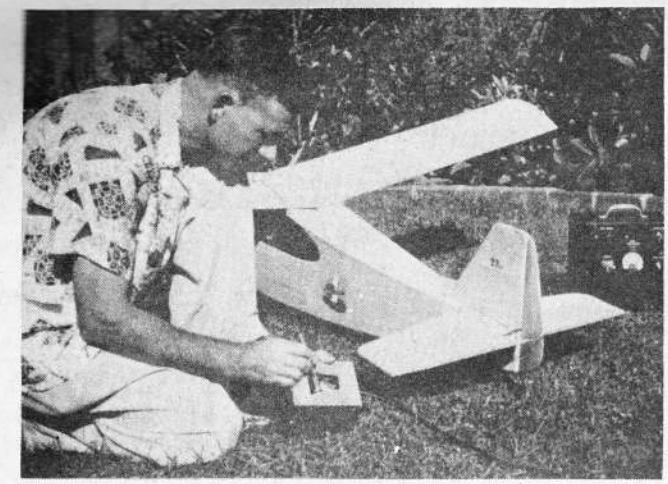


Robert Trainer, now of Temple City, Calif., seen when he operated as member DC/RC Club (Washington, D. C.). His D-S-P's not hard.

Bob Trainer's Improved Dual Proportional Control System

"Dual-Simultaneous" Radio Control is here to stay; tho Bob's intermediate setup is more advanced than Kuehnel's, it's less complicated than Doc Good's

Editor's Note: Many readers made copies of the Simplified Dual Proportional Control System, printed in the April 1955 issue of A.T.H. Most worked well, but some didn't. A large proportion of the failures were caused by use of actuators that would not give the necessary "kick" upon which the system is based.

Since it seems that the pulse rate and pulse length systems will continue to offer about the easiest means of obtaining Dual-Simultaneous Proportional control, we show here details of an entirely different means for obtaining the same sort of control action; with this system, however, any type of actuator may be used, and relay adjustment is not at all fussy.

The author has been flying this setup since 1953, and has refined it to the point where it is about as "fool-proof" as anything of this complexity can be. Several copies made by his fellow club members have also worked just as well. We feel this system fits in as a sort of intermediate step between the simple Kuehnel arrangement, and the more advanced Good Dual-Simultaneous control; the latter described in "A.M." offers certain advantages over the pulse rate-length controls, but is considerably more complex, and requires special transmitting and receiving equipment.

The Trainer circuit shown can be used with most any transmitter and receiver which will produce and follow the necessary pulse changes, so is ideal for those who want to try D.S.P. control with existing apparatus.

■ The control system described can be applied to practically any R/C transmitter-receiver combination, the only point to watch being that the circuit can follow the necessary pulse rates. The components were chosen to allow the desired range of up-down elevator with a pulse rate change from about 2 to 8 pulses per second.

This system has been used with the WAG non-selective audio tone receiver, which was originally designed not to respond to very rapid pulses; the receiver was easily adapted to the job by reducing the grid to ground condenser on this receiver from the original .001 mf to .0001 mf, and adding an 8 mf electrolytic condenser from B plus to ground.

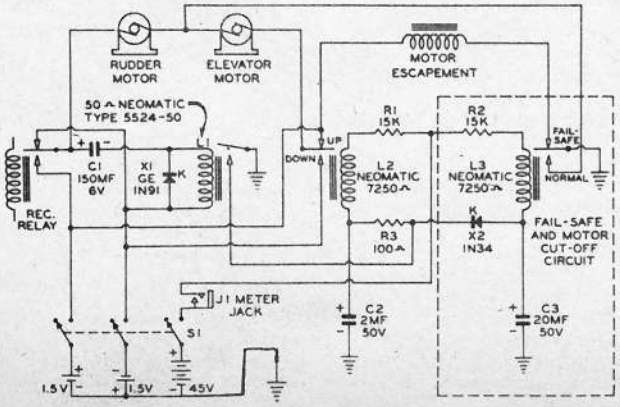
If your receiver won't follow the pulses fast enough, the rudder neutral will shift as the pulse rate is changed; also, as the pulse rate is shifted to the high rate (which normally gives Down elevator) the elevator might jump to full Up!

