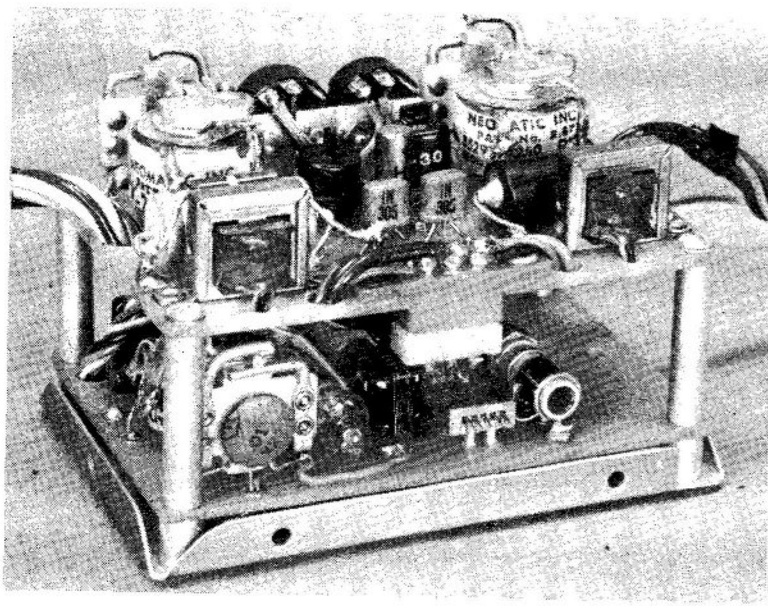
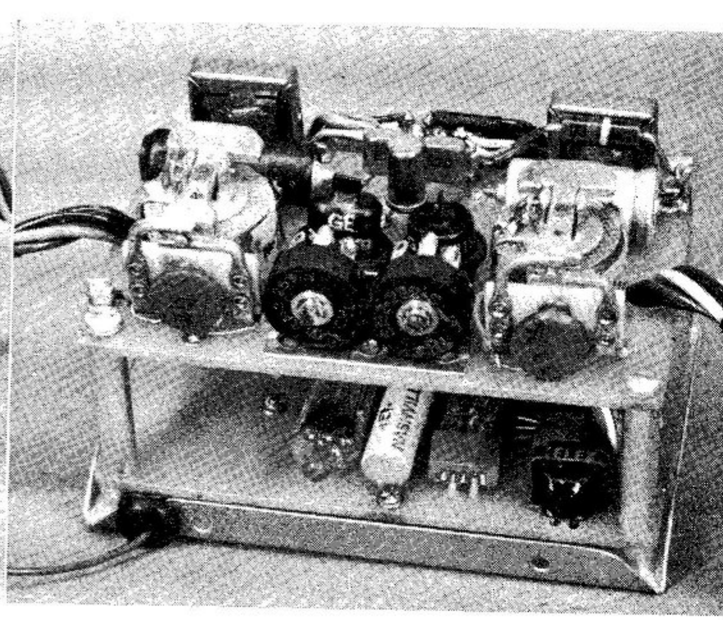




The "Kickin' Duck" Strikes Again!

To many modelers this is just a bunch of electronic Greek, but to radio control fans it's a real find! For those in the know, here's McEntee's updated Intermediate System—the best ever.

■ A lot of water has gone over the dam . . . and a lot of flights have been racked up since the original story on the "Kickin' Duck" was printed (see reference 1). An improved system, tested in two more shoulder-wing planes, is based upon the same principles; we advise all interested in this simplified dual proportional control to check into the original article for useful background material.

