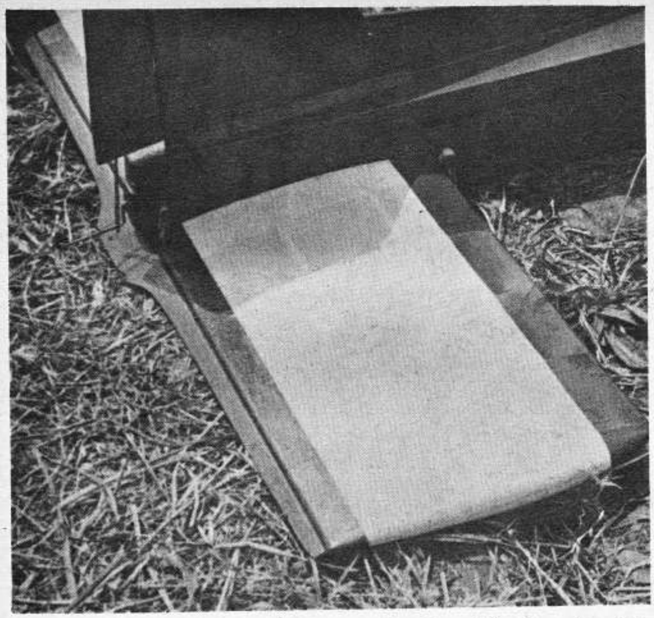
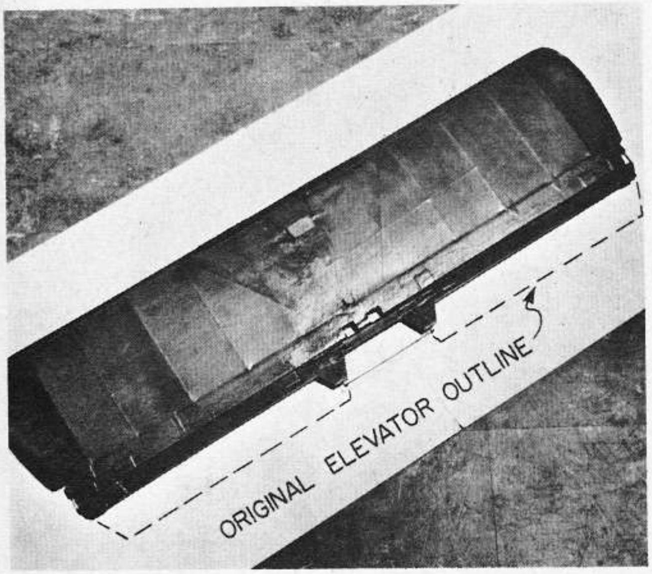
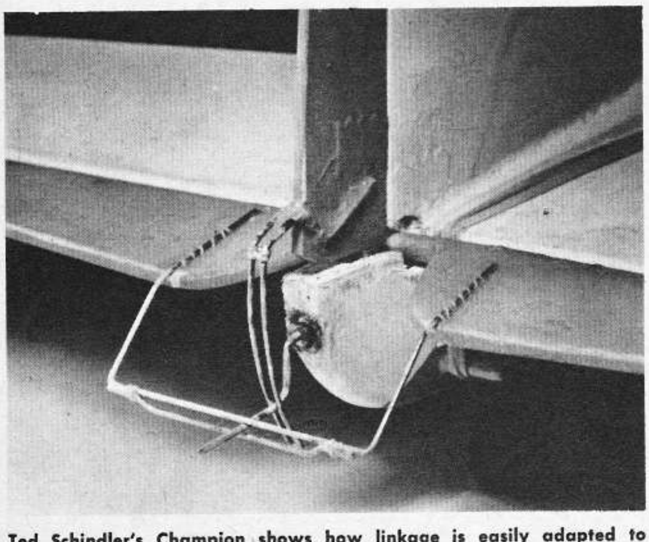


"Toothpick" elevator on Don Brown's Esquire. Ship flew inverted, topped pylon racers, best single-channel Langley round-up, '57.

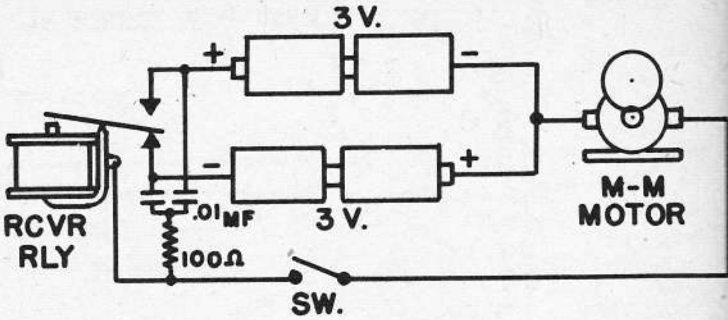


Modified stab, elevator, author's Cruiser, gave more control by ⅝" wide flipper. Counterweights on tips relieve actuator load.



