improved pulse system

by E. PAUL JOHNSON

AFTER returning from the 1949 Nationals in Olathe, Kansas, happily in possession of Second Place in the Radio Control event and a whole head full of ideas. I immediately set to work to improve my simple pulse control. Half the fun of competing in the radio control event is meeting the other contestants and discussing and exchanging ideas with them; and believe me, the number of ideas was outstanding. Proof of the practicalness of these new ideas is the fact that not over three or four of the thirty-one entries got out of control. This is really some record when you consider that nearly half of the 17 entries in 1948 went out of control.

One thing I wanted to incorporate in the new pulse control model was a second control, preferably for two-speed motor operation. The single control I was using for rudder suited me fine, but I desired also to vary the speed of the engine. I considered installing a second receiver in the plane and using a second transmitter on the ground. On advice of such well-known radio control pilots as Good, Foxworthy, Hughes, and Brown, I discarded this idea as being impractical. It is virtually impossible to operate two receivers simultaneously on the 50-54 mc. band without interaction. By using some of the ideas I picked up at the Nationals, and using a few of my own, I was able to develop a really practical second control. As I stated before, I desired two-speed motor operation and this second control works out fine as such, but it can also be applied to elevator control, parachute dropping, bomb dropping (for the Navy's new 1950 Nationals events) etc. Another goal was to do away with the necessity of winding a long rubber motor for the control system, before every flight. I am happy to say that this inconvenience is also very successfully overcome.

First, a short review of my original pulse control unit as described in my article in July '49, M.A.N. This will acquaint the reader with how the system works. I will go on from there to describe the improvements I have made on it.

The signal from the transmitter is pulsed on and off at the rate of one or two pulses a second. This pulsing is done by an HO gauge train motor and gear train operating a micro switch, the speed of which is controlled by a power rheostat. This signal can be held on steadily or turned off completely by means of a three-position toggle switch. Thus the center or neutral position of the toggle switch allows a pulsed signal to be sent from the transmitter. Turn the toggle right and a steady signal is sent out. Turn the toggle left and no signal is sent out. In the airplane the signal is received by the radio receiver and causes the escapement in the tail to be activated and de-activated at the rate of one or two times a second. The escapement is modified so that during signal-on, the rudder is in right, and with signal-off the rudder is in left position. When the rudder is turning right and left one or two times a second the plane flies straight. When the toggle switch on the transmitter is turned right and a steady signal is sent out, the escapement in the plane is activated, causing right rudder and the plane goes right. When the switch is turned left, no signal is sent out, the escapement in the plane is de-activated, causing left rudder and the plane goes left. Thus the plane follows exactly the positions of the toggle switch and cannot get out of sequence.

Eliminating the escapement proved to be very simple. It was one of those things that are so simple they are overlooked and thus appear difficult. I merely replaced the escapement with a small reversible D.C. motor. Of course an addition had to be made to the motor to make it practical; I put a small crank on the motor shaft, similar to those on an escapement. Now I ran into the same problem that I had so many times before; how to stop the motor in full left or right position.

