ELEMENTS OF MODEL AIRPLANE RADIO CONTROL

A Radio Control for Your Motor That Will Give a High and Low Speed

Part No. 3

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AS WE promised in the last article, (Part II), we present here a scheme for motor speed control.

Its use requires the operation of a single channel transmitter only, so that for control of speed and direction a dual channel job such as shown in Part II will be required. It would be possible to control both rudder and motor over a single channel by utilizing a sequence switch at the receiver which would connect first rudder then motor in a fixed sequence. This would be very inflexible, however, and the real benefit and pleasure of this speed control can only come when the dual-channel system is in use.

It has always seemed to the writer that in addition to directional control, such as achieved by rudder or elevator movements, or both, it would be highly desirable to have *motor speed control* as well. This would call for some system by which the motor could be made to operate on at least two speeds, high and low. The low speed would not necessarily be idling, but slow enough so that the model would have insufficient power to climb or fly level.

One can well imagine the thrill of having such motor control, which in conjunction with rudder control (and a reasonable amount of luck), would enable one to practice landings just as though a real plane were being flown. In operating, the motor control would allow the operator to cause the ship to climb or glide providing proper adjustment of the elevator had been made. You could even "jazz the throttle" as the ship was coming in. In our opinion, motor speed control together with directional control would offer about the last word in thrills and realism.

The system worked out for this purpose is quite simple and requires no additional equipment beyond the ordinary receiver equipped with a single pole double throw relay, such as the Sigma 3A used in these experiments. A little work is needed upon the motor, but this is within the province of practically every builder, as only ordinary hand tools are needed.

The speed of a two cycle motor is best controlled by manipulation of spark adjustment, so the problem is simply one of changing the spark setting electrically. This could, of course, be done by a system of gears and a reversible motor, the latter hooked up in some such circuit as that of Fig. 1 D shown in Article I. This, while enabling full range control, would also introduce weight complications, so a simpler scheme was settled upon.

The circuit is shown in Fig. 1, and it will be seen that two sets of ignition points are used. These points are connected in the circuit at will by proper operation of the relay. The ordinary points as furnished with the motor are used for the high speed position, as they are engineered for best operation at full power. What we must do is to provide an auxiliary set of points to run the motor at a retarded speed.

This system has been tried only on a Brown Jr. Model B engine; the exact same system, of course, is applicable to all Brown Jr. types. The application of this principle is undoubtedly possible on the majority of gas engines on the market and will simply take a bit of headwork and smart designing by the prospective builder.

The auxiliary points, of course, are timed to fire the charge in a retarded position, relative to the normal or high speed points. The very first step in the process is to run your motor and find out about how far the spark may be retarded and still have reliable slow speed operation. The greatest drawback to slow speed operation is the mixture, which of course is adjusted for full speed work. The ideal would be to have the motor just tick over when on the auxiliary contacts, but this is quite impossible due to the simple mixing valves used. The best that can be done is to cut the speed in half. A model loaded up with radio apparatus certainly cannot climb very well on half throttle, so this serves our purpose very well. Under certain conditions a wider range of speed is possible and naturally the widest possible change is what we wish, *provided* the motor will run reliably on low speed and will pick up again when the relay moves.

Use of an auxiliary carburetor jet or air valve would enable better results and this will doubtless come later, but meantime, we must do the best we can with the necessarily simple and lightweight mixing valves at hand.

From all this discussion it will be appreciated that the preliminary testing is highly

