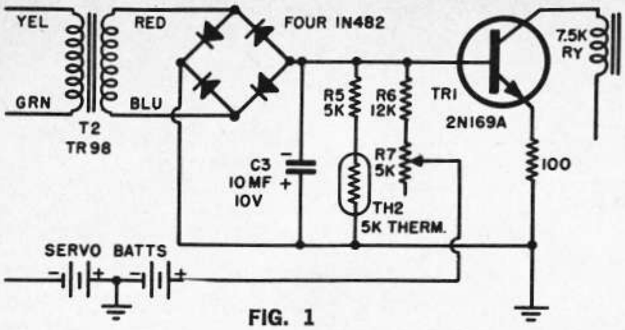


FIG. 1

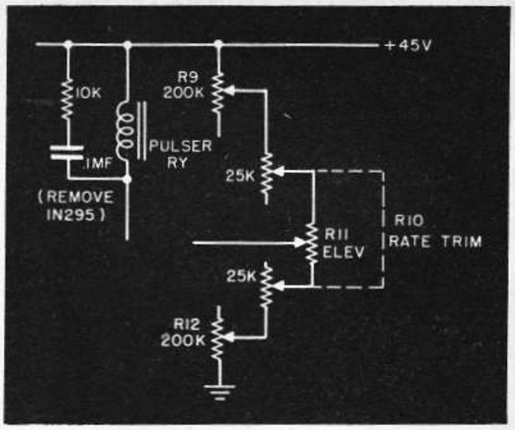


FIG. 2

Mac's Duck: Still Kickin'

Just doesn't seem to be any way we can get rid of this ole radio controlled fowl . . . the bird keeps reappearing with modifications, updating, new tail feathers. Actually, the "inductive-kick" system offers a lot for very little money.

BY HOWARD McENTEE

No, this isn't about an irate fowl. Kickin' Duck is the popular name for a control system known technically as "inductive kick" which offers a useful way to get another control channel from a single channel and single proportional control. You actually see the "kick" . . . it's the spark that appears at the rudder relay contacts when they open. With K.D. we put it to work *for* us, otherwise it would be a nuisance making relay contacts stick.

Why do we keep updating this old bird? Just one reason. K.D., a most reliable system, will give a close approach to such two-channel propo jobs as the TTPW and dual Marcy. Our last exposé appeared in Sept. '61 A.M. just when the Duck won the Intermediate event at the Philly Nats in our KD3 plane. Since then many have been built and flown, so the system has had a good shaking down. Improvements which have come we detail below.

True, the big excitement in big-time R/C is multi propo. But what about fliers who can't ante up $500 or more? They can obtain invaluable training in stick operation and plane trimming from our low cost K.D. (Jim Kirkland, winner of Class 3 at the 1963 Nats and other meets told us his earlier K.D. experience was invaluable when he took up multi propo).

Those interested in background details should check that Sept. '61 A.M. We include references to other articles and A.M. items concerning useful data for experimenters. Multi propo has sparked interest in Class 1 (rudder) and Class 2 (rudder and elevator) propo flying. K.D. is ideal for "2" and for C.A.R. (Ref. 1)—latter has been "kicked upstairs" into Class 3 competition. K.D. has given a fair account of itself even here: we placed 3rd to 7th in five large meets; given a better pilot and a plane with more power and trike LG the score could be better.

Original K.D. receiver had some 250 flights in two different planes, then in 1961 the receiver deck was changed to the Mac-Tone (Ref. 2). The same "upper deck" of control circuits has made 650 more flights. This is really getting your money's worth from a piece of equipment! The KD3 plane (Ref. 3) was flown from '60 to '62, bit the concrete at Chi Nats ("the Kickin' Duck quacked up" they all said). KD4 (like KD3, but a bit lighter, and with S.T. 40 power) is going strong. Now KD5 is on the boards—again a shoulder winger, but with trike LG, strip ailerons, S.T. 46 power, plus detail changes. This history is given simply to show that K.D. control can provide a lot of contest and/or fun flying, last almost indefinitely with good maintenance.

