R/C PRIMER:

Moving the Control Surfaces—II

In this concluding report AT's R/C columnist covers the very fascinating field of proportional control

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■ In our recent July issue the opening "primer" article outlined the basic methods of moving the control surfaces of a modelplane equipped with a radio receiver. Without getting too technical we moved down the line to proportional control—a subject of much interest to would-be R/C'ers, but one which has been obscured frequently by too much mumbo-jumbo. Let's see how simple we can keep an explanation.

There are several types of control that might be called semi-proportional, which are very simple, yet have considerable advantage over the plain motor drive, such as that illustrated in Fig. 1 of previous article. Suppose, for example, that the equipment in the plane be changed slightly to that in Fig. 8 shown here; at the transmitter, instead of a plain pushbutton, we add a mechanism to turn the transmitter on and off continuously, the on and off portions of transmission being of equal duration.

If this equipment were connected to the transmitter and set into operation, the motor in the airplane would go forward and back so rapidly that the rudder would hardly move. If the transmitter were keyed to send a steady signal, the rudder motor would be able to move to the left, let's say, while if cut off entirely it would move to the right. The movement could be stopped and held at any desired degree of rudder deflection by turning on the pulsing mechanism.

Such a system is quite satisfactory and can give very good results. Some flyers have built the pulsing units from relatively inexpensive electric train motors, using the gear train supplied, and simply filing one wheel flat to act as a cam. A pulsing speed of around 200 per minute is a good average to start with. A lever-type switch that has three positions may be hooked up as in Fig. 9 to give the required results.

For such use, it is desirable to fit the motor in Fig. 1 with what are termed limit switches. These switches stop rotation of the arm on the gear box at a definite position each side of center. Connections of the switches are such that when the arm is stopped at one limit, the motor can always be made to turn back the other way.

Another approach to proportional control is possible with the simple magnet-operated rudder of last article's Fig. 2; the stops must be reset so that full signal will give, say, left rudder, and no signal, right. Using (*Continued on page* 54)

