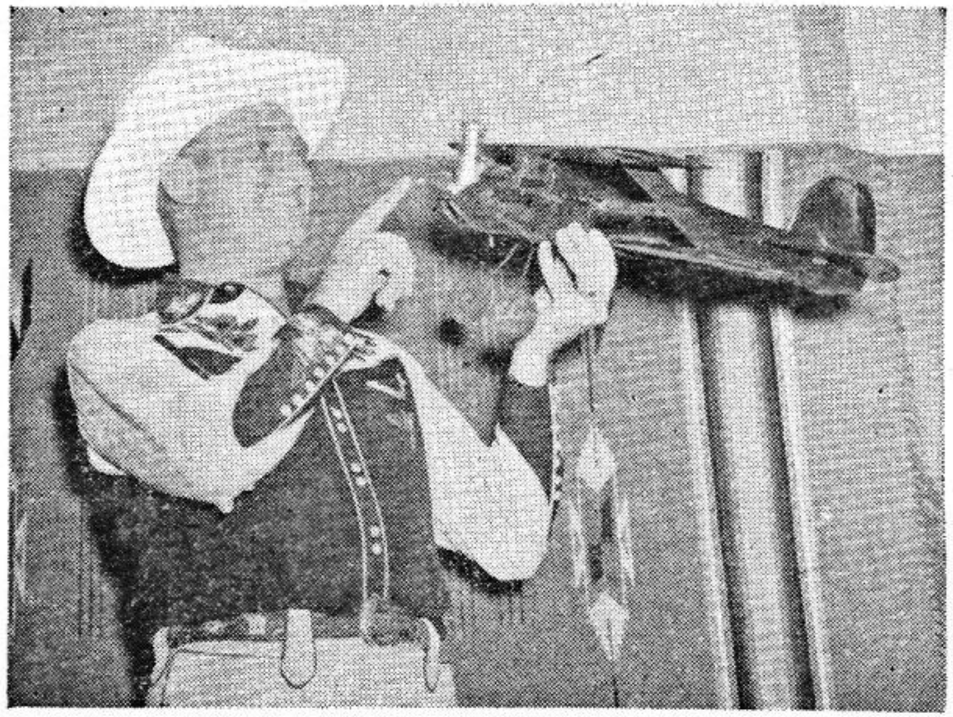
same procedure follows and the arm and pin continue around to the left, 2D. When the key is again released the arm returns to 2A. If a yoke is placed over the pin and pivoted at the control hinge, a neutral to right to neutral to left and back to neutral movement will occur as the arm rotates. This matter of going through this sequence at all times should be of no concern since the movement is too rapid to have any noticeable effect on the flight path of a plane or on the path of a boat.

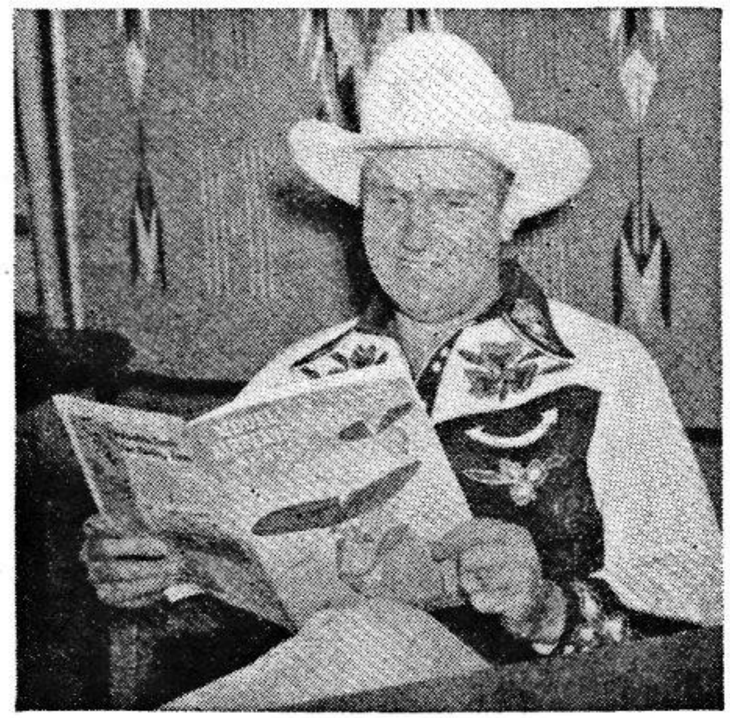
Two pencells in series will supply power to the escapement for several 15 to 20 minute flights. Small electric motors, suitably geared down to 6 to 10 rpm's may also be used. These of course will place a larger drain on the power supply, thereby necessitating more or larger cells. If one can tolerate the extra weight and size of the additional equipment needed to use an electric motor, a motor will make an ideal method of moving controls. With an electric motor actuating the control, the control may be stopped in any position and may be placed on either side of neutral, consecutively, without going through the sequence required with an escapement. Using an electric motor in



**Famed cowboy star Gene Autry has a great interest in all phases of aviation. Below we see him catching up on the latest angles of model plane work. At left he examines a new experimental *Micro Diesel* mounted in a *Dmeco Bipe*. Gene owns a *Beechcraft* and has added up over 2500 hours flying time**

such a hook-up usually requires two receivers, one to close the circuit so that the motor runs in one direction and the other to reverse the current to run the motor in the opposite direction.