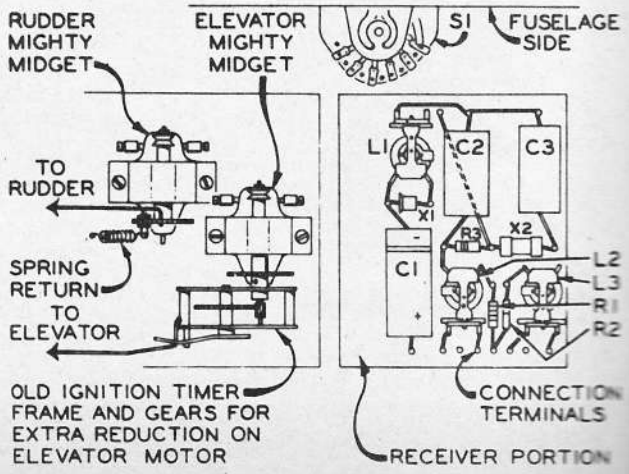
As with most of the rate-length systems seen so far, pulse length is used for the rudder and rate for the elevator. It doesn't make a great deal of difference whether long or short pulses are used for right or left rudder, but slow pulse rate is usually employed for up elevator. A basic part of this system is a Fail-Safe arrangement whereby the two controls are neutralized (and motor cut-off applied if desired) when pulses stop entirely, or a solid signal comes in. Thus heavy interference, transmitter or receiver failure, flying out of range and similar torubles will trigger the Fail-Safe circuit. The latter can be utilized for motor control, by fitting the pulser with a button to cut the signal entirely. Or, the Fail-Safe circuit may be omitted entirely by eliminating parts R2, X2, L3 and C3, and connecting the L3 contact which is marked "Normal" to the ground. If this is done, signal failure will give hard-over rudder and full up elevator.

Power to operate part of the system comes from a 45 V B battery, and the same battery has always been used for the receiver. Average B drain will be about 2 ma, and this drops to a 1 ma average if the Fail-Safe circuit is omitted.

Operation runs like this: as the receiver relay pulses, relay L1 follows the pulsing receiving power from its operation from C1, which is charged up at each pulse from the 1.5 V supply which runs the rudder motor. The diode X1 across L1 prevents the latter from giving a kick when the receiver relay releases (that is, when the armature hits the contact against which it is shown in the drawing).

Dual control system shown below. At right is diagram of parts as installed in plane (also shown in photo on right hand page). Diagram covers components from left and right sections of photo.





Thus for every pulse that comes along, L1 will give a quick closure and opening, this action being the same regardless of the length or rate of the incoming pulses. This pulse is not enough to work the elevator motor, so it must be "stretched," this job being accomplished by R1, C2 and L2.

The latter three components are chosen so that neutral elevator comes when the pulse rate is about 5-6 PPS. At 2 PPS you should have about 80 percent Up, and at 10 PPS you have full Down. Minor shifts in the neutral elevator setting may be obtained by adjusting the spring tension of L2, but this isn't at all critical.

L2 kicks once for every pulse, but this relay has a slight lag, so that as the pulses get slower it holds longer on the Down contact, thus driving the elevator motor toward Down. A somewhat similar pulse-stretching circuit is used for L3, but this one is made to stretch so much that L3 will always be held closed (with the armature on the "normal" contact) for all normal pulse rates. This means that the pulser at the transmitter must be set so that it will never turn the transmitter full off or full on, unless you push a button to obtain such action. Normal practice is to "stop" the pulser control lever so you get about 80 percent and 20 percent pulses, rather than full on and full off.

All three relays, L1, L2 and L3 should be open or de-energized, when there is no signal coming from the receiver. If you tap the receiver relay armature, L1 should close and release immediately. L2 should release about 1/10 second later, and L3 about 1 second later. The same result should be had no matter how long you hold the receiver relay closed. During the instant that L2 is closed it should pull the elevator Down; if you get up instead, reverse the connections to the elevator motor or actuator—not the battery connections. If you flick the receiver relay about once per second, L3 should hold closed. That's about all there is to it!

The rudder and elevator motors shown are Mighty Midgets, and if pencells are used for the two 1.5 V supplies, at least three cells should be paralled for each. J1 is used to check receiver B current, since the same 45 V battery also supplies the receiver. All three battery circuits should be broken when the outfit is not in use, due to slight leakage in the electrolytic condensers. If your motor escapement requires more than 1.5 V, an extra cell can be connected in one lead right next to this escapement, where it will have no affect on other circuits.