The last K.D. article in A.M. ended with comments on future changes. One pressing need was for a better motor control circuit; this we now have . . .

Faster MC Circuit: The Shows-Dickerson idea for a full wave rectifier has proven most satisfactory. Fig. 1 is the present MC circuit; while most parts of the half-wave circuit have been retained, now there are four diodes and a much smaller C3 (parts labeled same as in older circuit). TR3 windings are reversed—low resistance winding (yellow and green leads) goes to servo circuit. Present C3 actually measures 9-mf on a capacity bridge, but a nominal 10-mf unit would do. Several types of tiny glass rectifiers were tried, and surplus units are now in the outfit. But Int. Rect. type 1N482's were found very good. Other high conductance silicon units should do equally well.

To get still faster MC action, lower end of transmitter pulser range was raised. Pulser now goes from about 6¾ to 11¾ PPS (we show later how pulses are counted). Pulse omission detectors must be set so that they do not operate when you don't want them, at the *lowest* pulse rate of your system; relay stays open at any higher pulse rate. Rapid movement of control stick from one extreme rudder position to the other with stick at full-up elevator (lowest pulse rate) will also cause them to close the MC relay . . . so adjustment has to be set a bit above this point. With the new POD setup, a touch of the off-signal button will operate the MC relay and start the MC servo turning. Even if the plane is travelling a high speed, this causes only a slight lurch in the flight pattern whereas it used to produce a snap roll.

Adjustment pots in the Handy-Mac transmitter pulser have been changed to permit wider trim adjustment range, per Fig. 2 . . . same part numbers used here as in original circuits for transmitter (Ref. 4). Also, 1N295 diode in pulser circuit across RY1 has been changed to a 10K resistor and .1-mf capacitor in series. The diode worked fine but probably produced a little lag in relay operation at the highest pulse rate, especially on very short pulses where control stick is at either side extreme.

Reducing capacitor value in MC circuit made such an improvement it was decided to try just this change, while retaining the original half-wave rectifier per Sept. '61 article. Sure enough, it proved possible to speed up MC operation considerably, yet retain reliable relay operation. 20-mf seemed about optimum. This setup appeared about as fast as the full wave circuit with *same capacitor at C3,* but full-wave rectifier allowed C3 to be reduced to much lower value, with consequent further shortening of MC relay lag.

Counting Pulses: K.D. experimenters have asked us how we count pulses. This can be quite a problem. Motor driven pulsers can be checked with rev counter if you can reach the rotating contact to check its speed. But electronic pulsers require electronic means. Our solution is seen in Fig. 3. Normally-open contacts of pulser relay are connected to scope and AF signal generator

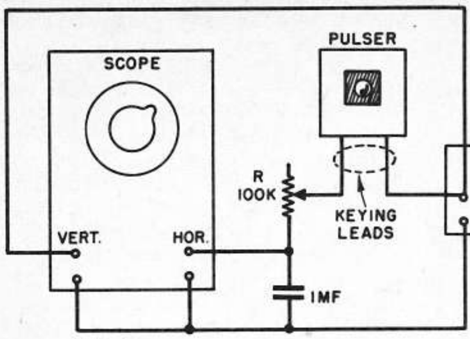
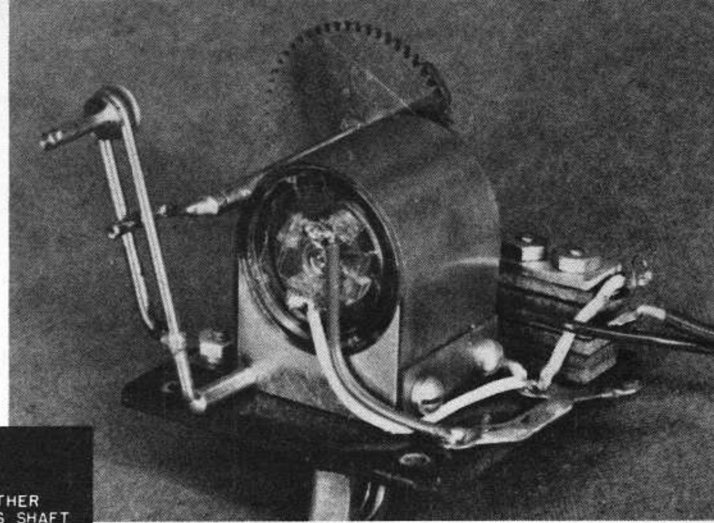