Ted Schindler's Champion shows how linkage is easily adapted to existing models. Elevator and rudder yokes wrapped and soldered.

Basic S/S Wiring Fig. 1



SIMPL-SIMUL

PART TWO

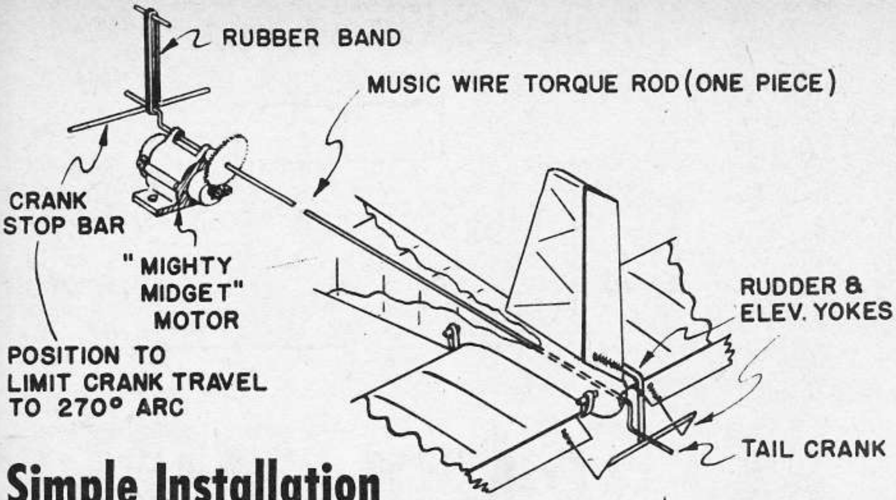
The mostest for the leastest, dual-simultaneous control system is easily installed in existing models. Prove it? That's a cinch!

by JOHN WORTH

► It was briefly explained in the preceding article that the Simpl/Simul control system provides simultaneous proportional control of both rudder and elevator by means of an uncomplicated model installation. The simple wiring diagram (Fig. 1) shows that only one actuator and two sets of batteries are used; controlled by a standard single channel receiver/relay combination. This is not a deliberately oversimplified schematic—that's all there is to it! When switched by pulsed transmitter signals of varied rates and widths, the relay alternately reverses polarity of current through the actuator, causing it to oscillate in various patterns which are related proportionally to the signals. Simple torque-rod linkage transfers the oscillations to rudder and elevator yokes which continuously flap the control surfaces about average positions corresponding to the signals. Natural damping of the model then irons out the action and the flight path is smooth despite the fluttering tail surfaces. The model responds instantly to an unrestricted control stick and flying calls for real piloting. With controls that can be mixed and coordinated as desired, the S/S puts you in command all the way, unhampered by control sequence lags or one-at-a-time control availability. That's the pitch and here's the know-how to get you into the act:

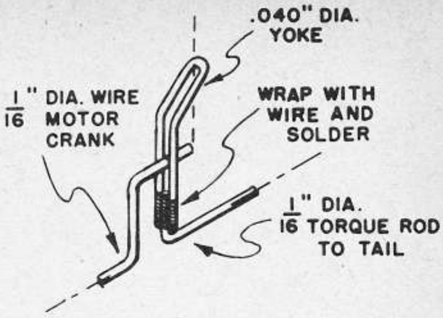
MODEL DETAILS

Suitable Designs: The S/S has been flown in a dozen different models, ranging from an .09-powered Breezy Jr. to a .35-powered Live Wire Cruiser. All have been fine performers. If there is an optimum size, it probably is represented by the .15 glow-powered Esquire or the .15 diesel-powered deBolt Champion. For any size model, best performance is obtained with a wing loading below 16 oz. per sq. foot, though up to 20 oz. is acceptable if provided with ample engine power. High wing loading, however, produces a fast flying "bomb" that requires considerable piloting skill to fly. Low wing loading eases the learning period and also provides spectacular performance, including inverted flight which is otherwise practically impossible to achieve.