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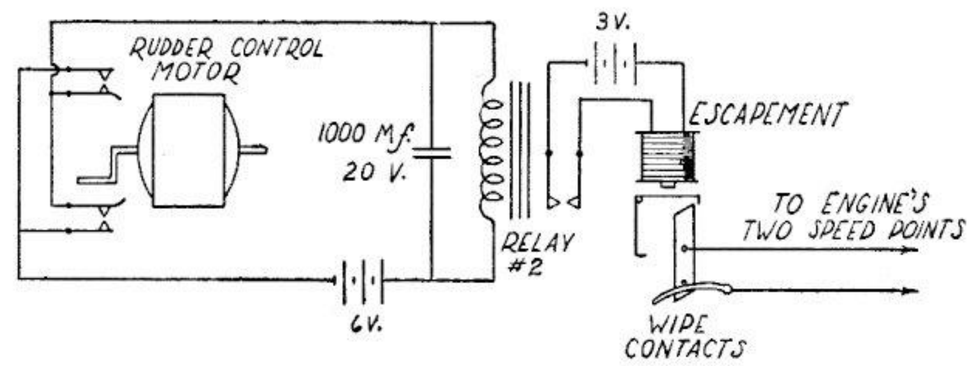
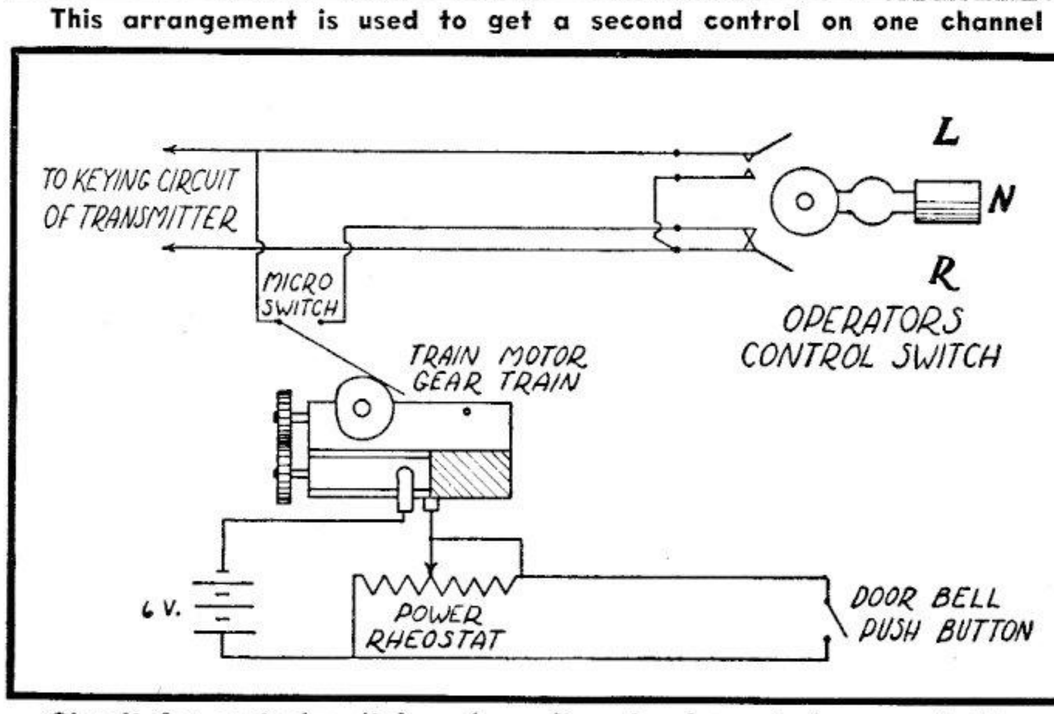
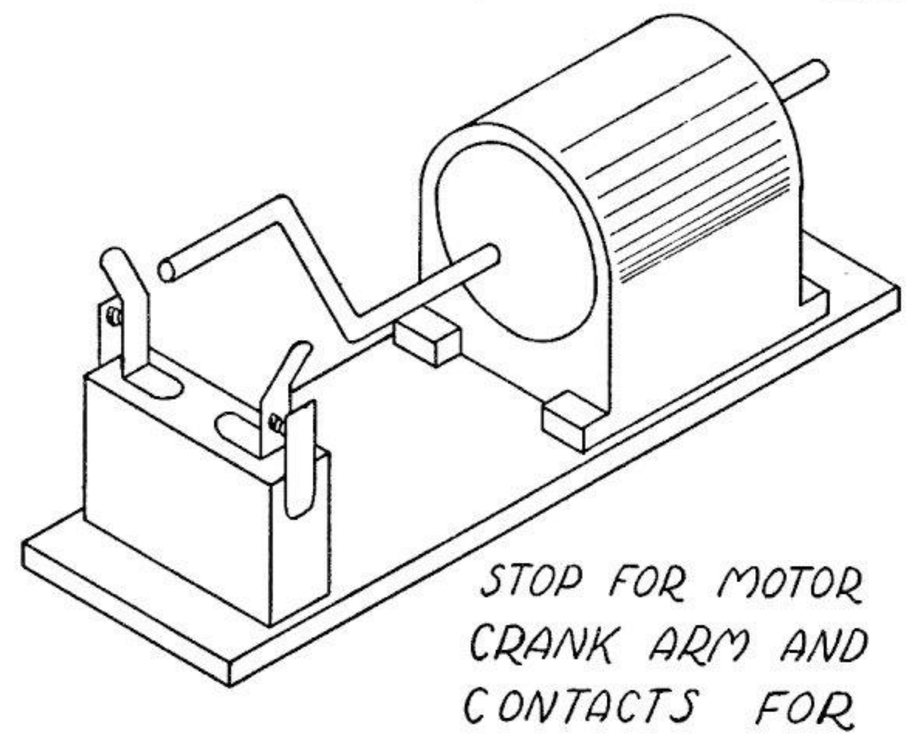
The author with his modified *Rudder Bug*



This arrangement is used to get a second control on one channel



Circuit for control switch, pulse unit and pulse rate increase button.



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Then the simple solution came to me. I merely mounted a block of wood so it would stop the motor crank in full right and left position. Thus the motor could turn only 180° each way. The current a D.C. motor draws, when it is locked so it cannot move, is fairly high and I was afraid the battery drain might be excessive, but I have found through experience with this system that I don't have to change batteries any oftener than I did with an escapement.