FIG. 3



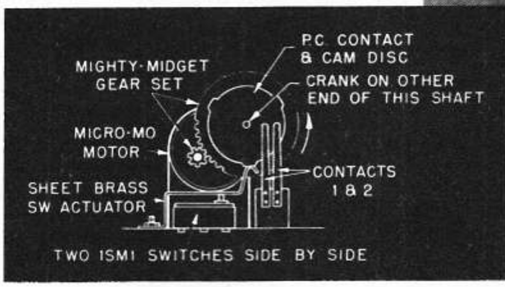


FIG. 4, left; unit, above.

as indicated, latter must be accurate down to very low frequency. Our choice here is a Heath AG-9 calibrated down to 1 PPS; the ranges are selected by switches, so it is easy to pick the exact pulse rate you want.

The scope may be any sort, its internal sweep is not utilized. Set resistor R for an approximate circle on scope tube, and AF generator near frequency range you wish to check. Turn on pulser and hold stick full to one side (whichever produces a "bump" in scope circle). If this bump is stationary, it indicates your pulser is operating at exactly the same frequency as the AF generator. It will probably be going around the circle one way or the other, but it is not difficult to interpolate pulse rate to ¼ PPS or so. Two notches on the scope pattern show pulser is running at twice the speed of the generator, etc. You can count verbally up to 5 or 6 PPS, so it shouldn't be too hard to go on to higher pulse rates with this setup.

Motor Control Servo: Control surface servos in KD3 (still in KD4), detailed in A.M. (Ref. 5), continue satisfactory. Centering has been changed to that in our C.A.R. (Ref. 1, Fig. 7), but the MC servo used in KD3 and KD4 has never been described. It has 3 positions plus additional Fail-Safe; latter position automatically centers controls and puts motor in low speed. This has been demonstrated many times by turning off transmitter with plane high above. Servo is based on a 60-to-1 ratio Micro-Mo motor, to which has been added a set of Mighty Midget gears. Fig. 4 shows idea simplified. Small MM gear is soldered on Micro-Mo output shaft, large one has contact disc attached with crank on other end of shaft. Crank moves an arm fore-&-aft in plane which operates wiretube link to throttle.

Two fixed contacts bearing on P.C. disc are concerned with FS action. Other switching is via a pair of SPDT Micro-Switches, actuated by cam points