One phase of radio control that has not been fully developed as yet is audio control and pulse modulation. As you have learned in physics classes, audio frequencies are those that fall within the range which can be heard by the human ear, roughly between 16 and 15,000 cycles per second. By super-imposing one or more audio frequencies on a single radio frequency carrier, at the transmitter, we have the equivalent of several channels. The main difficulty with such a system is with the receiver, because of the filters needed to separate each audio frequency through its own relay. Until recently such an audio system weighed approximately



4 to 8 ounces per channel, not counting the weight of the receiver-detector circuit. In addition to this, larger batteries also added to the total weight. In recent months, however, smaller components have become available, with which a single audio channel receiver may be built to weigh as little as 1¾ ounces. Much experimentation still will have to be done along this line, but audio control may definitely be the coming thing.

Pulse modulation is a system whereby the regular radio frequency carrier is interrupted at a low frequency rate. Since this is not a technical article, we will not go into detail on this system, but it has the advantage of providing what is known as proportional control. Instead of a button or key, a small control stick similar to that used in a large plane is employed. The controls in the plane follow the same movement as the stick on the control box. Needless to say, this is as near the perfect answer to complete radio control as can be imagined. Perhaps the most famous designer and exponent of this system is Jim Walker, who won the R. C. event at the '46 Nationals using proportional control. Second place winner George Trammell at the '48 Nats used a simplified form of proportional control. (See M.A.N. June 1947 for description of equipment used by Trammell.)

Don't get excited over such a system, however, and start visualizing a multi-engined job having everything but hot and cold running water. A unit like this is not so simple and it is heavier and bulkier than most commercial units on the market today.

For those who intend to buy their own equipment, we'll give just a summary of what is available. Many components used

in commercial units are not readily available to the individual who wishes to build his own unit. All the sets that will be described here have been advertised in the leading model magazines. The first unit to appear on the market was put out by Radio Control Headquarters and did much to promote radio control among model builders. Both escapement and electric motor controls are available with this unit. Next appearing was the Good Brothers unit, produced by Beacon Electronics. This unit is similar to the one that has won them many contests and skyrocketed them and radio control about to the point where it is today. The Bell Sound System next put out a unit which was a little ahead of its time as far as design is concerned. Although it is larger in size and heavier than most other models, it is the ideal unit for a boat. The latest to appear on the market is the *Aero-Trol* set, produced by Aero-Spark. This particular unit has appealed to modelers because of its very small size and extremely low weight. (Receiver weighs less than 2 ounces.)

All of the units mentioned, with the exception of the Bell unit, are of the single channel type using an escapement to actuate the control. The Bell unit uses an audio-pulsed circuit and has an electric motor to move the control. This in effect is similar to two channels.

It is believed that the present amateur frequencies will be the only ones available for radio control work for at least another year, perhaps longer. The much talked about license-free bands and the Citizens' Radio Service band present design and construction problems that must be overcome, due to the nature of the high frequency of 462-648 megacycles. When these new units eventually reach the market radio control will be wide open and someday will enjoy the popularity now held by U-control models. Until then, the radio control fan would benefit himself and this rapidly gaining phase of model building if he would concentrate on developing various types of control actuating devices. An outstanding example of this is the development of the Rudevator (see M.A.N. July '48, p. 32). Keep your control device simple, lightweight and economical on battery drain.

The first radio control contest of 1948, and so far as is known the first of its kind anywhere in the country, was held at Valley Stream, New York on May 2. The contest was liimted to radio controlled planes and a payload event. The R. C. event had 8 entries and was won by Joe Raspante, who used a set of his own design employing an RK-61 tube in the receiver.

After the wind subsided, towards evening, Fran McElwee flew his Drone-powered model with an Aero-Trol control unit. This 5 ft. model showed excellent control and executed various turns, spirals and spins using rudder control only. Magee's Model Shop of Mamaroneck, N.Y., had a two channel unit installed in a *Buccaneer* with rudder and engine control which had excellent response on the ground. The ship was not flown since it had not been test flown previously and no chances were taken with the stiff breeze. All in all, this one contest showed a bright future for radio control and emphasized the fact that rudder control alone is sufficient for excellent flights.

The 1948 Nationals had the best R. C. turnout since the event was inaugurated. Jim Walker proved his years of experience with R. C. by winning first place. As mentioned before, G. Trammell took

2nd place. The latter used a proportional type control, while Walker used what he calls a *Pozzipo* unit. The other contestants used stepping relays, multi-channel units, and the old reliable escapement type of control. This one contest alone did more to stimulate R. C. than all the rest of the National contests combined. As this is going to press, there are rumors of a license free band radio control unit being developed that may hit the market by this spring. Miracles should not be expected from these free bands, but at least it will give the modeler something to work with, and allow more modelers to take advantage of this interesting phase of modeling.

The author hopes to be able to cover all commercial radio units on the market now, including several English jobs, in an article to be printed in M.A.N. soon.

In closing this brief summary of the essentials of radio control, the modeler should first determine the type and size model he wishes to build. Next, check all available units on the market, and the prospects of building his own set, to see that the radio set fits the plane, just as the proper size engine is needed. After building the plane and installing the radio, plenty of flying experience is needed to get maximum performance. A few extra hours spent in practicing turns and spirals will pay off at the next contest.

**NOTE—Readers interested in radio control may obtain a list of articles on the subject which have appeared in past issues of this magazine by sending their request to our editorial offices.**