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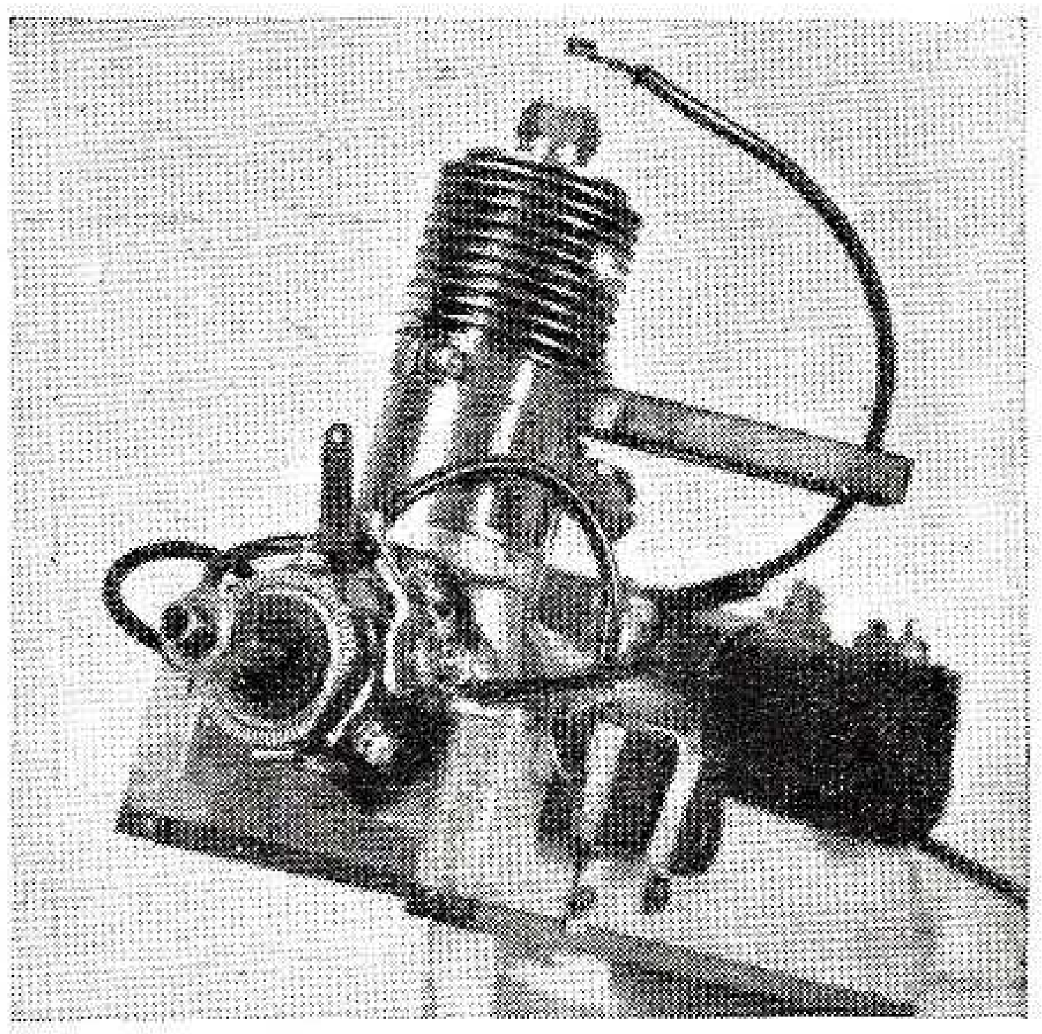