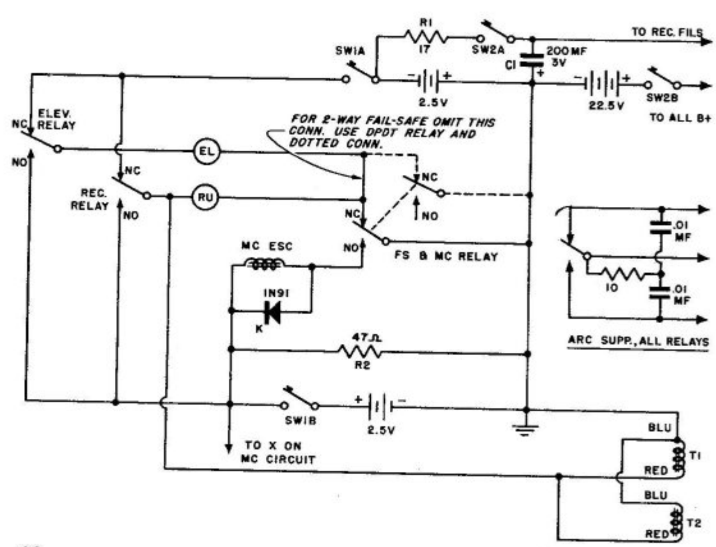
Some improvements have been made on the original outfit, a motor contral has been added; further refinement can be expected but the system has worked splendidly in 500 flights on three different planes, so we present it to those who want "simplified" dual proportional control right now. (Matter of fact, this article has been forced upon us—it just takes too long to copy off the circuit and all the data that should go with it, to fill all the requests received for this information!)

It will be noted that simplified is in quotes above; we feel this control system can be made to approach the results obtained with such true multi systems as WAG-TTPW and Dual Marcy. It does take a bit more tinkering than these, but the advantage is that it can be used with existing transmitters and receivers. It will work just as well with a CW outfit (about half the mentioned flight total was with CW transmitter and receiver) or with single channel tone providing the equipment, especially the receiver is a good high-speed pulser. Most receivers now in use, were designed with good high speed pulsing in mind.

If you have a single channel transmitter and receiver of any type that will work well at pulse rates up to 15 PPS (pulses per second) you can use it with the system to be described. Our quotes on the "simplified" come simply from the fact that in the plane the equipment must be just about as complex as that of TTPW or any similar dual proportional system—you need the same number of relays, the same servos and battery drain for same, just about the same overall complexity in the receiver circuitry itself. At the transmitting end the equipment can be much simpler—you could get along fine with a single tube transmitter and a mechanical pulser, about the same apparatus needed for the simplest rudder-only proportional controls.

For those modelers who have come in late (and who possibly can't obtain ref. 1) we might state briefly that the name "Kickin' Duck" came from the mode of operation of the control system we are describing . . . "IN-DUCtive KICK". It is based upon operation of the rudder relay of the receiver. The rudder itself is controlled by variation of pulse length, as in all rudder-only proportional models. Across the relay is connected a small transformer (we actually use two), and every time the rudder relay opens and every time it closes an inductive pulse is produced in the associated winding of the transformer. It makes little difference which kick you use, but you take one of them, put it through a "pulse-stretcher" (consisting mainly of C2) and feed the result to a transistor. The latter will then close a relay once for every on-off pulse going through the rudder relay; it also holds the elevator relay closed as desired to give about a 50-50 on-off pulse to this relay at neutral elevator stick position.

The elevator circuit is "rate-sensitive," that is, it varies the elevator positon as you vary the pulse rate at the transmtter. The basic problem therefore is to set up a system that has the least possible interaction between pulse length (which works the rudder) and pulse rate, for the elevator. We'll show how this has been done, to end