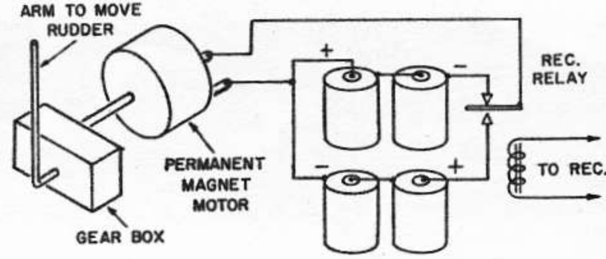

Figure 8

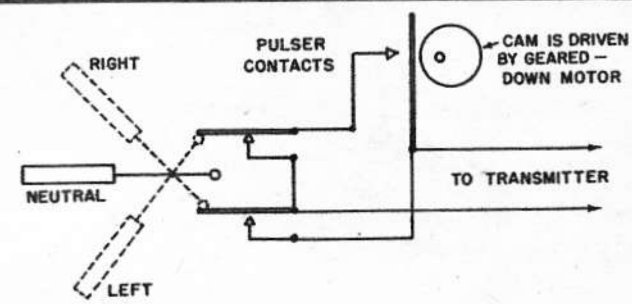

Figure 9

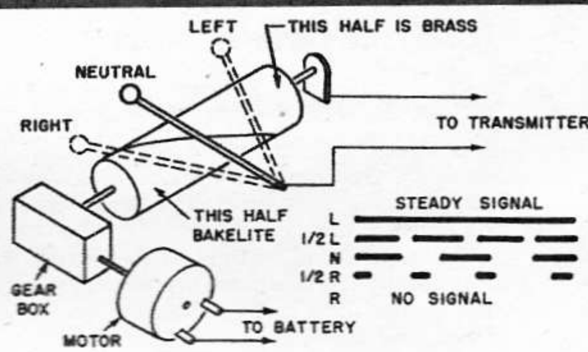

Figure 10

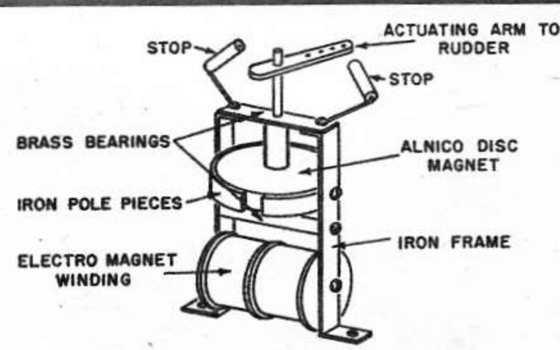

Figure 11

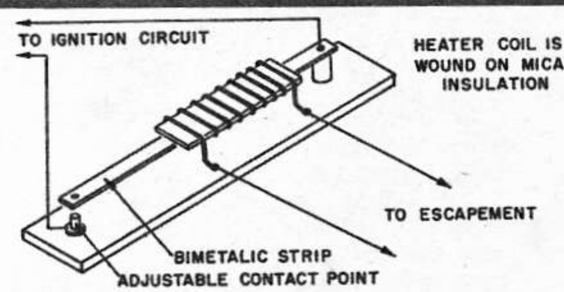

Figure 12

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the transmitter control in Fig. 9, the same sort of operation as that obtained from the plane equipment of Fig. 8 might be had; however, you could have only neutral (equal on-off pulsing) or full right and left rudder—there could be no intermediate stops as with the geared-motor drive.

Addition of an arrangement at the transmitter that could give not only equally spaced pulses for neutral, but also pulses varying in any desired ratio of on-to-off signal would allow the rudder to be moved to any desired deflection either side of neutral and held there as required. A simple way to produce such pulses is depicted in Fig. 10.

This device (first put to practical use as a control for German glide bombs during the last war—they called the controller a "*Knupple*") consists of a motor-driven drum that is half metal and half insulation. Driven at 200-300 rpm by a geared-down motor, it can easily be seen that with the control lever (which is actually one side of the transmitter-operating circuit) in the central position, the pulses and spaces will be equal, and we have neutral rudder. Move the lever half-left and the pulses would lengthen as shown by the bar lines in Fig. 10. Full left lever position would be a steady signal and you would have full left rudder; full right would be no signal and full right rudder.

The same transmitter control would work with the rudder motor drive of Fig. 8, but couldn't be called real proportional control, since it would not be self-centering; various degrees of movement of the control lever either side of center would simply produce different speeds of rudder motor operation. Centering the control lever would hold the rudder in any desired position. The airplane rudder-operating equipment could be modified to give a closer approach to proportional operation, but the added complications are too detailed to describe here, and the magnet-operated rudder system is much simpler and more practical for a first try by the novice at radio control.

Many experimenters with "proportional" are getting good results from a type of rudder moving mechanism called simply an "actuator." This was worked out by George Trammell, one of the pioneers in simple model plane proportional control, and has been built in many sizes and forms. One style shown in Fig. 11 is essentially an electric motor without a commutator, which can only turn about 90 deg. each side of center, or neutral. It has the advantage that power is very good, while current required is quite low.

It may seem that you are getting something for nothing in proportional control, since you can have right or left rudder in any desired degree on a single conventional radio channel. There is a fly in the ointment, though, and it's only fair to warn the uninitiated of it at the outset. As we have seen, with either the geared-motor or the magnet style of rudder drive, steady-signal gives one extreme of rudder position, while no-signal gives the opposite extreme. What happens if your transmitter—or receiver—goes dead during a flight? You get full rudder and can't do a thing about it!

Hard-over rudder on most powered planes means impending trouble, to say the least. However, you can set things up so that a failure is not necessarily fatal. Since the airplane radio equipment is probably more apt to fail than the relatively heavy and rugged transmitting equipment, it is wise to connect your proportional control circuits so that a receiver failure (which in most cases means that the sensitive relay assumes the non-operated position)

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would result in a turn in the "safest" direction for your particular airplane. You can also set up your rudder stops so that rudder movement (in the direction that would result, should the receiver fail) is held within safe limits.

It is possible—and advisable too, though few flyers do it—to fit cut-off switches or reversing switches to the rudder actuating arm so that if the receiver fails, the rudder is made to swing automatically and slowly from side to side, or is made simply to take up a safe near-neutral position. If your receiver is of a type that gives a non-operated sensitive relay with *either* a receiver failure or no-signal from the transmitter (Rockwood and Citizen-Ship receivers are of this type) you can protect yourself against both transmitter and receiver breakdown—also against inadvertent flying out of range.

(*To be concluded.*)