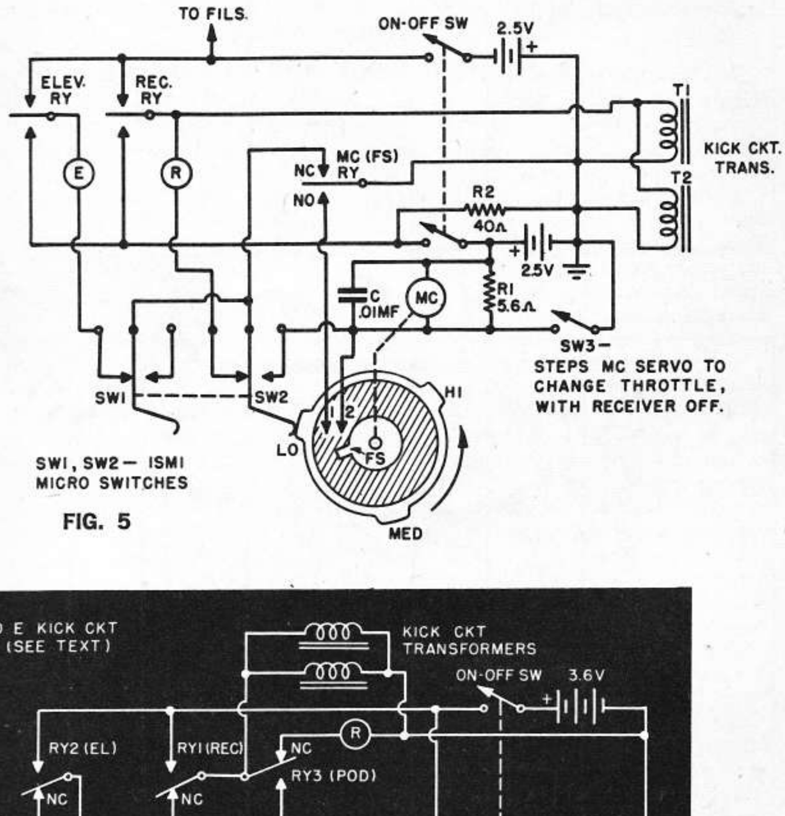
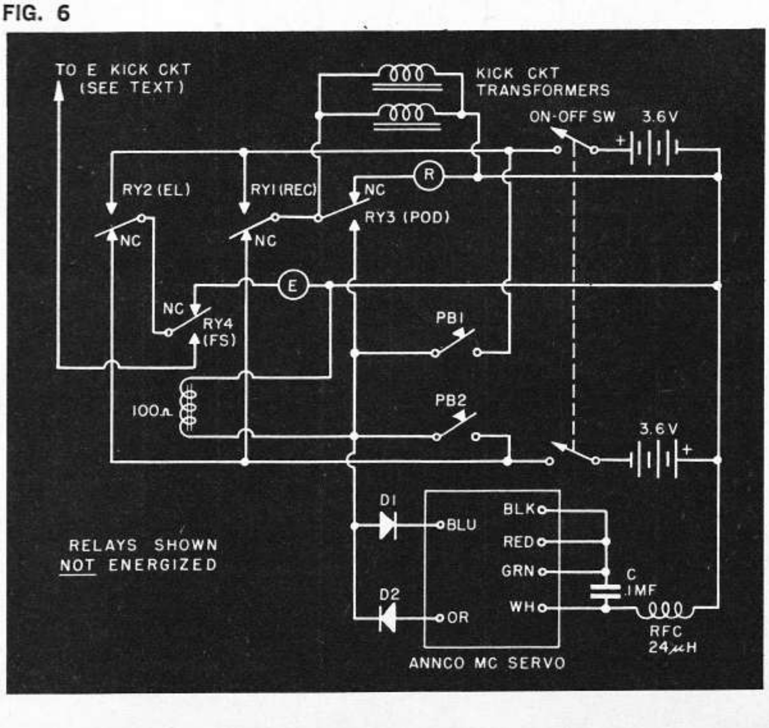