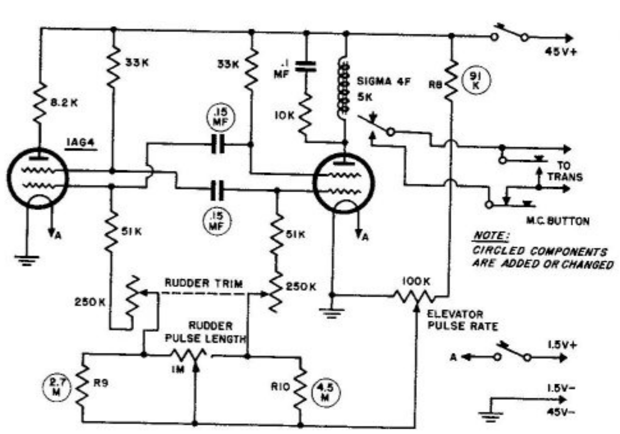
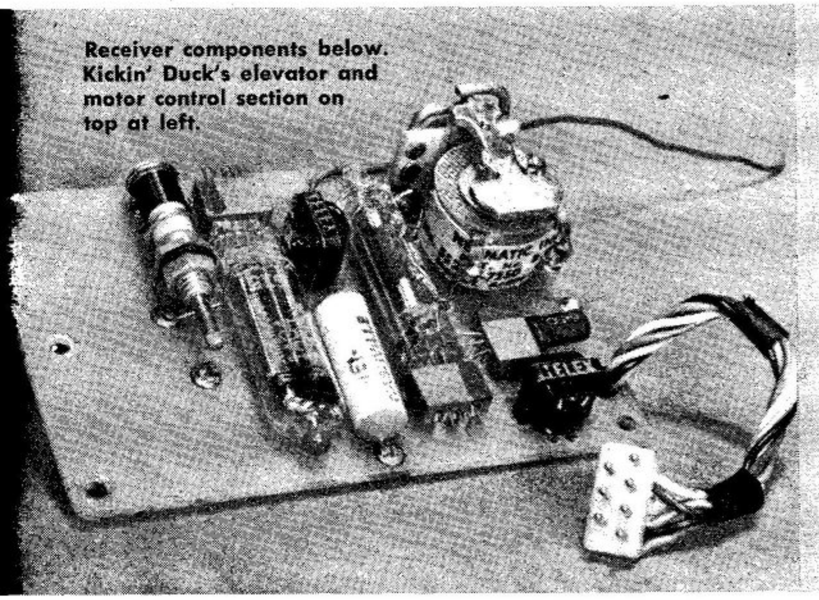
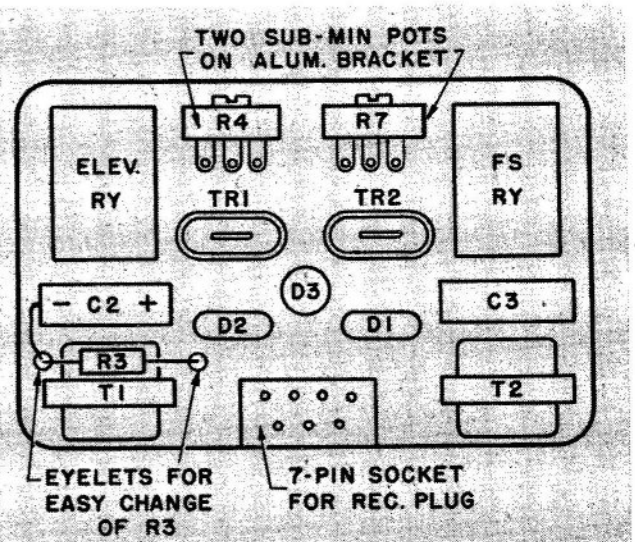


Figure 1 (left) gives the low voltage circuits; Fig. 4 (above) is Mac's Compact Pulser; changes made to previously published circuit are incorporated herewith.



Receiver components below. Kickin' Duck's elevator and motor control section on top at left.



Full Size Inductive Kick Chassis Top; see article data.

up with a system which for most practical purposes can be said to have two controls that DO NOT interact.

In any system with variable pulse rate, it is always desirable to use rates high enough so that the plane itself cannot follow the pulsing—that is, it won't "wag its tail" as it goes through the air. True, the elevator and rudder surfaces will wiggle, but at such a high rate that the plane can't follow them. We've accomplished this, too, in the present modification of the original K.D.

One more addition is a motor control and fail-safe circuit, which was not used in the original plane. This is operated simply by interrupting the pulsing. The present plane being flown with this system has a tone receiver and anything that interrupts the pulsing tone will cause the FS and MC circuit to act; normally this is used to operate a motor control escapement, but a special type of escapement is used (ref. 2) that will go to low engine speed automatically if the MC circuit cuts in and is held that way. At the same time, power to the rudder and elevator servos is cut off and they are forced back to neutral (or very close to it) by centering springs. You can choose whether you want this action to occur with no pulsing, or with solid signal from the transmitter; unfortunately you can't have it both ways. The elevator relay will always go to the N.O. contact when pulsing ceases (i.e., with no signal or with solid signal) but the rudder relay will be on the N.O. contact with one of these two conditions, on the opposite with the other.

With the MC relay on its N.C. contacts, one condition will allow automatic centering of the two servos by their springs, the other will drive both servos to maximum position! We chose to have centering with NO signal. The MC escapement will operate in either case, of course. Actually, we get hard over rudder and full up elevator in the "non-fail-safe" condition; this is fine for producing spins, will also give instant snap rolls, if you hit the button during level flight!