One of the troubles encountered by many radio control fliers, when using an electric motor for control purposes, is that the motor transmits a signal to the receiver, thus keeping the relay closed. These small D.C. motors do transmit a weak radio-frequency signal that will actuate the receiver if the two are placed adjacent. The easiest solution is to place the motor as far from the receiver in the plane as is practically possible. I have mine mounted about half way between the receiver and the tail of the plane and have never encountered any trouble from this source.

After eliminating the objectionable necessity of winding a long rubber motor before every flight, I set to work to incorporate a second control. I first tried an inductance method similar to the one described by George Trammell in his article in July, 1947, M.A.N. I had fair luck with this system but it wasn't exactly what I wanted because the relay setting was too critical and a small decrease in battery voltage resulted in the necessity of readjusting the relay.

The method which I finally worked out and the one which I am using at present with very good results, is a capacitive circuit. The relay setting is not at all critical, because the current is either on or off, and thus the relay does not operate on a change in the amount of current, as in other control systems. The relay I use is one sold in all model shops for remotely controlling the engine speed on U-control models; it is mounted on a piece of sponge rubber in the plane to prevent motor vibration from affecting it. This relay should not be confused with the sensitive relay on the receiver. It is a separate unit that is used only to operate a second control. To prevent further confusion with the receiver relay I will refer to this second relay from now on as relay No. 2.

A 1000 mf. 20 V. capacitor is hooked in parallel with the winding of the relay No. 2. When a voltage is applied to this winding it not only activates the No. 2 relay but also charges the capacitor. If the activating voltage is removed from the No. 2 relay, the charge in the capacitor will keep the relay activated for about three seconds. The pulses sent by the transmitter are at a rate of about one or two a second; thus if an activating voltage is applied to the No. 2 relay at every pulse it will remain activated because the charge in the capacitor keeps it operated between pulses.

I mounted a set of contacts on each side of the small electric motor that operates the rudder, so at every pulse right and every pulse left these contacts are closed by the motor arm crank, sending a voltage to the No. 2 relay and capacitor. If the rudder is held in the right position, the right-hand contacts are held closed and the No. 2 relay remains operated. In full left rudder position, the left-hand contacts are held closed and the relay still remains operated. As long as the pulses are kept slow (about one or two a second) the motor arm will swing full right and full left thus sending an activating voltage pulse to this relay winding, keeping it activated. However, if the pulses are speeded up to between five and ten a second, the motor arm will not swing full right or left but will practically stand still in the middle. Since the contacts are only closed on full right or left, no activating voltage pulses will be sent to the No. 2 relay. It is only necessary to speed up the transmitter pulses for three seconds at the end of which time the capacitor across the No. 2 relay winding will discharge, and thus allow the relay to de-activate. The contacts will then close and operate any second control that is connected to them.

For speeding up the transmitter pulses I use a doorbell button connected across the power rheostat. Since the power rheostat controls the speed of the HO train motor, closing the doorbell button shunts out the rheostat, allowing the train motor to turn at full speed. Releasing the button causes the train motor to resume slow speed. The slower pulses again allow the rudder motor arm to swing full right and left closing the contacts and activating the No. 2 relay. Thus every time the button is depressed for three seconds, the second control is operated.

This system works fine for glider release, bomb dropping or the like, but does not work out too well for two-speed motor control without further additions. The reason is that if the No. 2 relay contacts were connected to the airplane engine's two-speed points, the engine would go into low speed every time the bell button was depressed, and immediately return to high speed when the button was released. A better method would be to have the airplane engine go into low speed when the button was depressed and released, and stay in low speed until the button was depressed and released again. To get the control system to do this, I connected a rubber-powered escapement across the No. 2 relay contacts. Every time these contacts are closed the escapement operates once. A wipe contact is mounted on the escapement arm so that it closes the points in one position and breaks them in the other. Now when you depress the doorbell button once for three seconds and release it, the escapement operates and closes the wipe contacts which are connected to the two-speed points. The engine goes into low speed. Depress the button again for three seconds and release it. The escapement operates again, opening the wipe contacts and the airplane engine goes into high speed.

This system is light and simple and easily constructed; any average modeler can make it. I have mine mounted in a small modified version of the *Rudder Bug* (May and June, 1949, M.A.N.) and the whole plane, equipment and all, only weighs 5-1/2 lbs.

I have used two types of D.C. motors for the rudder control. One is the small D.C. motor sold by Control Research and the other is one of the small plastic motors carried by most model shops. Both have worked out equally well. My radio equipment is "Good Brothers" throughout and the plane is powered with a K and B *Torpedo 29*.

We fly every evening and all day Saturday and Sunday, if the weather permits. Two other fellows I know have built up and are using this same system with equally good results. Try it yourself, I'm sure you'll like it.