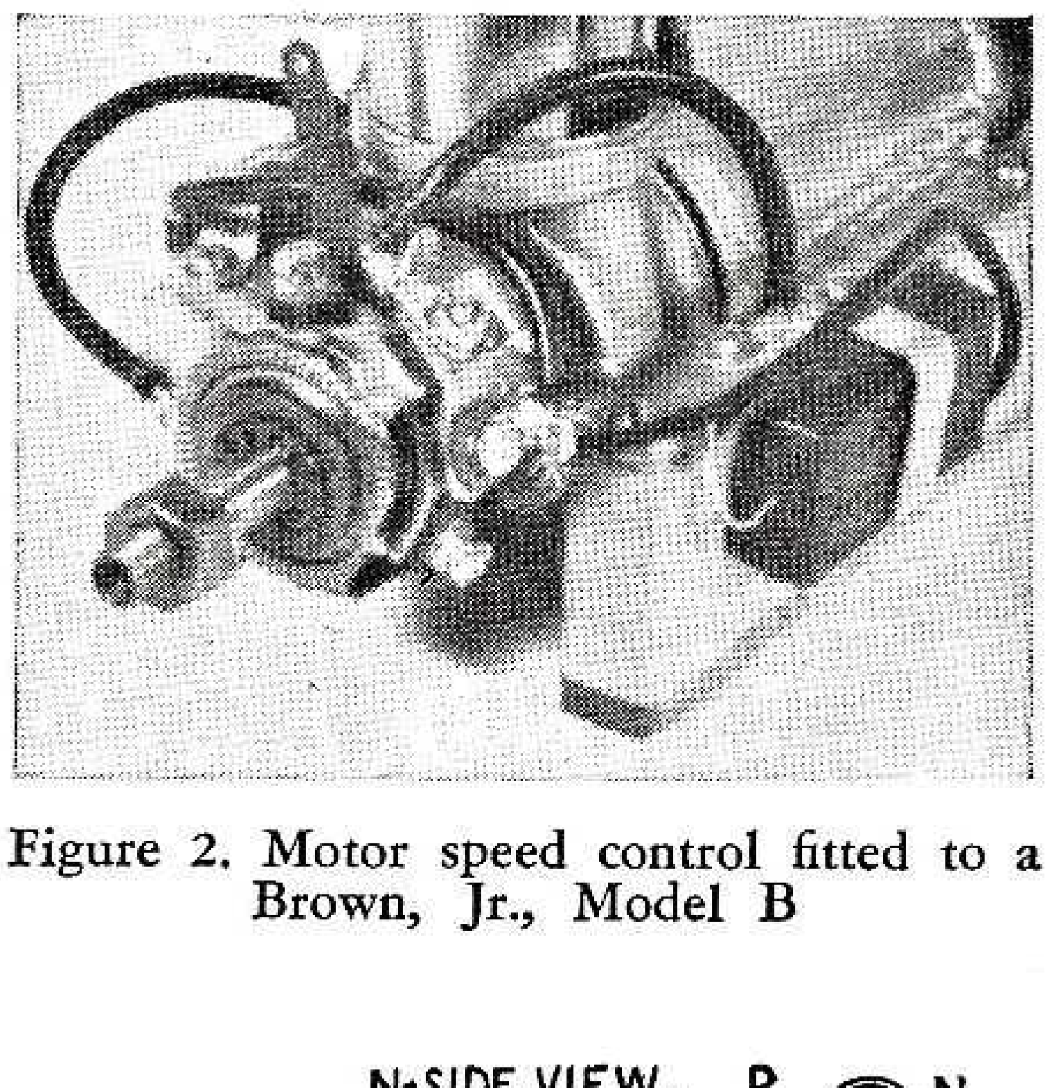

Figure 2. Motor speed control fitted to a Brown, Jr., Model B

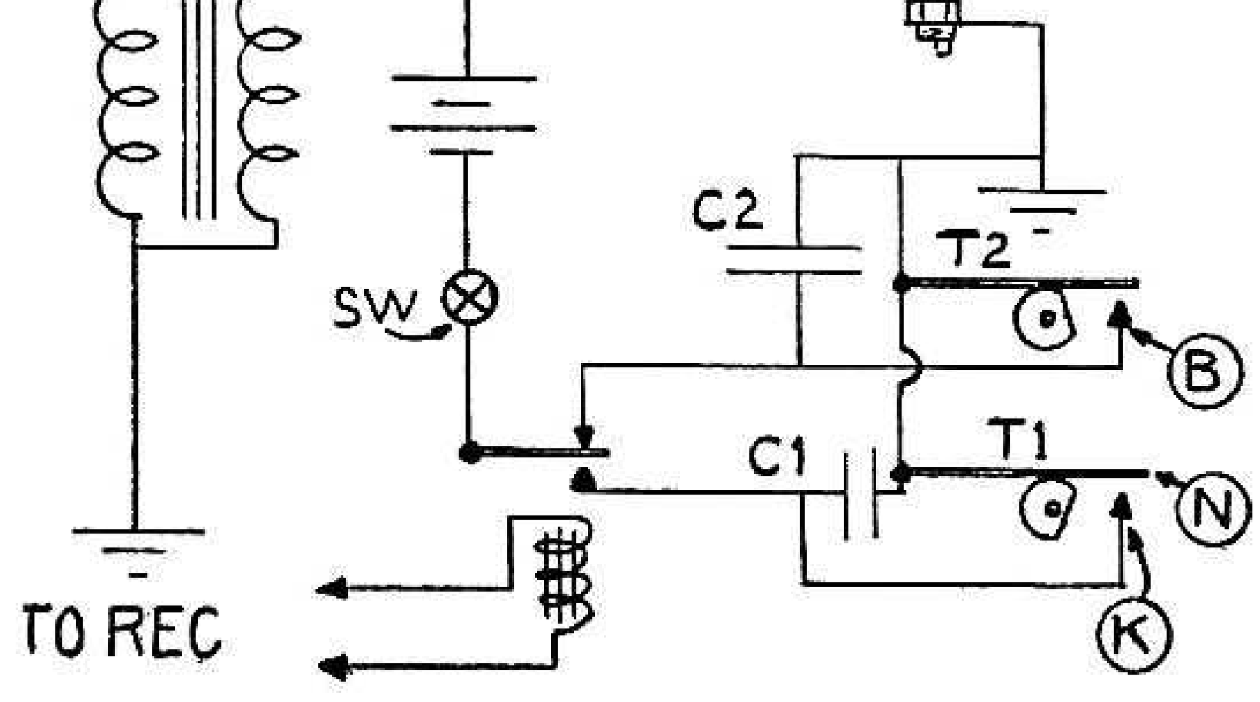

Figure 1. Connections for motor speed control. The relay is a Sigma type 3-A

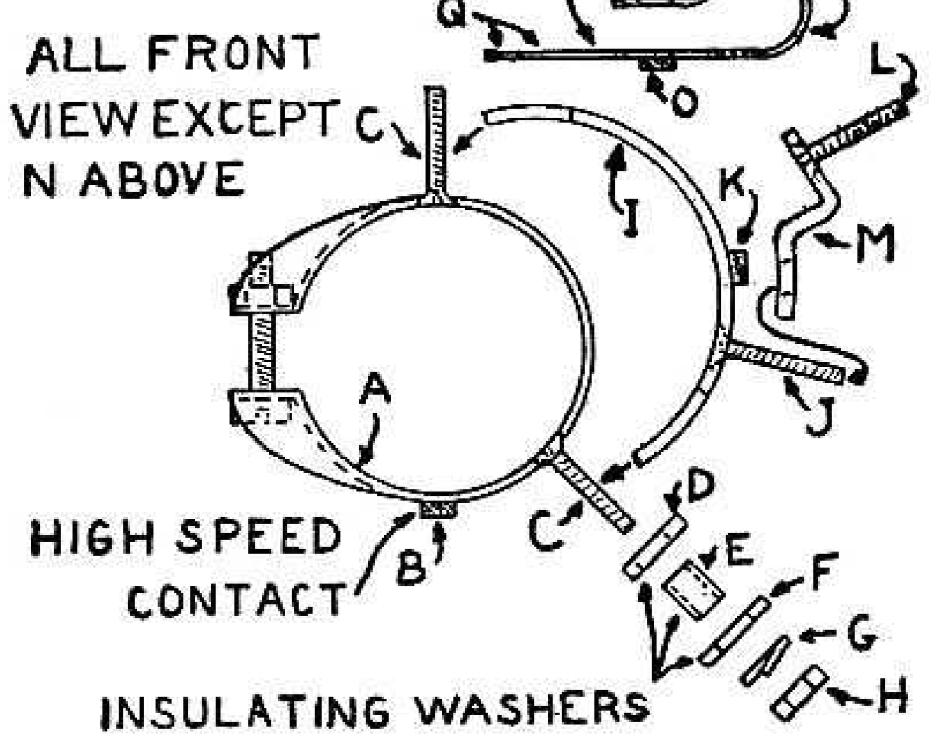

Figure 3. This sketch of the speed control is not to scale

The Bell XP-39 Pursuit Plane

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ing fields cannot always be the most select of places."

Already plans are underway for rapid construction of more of these ships to fill the Air Corps order which did not reveal the number to be purchased. Within a short period, however, the pursuit groups of Uncle Sam will be reinforced with the "greatest little ships that engineers have so far produced."

Elements of Model Plane Radio Control

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important. From it the constructor will be able to ascertain how many degrees the spark may be retarded and still retain reliable operation.

On the experimental motor it was found the spark could be set back about 10 to 13 degrees for "idling." The range was therefore made adjustable from about 5 to 25 degrees retard relative to the high speed points. The auxiliary points may be mounted directly on the motor frame and independent of the regular points, or the two can be mounted and moved together. The former is undoubtedly the best, as it allows independent control of each speed. However, it will be found more practical in some motors to fasten the auxiliary contacts right on the main breaker, this system being employed on the Brown Jr. shown in Fig. 2.

Details of the installation are shown in Fig. 3. This drawing is not to scale and the thickness of some of the parts has been exaggerated purposely to show hole locations.

Piece A is the regulation Brown Jr. contact point assembly, with the point itself indicated at B. Holes for the screws C-C are drilled in A. These screws are 2-56 flat head and may be 1/2" long. The metal around the holes in A should be forced outward from the inside so that the screw head will fit flush with the inside surface of A. Countersinking may be employed, but it thins the metal so that C is apt to be pulled through when the nut is tightened. Screws C-C are then soldered in place, preferably with Alumaweld solder, or any other kind that is stronger than the ordinary variety. Silver solder is not required, but something between it and ordinary "radio" solder in strength is advisable.