If you insist on fail-safe with EITHER on or off signal, you can get it by use of a DPDT relay, as indicated in dotted lines in Fig. 1.

Plane #2 in the K.D. series used two Austerman servos, which were based upon Mighty Midget motor parts. Thus the current drains and servo power were closely equivalent to what you would obtain from double-geared Mighty Midgets, several forms of which have been described in past issues (ref. 3 and 4). The power supply was four Eveready N-52 nickle-cad cells, two for each side of the servo circuit; filament power for the tone receiver was taken from one pair of cells, while the MC escapement was tapped across the other pair. Since the latter did not have the steady 55 ma drain, we added resistor R2 across them, to make them use up a charge at about the same rate as the cells supplying the filaments. These cells gave fine service, they were kept on a continuous 10 ma trickle charge night and day, except after flying sessions, when the rate was increased to put back into them about the same amount of power used in flying (only a very rough guess was ever made on this, but the cells will stand considerable overcharging, if the recommended charge rate is not exceeded, and they never let us down in flight).

For comparative purposes, the average current drains off the entire system, including the drain of filaments and resistor R2, also the two transformer windings, was about 340 ma on each set of cells, with the control stick in neutral. Of course in one extreme corner stick position this would rise to about 600 ma, in the opposite corner it would drop to perhaps 200 ma.

The cells mentioned gave fine service, but they did give a rather rapid voltage drop under this much load. We found it possible to get good operation down to about 1 volt per cell, but this depends mainly upon the receiver used, of course. Since the cells might be as high as 1.4 volts each when first taken off charge, a fair amount of change in circuit operation might be expected, with this total of .4 volt drop (for one reason, because the inductive kicks that you get also drop in strength as the cell voltage drops). Actually, this didn't cause as much trouble as we had anticipated, but we feel that the sintered plate type of cell is a better choice for this system. Possible selections might be the VO-800 (800 maH plastic-cased cells), the new VO-1 (1 AH metal-cased button cell) or the Gould 1.25 SC cells. The latter have been used in the latest plane, with very fine results.

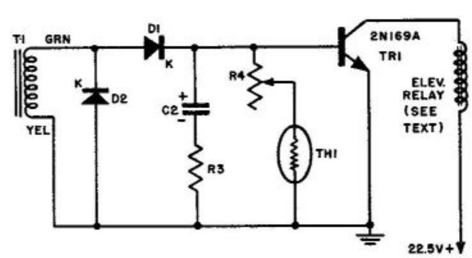
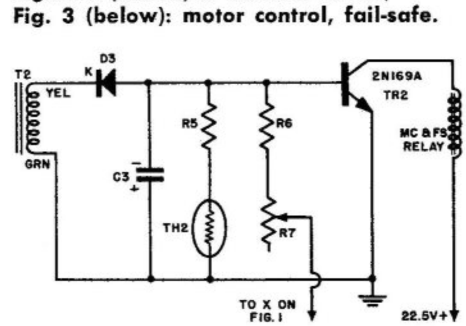


Figure 2 (above) is elevator circuit; Fig. 3 (below): motor control, fail-safe.



Sintered plate cells generally will stand much heavier loads, with only very slight voltage drop. Silvercels or Silcads would be a logical choice, if the very lightest weight were mandatory, but the high voltage peak of the former should preferably be drained off, before putting them in use.

For the B battery, we find the Eveready #420 to be an ideal size; the average current drain for the elevator and MC kick circuits plus that of the receiver is only about 3.5 ma; this figure will vary according to your receiver, of course. Our tone receiver idles at about 1 ma, draws some 4 ma with full signal. It will be noted that we show 7250 ohm relays in the E and MC circuits, and the same value is used in the receiver. This fairly high resistance was picked to keep the total battery drain down, so that the #420 unit would give good life, which it certainly does.

Back at the transmitter end, the prime requisite for a system like this, of course, is a pulser which will cover the range you want, and will do so with little or no interaction between pulse length and rate. All three planes mentioned have been flown with the Compact Pulser (ref. 5), used almost exactly as shown in the original article, but with a few modifications, as seen in Fig. 4, which we will describe later. We strongly suggest that a zero-center meter be used to check the pulser, the receiver relay and elevator circuit relay, when the system is first set up. Use of such a meter in this connection has been described in a past issue (ref. 6).