FIG. 5

FIG. 6



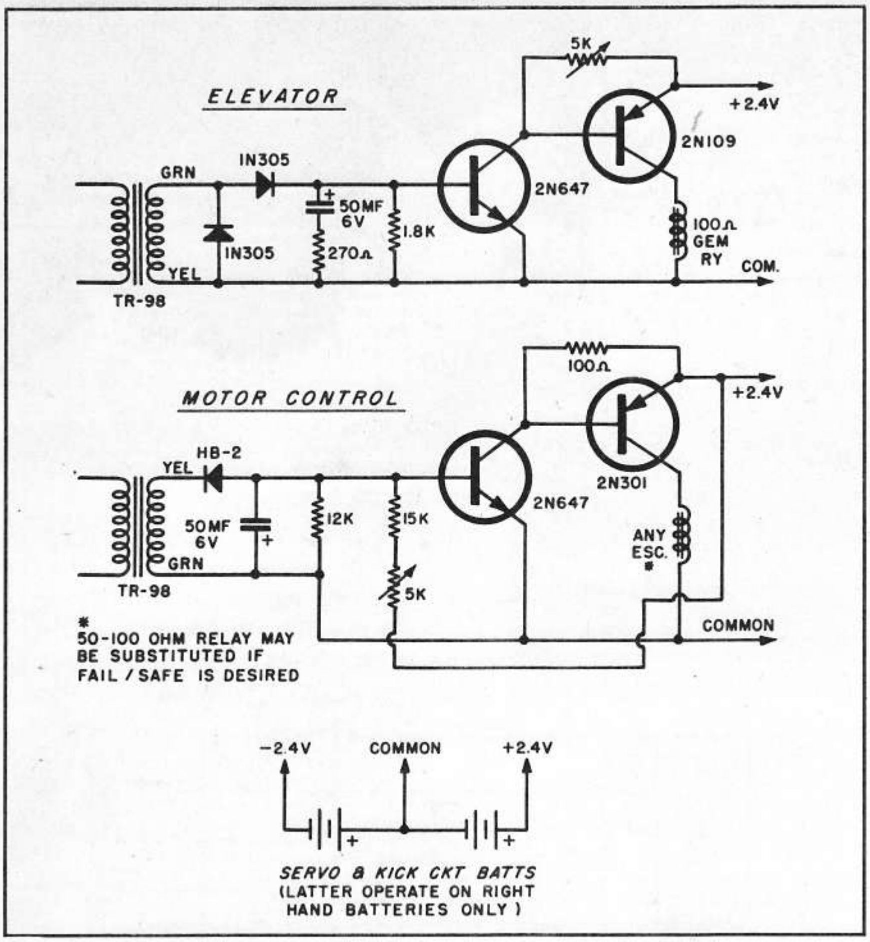
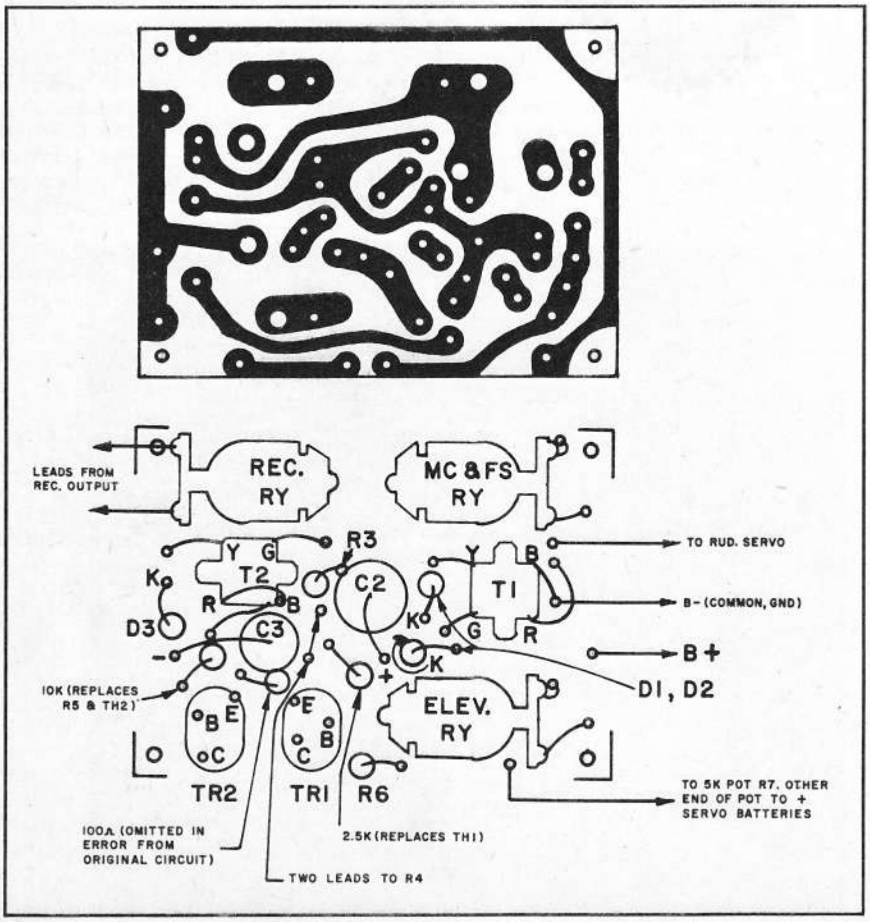