Next, piece I is bent from half hard brass at least 1/16" thick. It may be about 1/4" wide and is bent on a radius about 1/16" larger than that of A. I is slotted at each end for a length of 5/16" to 3/8", the slots being wide enough to fit over sleeve E.

Each screw, C, must have fitted to it a fibre sleeve, E, two fibre washers, D and F, and a lock washer and nut, G and H. D goes between A and I, E goes in the slot, and F outside of I, so that I is completely insulated from A and screws C-C. Any kind of insulation may be used for D, E, F, and in an emergency they could probably be made of tough cardboard with heavy paper for E.

Screw J is now soldered into I about 1/2" from the end. K is a contact point, which may be taken from an auto ignition repair arm or from a radio jack or switch. It is soldered to I.

Piece M is also of brass and is fastened on screw J with a set of insulating washers similar to D-E-F. Another 2-56 screw, L, is soldered to it.

The contact arm, N, is made of any springy material with steel having the preference. If possible, this piece should be hardened at point, Q, where it bears on the cam. N is fastened to M directly, without insulation and the proper place to fasten the contact point, O, so that it meets K squarely must be marked. O is soldered in place on N, then N is bolted to M with the arm running between M and I.

The whole business may now be assembled to A, with the latter in place on the timer arm. Connections are made as in Fig. 1. T-1 and T-2 are the two sets of points, and the letters in circles correspond to the parts shown in Fig. 3. It may be seen that a condenser is used across each set of points. If all leads in the system are short, a single condenser may be connected from ground to the relay arm. However, during tests on this system, the receiver and relay were connected to the motor through several feet of wire, and condensers right at the points gave much superior results. One of these may be seen in Fig. 2 below the motor.

So much for actual connections. The only point remaining is to operate the newly installed contacts, and this naturally calls for a cam. The regular cam on a Brown Jr. is combined with the propellor hub, so to speak. In other words, the cam which is about 1/2" in diameter, is made integral with the rear "washer" against which the propeller is held. The washer part of this unit is about one inch in diameter and it is this that we use for the new cam. It is simply necessary to grind this flat for a depth about 1/16" in from the edge. Grind the whole circumference of this part smooth, so that it will not wear the arm, N, unduly.

The place to grind the new cam must of course be figured from the data obtained in the test runs at reduced speed. Using the main contact points as a reference, it may be seen that if the new points open at the same instant as do the main ones, there will be no change in motor speed. If, however, the auxiliary points open a bit after the main ones, the spark will be retarded and the motor will slow down. This same line of reasoning holds true for any other motor and timer arrangement. Whatever system is used, you can figure the number of degrees to set or grind the new cam from watching operation of the original or high speed timing points.

It may, of course, be possible on some motors, due to their particular construction, to use the same cam for both sets of points.

To get back to the Brown, after the cam has been properly ground and the points set to open about as far as do the main ones, the propellor may be installed. It will be necessary to put a washer between the prop and the cam so the former won't rub against the end of N. If metal turning equipment is available, a new rear prop washer could be turned. It should be roughened or serrated on both sides so the prop will not slip.

Considerable experimentation will be needed to find the right amount to retard the spark and to get the mixture set properly. In the latter connection, it should be quite simple to arrange a small electromagnet with a shutter to vary the air supply as the speed is changed. This would lead to somewhat more complicated wiring but it certainly should aid in obtaining a good mixture at both high and low speed.

A final thought on speed control by radio is one of safety. Safety, that is, for your model. All gas model builders have a fear of losing their models, and when the value of the model is increased by the addition of from ten to fifty or more dollars worth of radio equipment, the fear becomes almost an obsession. It is great to fill up the tank for a half hour flight and then keep the model from running away by steering it so that it stays close to the field. But suppose some part of the radio control fails (as they can and will) when the tank is still nearly full? Immediately a cross-country chase starts with a fair chance of the model being lost or damaged in landing. Wouldn't the obvious solution be some form of motor control?

The most satisfactory system would be to have a continuous carrier transmitter, with the motor arranged to operate at full speed as long as the transmitter (or receiver) were operating. Should the current fail, or the circuit be interrupted in any way, the motor would immediately slow down, and if rudder control was still working, the ship could probably be landed safely. Even if all control was lost, the model would doubtless descent reasonably close. Intentional motor control would, of course, be obtainable by opening the transmitter circuit when desired.

Although dual-channel control offers some complications, it certainly enables us to secure more positive and realistic control, and the safety feature mentioned above makes it well worth consideration.

In the next article, we will present a "super" lightweight and compact receiver which is about the last word with present equipment.