With the Compact Pulser circuit, the pulse rate varies from about 5½ cycles to 11½ cycles over the full stick range. These exact values are not mandatory, but if you go much lower at the low end of the rate range, it becomes possible for some planes to start showing tail wiggle, in the full up condition, which corresponds to lowest pulse rate. Because the motor control circuit operates with lack of pulsing, we limit the rudder pulse length to about 80-20 and 20-80%; that is, the pulses are never shorter than 20% of the length of a full pulse. This limitation also helps in keeping the elevator circuit from acting up, which it tends to do with very short pulses.

While the original K.D. system worked with a pulse rate range of 3 to 12 PPS, we find the approximate 2-1 rate change ratio of the present setup very satisfactory. It was not felt wise to go higher than 12 PPS since some receivers tend to become erratic when pulsed much higher (this

(Continued on page 38)

shows up at the 20% and 80% pulse limits, not so much at 50-50 pulsing), and also the receiver relays themselves can distort the pulsing at high rates.

For clarity we have shown the actual circuit in the plane in three separate sections; Fig. 1 gives the low voltage circuits, including the two servos, contacts for all three relays, plus all the batteries. Since the B minus connection of most receivers is usually considered "ground" we use this symbol in all the circuits. Actually, of course, there is no connection to the earth —"ground" in this case merely means that the indicated lead is common to all the various circuits. A 1N91 diode is across the escapement coil, to kill its inductive kick and keep the FS relay from sticking.

Though omitted for clarity, all three relays have the usual arc suppressors on their contacts, as shown in the small inset on this drawing. The 17 ohm resistor R1 is right for our particular receiver, which has 1AG4 tube and a 6007 tube; for any other tube complement, you will have to change this value, of course. The large electrolytic condenser helps keep the filament supply stabilized despite the pulsing load on the batteries from the two servos. R2 should be chosen to draw about the same current as the receiver filaments do. All three relays are shown in the position they give with power supply turned off.

The elevator circuit is given in Fig. 2. Be sure the transformer is connected as shown. While an NPN transistor is indicated, this was used only because this type of transistor is mandatory in the MC circuit. A PNP could be used just as well (if it is, reverse the B battery leads, the two diodes and the electrolytic condenser). The diodes are a high conductance type and were picked mainly because they are rather compact and fitted on the cramped baseboard well. Actually, 1N91 diodes will do just as well, but they take up much more space. Doubtless other "high conductance" diode types will work well in this circuit, but these two we KNOW are usable; if you substitute others you are on your own! As a matter of fact, we strongly suggest that ALL parts be just as indicated; we know they work and that the circuit can be "tuned up" within the range of the variable controls shows. Other diodes, transistors, transformers, even battery voltages might require rather extensive changes in the circuit.

You will note a thermistor (TH1 and TH2) shown in both elevator and MC circuits; these help to temperature-stabilize them, but actually, the system was used for over a year without these units, carbon resistors of the same value being used in their place. We feel the small extra cost of the thermistors makes their inclusion worthwhile, though. Other values of relay coil resistance can be used if you wish. For the 7250 ohm units we used, it was found satisfactory to set all three to operate at 2 ma and open at 1 ma. They get a maximum of a little over 3 ma in operation.

The variable resistor R4 is used to set the elevator center position. R3 may require some change, as noted a little later.

The motor control and fail-safe circuit is seen in Fig. 3. You will note that it is somewhat similar to that of the elevator, one of the main differences being that the diode and electrolytic condenser are polarized in the opposite direction to the corresponding parts in the E circuit. The reason is this: The transistor in the elevator circuit draws practically zero current (just a slight leakage current—the less the better) when no pulses are coming in. With pulsing, the inductive kicks from the transformer are passed by the upper 1N305 and "bias" the transistor into a conducting condition, so that it will operate the E relay. The MC circuit, however, draws full transistor current with no pulsing, and when pulses come in, they tend to drive the transistor to LOW current, so it will not close its relay.

To make the MC transistor conduct, we have to put a steady bias on it, and this comes via R6 and R7, from one set of servo batteries. This bias could have been taken from the B battery—in fact the circuit was set up this way originally—but there is a good reason why it isn't. As noted previously, the servo batteries drop their voltage quite rapidly as they are used; as they drop, the inductive kicks grow weaker We normally set up the MC circuit to operate with the very least time lag possible so that the plane will not be deflected from its straight flight path as radically when the MC button (actually, the no-pulsing button) on the pulser is depressed. With a steady bias voltage coming from the B battery and decreasing kick pulses, this time lag is upset.