FIG. 7

FIG. 8 and 9



cut in P.C. disc edge. As detailed in 8/61 KD story, it is desirable to open circuits to rudder and elevator servos *individually,* so Fail-Safe centering of these controls may via *either* on-signal or off-signal. Fig. 5 circuit does this. With normal pulsing motor control relay is closed on NC side; this allows battery power to flow through NC contacts from battery common, through SW1 and SW2 and the two servos to E and R relays, and through their contacts back to the two batteries. When FS (Fail Safe—FS, and Motor Control—MC, generally refer to same relay and kick circuitry) circuit operates FS relay, power is applied through contacts 1 and 2 on P.C. disc, so MC servo starts turning. As it does, SW1 and SW2 open E and R motor circuits. A quick punch of transmitter No-Signal button is sufficient. As pulsing starts again, FS relay goes back to NC position, but MC servo turns until next cam point shoves arms of SW1 and SW2 to left. This also breaks contact for MC servo which stops at new motor speed position.

Should you hold the button down (or have system failure) motor control relay operates and MC servo will turn until contact 2 on P.C. disc comes to gap; this also stops MC servo, but note SW1 and SW2 now hold E and R servo circuits open. Should normal pulsing be resumed, MC servo steps short distance from "Fail Safe low" to "normal low" and you then bring engine back to full speed with quick punch of button.

"C" is to suppress commutator arcing that can bother receiver; R1 is "braking resistor." Despite drag of throttle linkage, motor has so little internal drag it will coast past desired stop positions and continue to cycle round and round. When power is cut, this resistor brings motor to rapid stop; true, it draws considerable current (more than the motor itself) but this servo is operated only a very short period during a normal flight. R2, same resistor shown in earlier K.D. circuit, balances out continuous filament drain on upper servo battery.

Trimmable Motor Control: K.D. system is capable of operating trimmable MC servo, giving high engine on solid signal, and low speed on no signal (this is the desirable setup, but can be reversed easily if you wish). Fig. 6 circuit devised by Ernie Reuther of NJRCC is in wide use by this club on K.D. outfits built by Ernie. Partial circuit shows only basic low voltage circuits, servos, relays and batteries. Reuther uses mighty Midget motors in his servos, drives them with two 3.6 volt nickel-cad batteries. His "Pulse-Master" receiver has front end much like Kraft's tone, all components mount on single P.C. plate. RY1 is receiver relay; RY2 is elevator kick ckt relay; RY3 is pulse omission detector relay (corresponds to MC relay of Fig. 5). Added RY4 relay operates whenever current of either polarity reaches diodes D1 and D2.

When pulsing ceases for any reason, RY2 always closes NC contacts, but RY1 can be either open or closed (depending upon whether no tone (*See pg. 72*)

Kickin' Duck

(*Continued from page* 38)

comes through or a steady tone). Thus RY1 can send either positive or negative to armature of RY3; with no pulsing, RY3 always opens R servo circuit and makes connection with the two diodes. One diode passes positive to MC servo, the other negative, so this servo may be driven either way, as far as the operator wishes. Diodes are high-conductors such as 1N91 "C" and RFC are arc and receiver interference suppressors; capacitors for same purpose are used on all relay armatures to battery common and across input of MC servo.