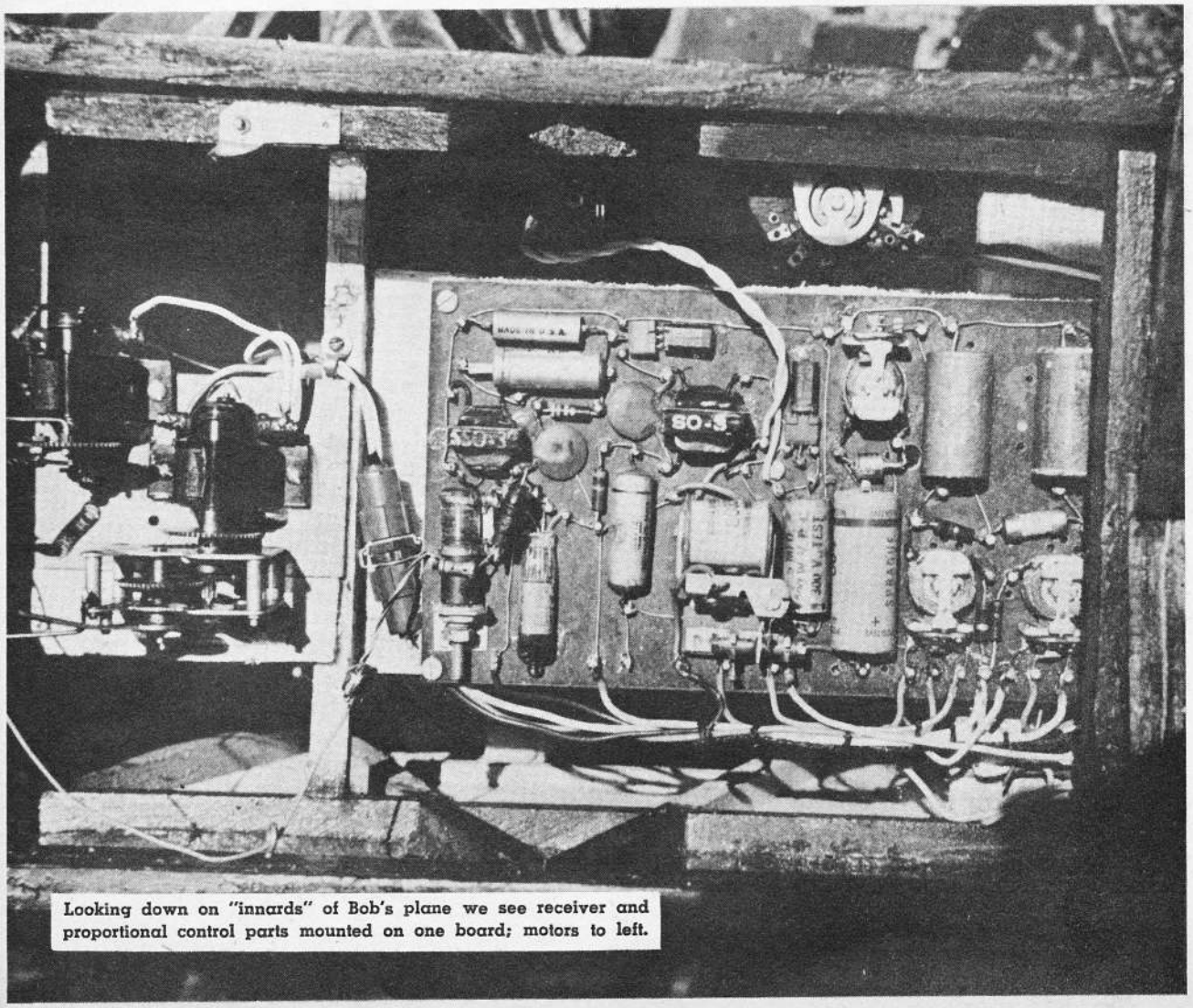
While a special low-voltage Neomatic relay is shown at L1, any small relay of about 50 ohms that will follow the pulses will do just as well.

Shown is the actual layout used in the author's plane. All the control circuits were actually mounted on the receiver chassis, but for simplicity's sake the latter parts have been left out of the drawing. The two motors are on their own little chassis. Layout of parts in the control circuit is not in the least fussy, of course, and is just shown here as a general guide (don't try to follow the connections on Drawing 2, since quite a few of them are not shown—they are on the underside of the chassis!).

The higher gearing on the elevator motor gives more power, but is mainly used to minimize "gallop" of the plane, which occurs at the low pulse rates. Don't gear too high though, as you will get a lag in elevator action that defeats the whole purpose of this sort of control system.

One last hint: it is strongly suggested that first flights be made with rudder only, especially if you have never flown proportional control before. The elevator will just get you into trouble at this stage, even if it works perfectly!

For the most informative, interesting and easily understood reporting on radio control modeling, read Howard McEntee's "Radio Control" Column in each monthly issue of American Modeler magazine. Affectionately termed "Mr. R/C" by thousands of loyal followers of his radio writings, Howard covers "everything under control."



Looking down on "innards" of Bob's plane we see receiver and proportional control parts mounted on one board; motors to left.