By taking BOTH the kicks AND the transistor bias from the same batteries, we make one compensate for the other, and the MC setting holds very stable. It was not found worth the added parts to apply this sort of compensation to the elevator circuit.

It was because of this bias arrangement for the MC circuit that we went to NPN transistors, such a transistor being mandatory in the MC circuit due to our use of a common B battery for all circuits, and use of one set of servo cells for the receiver filaments. The 2N169A transistors have been found ideal for this outfit; they have extremely low leakage current, ample gain and are rated for use on 25 volts.

The receiver and kick circuits in the plane are mounted on two decks, both contained in a single sheet aluminum box. We give a rough layout of the kick circuit chassis, but if you have more space it would be wise to spread things out a little more. The outfit uses Neomatic relays, but these are not generally available now, and Gems will fit on the base very nicely. Overall size of our complete receiver package is 3 x 2⅜ x 2" and it weighs 6½ oz. Parts placement on the kick circuit chassis is not too fussy, but that shown has worked out well and is recommended. We used point-to-point wiring, but a P.C. plate could doubtless be worked out nicely.

Now, what about getting the rig operating? First point is to be sure your pulser works correctly, and here is the first use for that zero-center meter we mentioned earlier. If it does, then shift the meter to the rudder relay on the receiver and check again. This should follow the pulser with no nonlinearity or crowding, at various pulse rates and lengths. With no pulsing, check the relay current in the MC relay circuit; it should be about 3 ma or a bit more for relays around 7,000 ohms, or about 4½ ma for 5K relays. With pulsing, this current should drop. The elevator relay circuit should show almost zero current with no pulsing, around 1 ma (this is an average meter reading figure) with the control stick in neutral; this figure will vary as the elevator adjustment R4 is varied.

Before we go into the final adjustment of the circuit, we ought to look at the changes made to the Compact Pulser, since all the values of the receiver circuits are based on the modified pulser. A look at Fig. 4 will show what has been changed; the two feedback capacitors were reduced to raise the pulse rate range, then R8 was added to reduce the maximum rate. R9 and R10 are used to compensate for a slight case of interaction in the system; there are probably other and more sophisticated ways to do this job, but this way works fine. What we found was that the pulser control stick, when moved from its center position to the right and left extremes would move the plane rudder just as desired, but it would give a little up elevator at the extremes, and a bit more on one side than on the other. (This action could have been partially due to the pulser itself—no attempt was made to localize it). The two resistors cause the pulser relay to speed up slightly as the stick is moved away from center, thus producing a little down elevator compensation. The lower the resistor, the greater the pulse rate change as the stick is moved to the sideways extreme; the values shown were right for the setup in plane #2, which used the N-52 servo cells, and Austerman servos.

When the outfit was put in the latest plane, using Gould 1.25 SC cells, and servos based upon Bonner motors, it was found necessary to drop R9 to a still lower value of 1.5M. We suggest setting up the system without these resistors first, checking out the two kick circuits, then adding R9 and R10 if they are needed.

With transmitter, receiver and pulser in normal operation, try setting the elevator to mid position with R4. Then move the stick to full up; we like to have the elevator ALMOST cease its pulsing at this position. If it is still pulsing quite strongly, reduce the value of R3 about 10 ohms, reset R4 for center elevator (with the stick centered) and try full up again. It will be found possible to get virtually solid up this way; at the other end of the rate range, the elevator will give practically solid down, due to its high pulse rate. Once set, R3 will not again require change.

With the elevator circuit set up this way, you can check for that slight up-elevator at extremes of rudder movement (stick held in neutral for elevator), and add compensating resistors as noted above. When this has been accomplished to your satisfaction, hold the stick full up and set resistor R7 for adjustment of the MC circuit time lag. You want a little leeway here, of course, to allow for wide battery voltage and temperature variations; if you find your motor control operates in flight (it will usually only do so when you have the stick in full up position) just back off on R7 a bit. We find that when this resistor set up too close, a rapid movement from full right to full left (or vice versa) with the stick in full up will trigger the MC circuit, so you will have to back off a bit more on R7 to accommodate this effect too. This latter effect seems to be inherent in the plane circuits, not in the pulser itself.