RY4 opens E servo circuit when operated; in this condition it also has a tricky function worked out by Ernie. Resistor R corresponds to R5 and the thermistor in our 8/61 K.D. motor control circuit; normally lower end would go to servo battery common or "ground". But in this arrangement, when RY4 is operated, a small negative voltage is placed on E-kick circuit transistor base, making it draw a little current (but not enough to pull in the relay).

Any time there is no pulsing, large kick circuit electrolytic capacitor (100-mf) discharges completely. When pulsing again starts it takes a noticeable fraction of a second for it to charge . . . during this period elevator relay stays open and you have full-up. Reuther's trick keeps a little negative charge on capacitor and transistor so this charging period is very short—he uses PNP transistors in his kick circuits, so negative voltage is utilized; if applied to our K.D. with NPN transistors, voltage would have to be positive. In any case, this prevents plane from giving an upward jerk after you release motor control button, a desirable refinement. particularly on a hot plane. PB1 and PB2 buttons move MC servo either way without turning on receiver and transmitter. Annco servos are generally used for MC in Reuther's system, but Duramites would be connected the same way. In either case, servo brown and yellow leads are not connected.

Low Voltage KD: Sept. '61's issue produced word from Tom Eshelman, Reading, Pa., he intended to operate receiver and all other circuits on servo batteries. System was flown to some extent. So while Fig. 7 circuits do test nicely, Tom suggests they be labeled "experimental". His early fears of temperature sensitivity were groundless—extremes show little effect. His servo, relay contact and battery wiring are same as in 8/61 article, except Fail-Safe relay was omitted and MC escapement driven direct from 2N301 power transistor. This large unit is low in cost. Tom attached it to the OS motor control escapement so a smaller P.C. chassis could hold all other components. Chicken-hearted modelers who won't fly without a fail-safe plane circuit (that's us!) can replace the big 2N301 with a 2N109 and use any relay with 50 to 100 ohm coil. TE's setup did have a fail-safe of sorts: MC escapement was linked to an Annco throttle which kills engine in middle position. Signal loss for more than about two seconds stepped throttle from high speed down to this cut-off position. All K.D. circuit components (except 2N301) were mounted on 2 x 2¼" printer circuit plate, including two ½" dia. Mallory

5K pots. Note that K.D. circuits all work from one set of servo batteries.

465-MC Pulse System: Use of 465-mc as RF link in a K.D. system comes also from Tom Eshelman. He has used Citizen-Ship 465-mc transmitter and receiver (latter is Model TC with transistor output stage and Gem relay), system pulses nicely up to 20 pps or so. There are lots of 465 pulse systems in Reading area, many on Galloping Ghost, which Tom himself has flown extensively. While he has not tried 465-mc K.D. he figures his Galloping Ghost success shows it feasible. 27-mc fliers suffering interference might try 465-mc. Main trick seems to be two 3.6 volt sets of nickel-cads for servos connecting receiver tube filament across entire 7.2 volts. Tom mounted transmitter "works" in new 10 x 6 x 3" case with a Phelps pulser.

K.D. Improvements. Art Schroeder of Glen Ridge, N.J., has been long-time K.D. booster; photos of his compact 2-deck version appeared in July/Aug. '63 A.M., p. 43. Art says since those pix were printed he has had countless requests for info on his P.C. plates. We reproduce the kick circuit plate in Fig. 8. This shows *underside* of plate—the copper foil side. Components mount on opposite side and Fig. 9 shows where. Circuitry is almost same as K.D. in 9/61 A.M. except Art did not use thermistors (which we feel are well worthwhile.) A 10K resistor takes place of our R5 and TH2, while TH1 is replaced by a 2.5K resistor.

Most leads to relays (except for coil connections of elev. and MC relays) are wire. Pots R4 and R7 are external to receiver so they may be adjusted from outside fuselage. (Our experience indicates it would be handy to mount R4 this way, but R7 never needs change, once it has been set; however, this has been only with thermistors in use).