All this adjustment might seem to be a lot of fuss. But remember, this is not a genuine "multi" system (at least under the AMA definition). It is a compromise arrangement, and when you come to think of it, you are sending a lot of information over a single radio "channel". If you don't like to tinker, this rig is not for you! Actually, it is not really tough to get into flyable condition; but if you want to get it as close to TTPW action as possible, then you will have to fuss and tinker as outlined above.

As noted, the outfit is in a plane now which uses servos with Bonner motors and 1.25 SC Gould nickle-cadmium cells. These servos give lots more power, but take more current; the entire system, including the same 55 ma filament drain, shows an average drain on each set of cells in neutral of about 460 ma, this can go as high as 800 ma in some stick positions. With this new installation, it was found necessary to change R3 to about 90 ohms. The new plane is bigger than #2, has coupled rudder and ailerons (CAR) and a .35 engine. It looks like a lot of fun to fly —when we learn how!

The system has a few peculiarities that should be understood at the outset. For one thing, as we've noted, it depends heavily upon a good pulser and a receiver that will pulse well at high speeds; things tend to be the worst at the top pulse rate (down elevator) and with rudder held full right or left. If your controls hold well at these extremes (a receiver or relay that won't follow fast and short pulses can give you sudden full UP elevator, as you hold the stick at full down and move it to right and left extremes!) you need have no worries on pulsing capabilities.

There is another little peculiarity to watch for—and it is quite normal. If you move the stick rapidly from one side to the other, with the elevator centered, you will find the elevator gives a short kick up when the stick goes one way, and a kick down in the other. But the elevator displacement is rather slight and it goes right back to neutral; this seriously worried one builder of the circuit, though, so we thought it better to mention it.

(Continued on page 60)

Duck

(*Continued from page* 39)

And now, what can be done to improve the circuit? For one thing, we would like to try the Shows-Dickerson full-wave rectifier circuit in the M.C., instead of the half wave rectifier we have used so far; this should result in much faster MC operation (in other words, less time lag in MC operation, and less of a twitch in the path of the model when you hit the MC button). It seems likely that a single transformer could be used for both the MC and elevator circuits; the TR98 has a center tap on the winding that goes to the transistors, and half of the winding might do for each circuit, with the center tap as the "ground". A little more work on temperature compensation might be done on the elevator circuit (the MC is already very stable).

Use of an emitter resistor (this would necessitate considerable circuit part changes), possibly different values of thermistor, even the use of silicon diodes and transistor in this circuit would be worth trying. We had hoped to try all of this before putting the circuit into print; but it began to look as though such experimentation would take a year or more. And meanwhile many modelers have been flying the outfit as it is; it does work well, as many who have seen our planes fly in the Northeast can testify. For further proof we can point to a fairly impressive array of Intermediate trophies that the equipment has brought us. We feel this is an ideal Intermedate system.

REFERENCES: (1) original Kickin' Duck article, '58 Air Trails Model Annual; (2) modified motor control escapement, Sept. '58 A.M., p. 29; (3) double-geared Mighty Midget, Nov. '56 Young Men, p. 52; (4) single geared M-M with cord drive, April '58 A.M., p. 31; (5) Compact Pulser, Oct. '55 Air Trails Hobbies, p. 37; (6) zero center meter, June, '56 Young Men, p. 54; see also Dec. '56, p. 48 for info on obtaining proper electronic pulser action.

PARTS LIST: All fixed resistors half watt; R1, R2, see text; R3, about 100 ohms, see text; R4, R7, 5K sub-min variable; R5, 5K; R6, 12K; R8, R9 and R10, as required. TH1, 1000 ohm thermistor, Lafayette 31TD1; TH2, 5K thermistor, Laf. 35-TF1. T1, T2, Lafayette TR98, 10K to 2K interstage. TR1, TR2, G.E. 2N169A transistors. D1, Hoffman HB-2 (Ace Radio Control); D2, D3, Raytheon 1N305. C1, 200 mf, 3 V electrolytic, Sprague TE1064 (Laf.); C2, 110 mf, 3V electrolytic, Sprague TE1060 (Laf.); C3, 50 mf, 6 V. elect. (Laf. CF-105). Switches, batteries, relays, etc., as in text, and per preference. Parts for modification of Compact Pulser not included herein.