Art used a standard Kraft receiver (with tube front end), p.c. board was left a bit oversize and receiver relay mounted on K.D. deck. Generally Art has 5K Gem relays throughout, sets them to pull in at 2.8-ma, open at 1.8; arc suppression is needed on relay contacts which need proper servicing of these contacts. He prefers to jam all components down tight to the P.C. board for better resistance to vibration, but this takes a fast hand on the soldering iron. All bare component leads should have spaghetti over them.

We believe Art discovered the benefits of putting an electrolytic capacitor across points of receiver relay; this smooths action in the K.D. circuitry by suppressing contact arcing and "bounce" effects. Our own quick check indicated it didn't make much difference to which of the two fixed contacts you hook capacitor—other side goes to relay armature. Polarize capacitor properly; positive end of capacitor goes to battery positive. This is a very worthwhile addition. Capacitor may be from 50 to 100-mf, rated 10 to 15-volts.

"Error gremlins" were with us when the Sept. '61 K.D. article was printed. D1 and D2 should be the 1N305 units, D3 is HB-2. There should be a 100-ohm resistor between emitter of TR2 and ground. These corrections, given in past R/C Column, are repeated for those who missed 'em.

Feedback Servos: While we haven't tried it, there's no reason why feedback servos can't be used with K.D. Biggest advantage would be reduced servo battery drain and control surfaces wouldn't "wiggle". Two circuits have been shown in A.M. to adapt commercial feedback servos to operation from standard R/C receivers. Bill Bertrand (Detroit) offered ideas for adapting Micro-Mite servos to either relay or relayless tone jobs (Ref. 6); same should work with Space Control units.

Maynard Hill adapted latter servos to TTPW outfit to fly a near-scale biplane. Circuitry involves only four extra resistors and two capacitors per servo; escapement is utilized for M.C. Normal three relays on output of TTPW receiver control the works—the three relays of a K.D. outfit should do same job. (Ref. 7). As Hill points out, besides advantages of feedback servos noted above, you also get full servo power at extremes of control movement, not possible with spring-loaded servos

Servos for K.D.: For simplest system, "wiggle" servos that are spring centered are certainly practical and give fine results. In past, lack of commercial servos has held back development of all simple propo systems. For those who wish to make their own, we have had many suggestions (Ref. 8). Servos developed for KD3, proven reliable, are still in use on KD4 . . . but they take a bit of work. Several manufacturers of commercial propo equipment offer spring-centered servos that will do fine with K.D. systems. Dee Bee Engineering and Glass City Model Electronics both sell servos based upon double-geared Mighty Midget motors. Imported Bellamatic II servo, tiny with high efficiency motor, has lots of power, drain is not too high. But most propo users have found it necessary to change spring centering method, ideas on this were in A.M. (Ref. 9). The concerns noted above also offer modified Bellamatic II servos for K.D. and other propo uses. The Reynolds servo is another commercial unit designed for propo. Based upon same Micro-Mo motor as Bellamatic II, it has somewhat similar spring centering system. Check A.M. for servo listings in past R/C Commercial News, study R/C catalogs for further ideas. New ones are entering the field quite rapidly. The "servo drought" is ending!

There is a lot of "kick" left in the ole Duck. If you can't afford exotic multi propo rigs, why not give it a try? If you already have a single channel tone transmitter and receiver that will pulse at reasonable speed, that's a good start.

References: (1) CAR (coupled ailerons-rudder) '64 A.M. Model Annual; (2) Mac-Tone receiver, July '62 A.M.; Aug. '62 A.M.; (3) KD3 Intermediate plane, Jan. '62, Feb. '62; (4) Handy-Mac transmitter, July/Aug. A.M.; (5) Propo servo, Sept. '62; (6) Bertrand feedback servo adapter, Mar. '62 A.M.; (7) Hill feedback servo adapter, July '62; (8) Servo hints using Mighty Midget motor, Aug. '61, Dec. '61, Mar./Apr. '63; Bellamatic II mods., Mar./Apr. '63.