Simple Installation

Fig. 2



Actuator Coupling

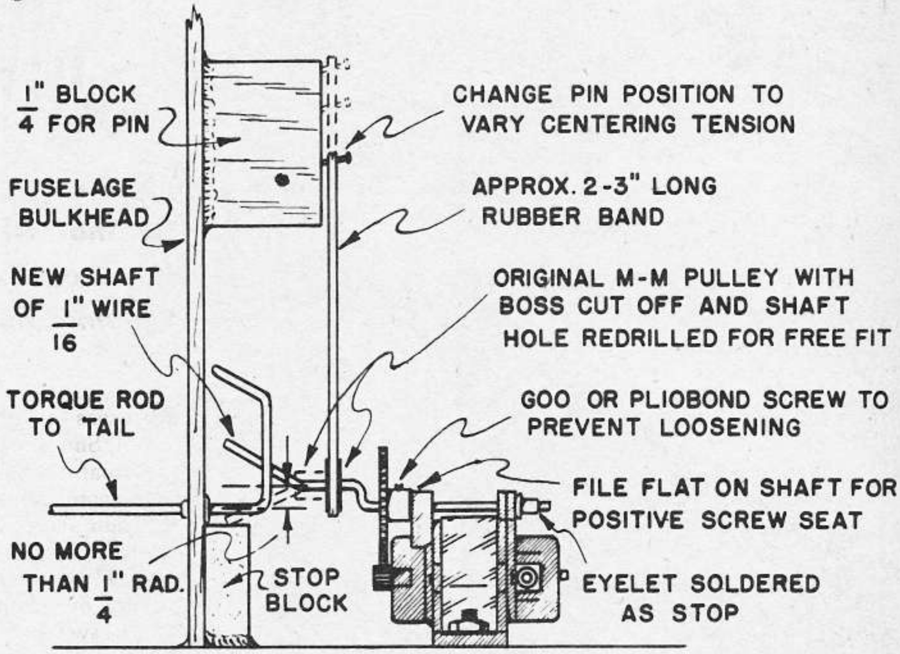
Fig. 3

Basic Installation: Most models can be quickly equipped for S/S with the simple arrangement shown in Fig. 2. The original shaft for the large gear on a Mighty Midget motor is removed and a length of 1/16" music wire is substituted. One short radius crank is provided at the motor and a larger one at the tail of the model. In between, the shaft is perfectly straight, being supported only by the motor, a bearing at the tail end and, if necessary, loose-fitting guides along the length to hold down whipping of the shaft. To prevent binding and alignment problems no other bearings are used. A rubber band hooked over the crank at the motor provides centering tension, and a bar placed across the crank travel arc limits total crank rotation to about 270 degrees. Fig. 4 illustrates details of a more developed actuator installation, featuring several recommended refinements, but the simpler Fig. 2 set-up performs just as good.

Linkage Disconnect: Many fliers prefer a coupling link which permits simple disconnection of the motor for inspection or maintenance. One such coupling is shown (Fig. 3); adaptable to most models and particularly to the very popular receiver/battery/actuator packages typical of the deBolt-type models. With this type of coupling, the package is simply slid in or out of the model, with automatic linkage engagement or release. Torque rod centerline should coincide with that of the actuator gear, though up to about 1/16" horizontal misalignment (side view) may be acceptable. Lateral alignment (as seen from above or below) should be exact.

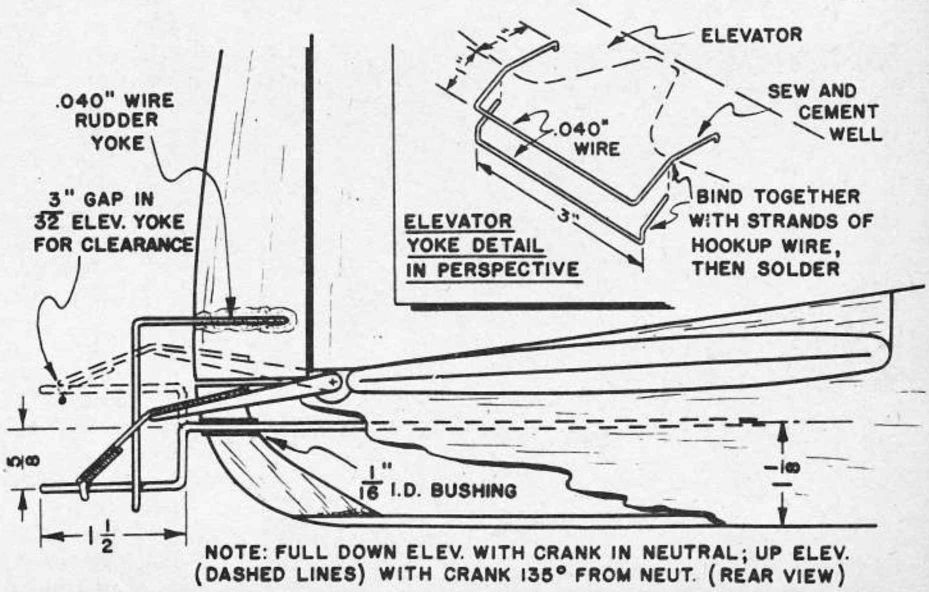
Centering Tension: The rubber band has proved to be completely satisfactory, with hundreds of flights made among a number of models without a case of breakage. If a band does break, air loads in flight provide enough centering action to maintain control. Hold-

(*Continued on page* 46)



Typical Actuator Installation **Fig. 4**

"Champion" Tail Linkage **Fig. 5**



NOTE: FULL DOWN ELEV. WITH CRANK IN NEUTRAL; UP ELEV. (DASHED LINES) WITH CRANK 135° FROM NEUT. (REAR VIEW) tioning the gear and the wheel-pants keeper. Solder securely. Cut a piece of ¼" scrap balsa to fit between the gear wires, and cement in place. Sand to airfoil shape and cover with silk.

Tack cement the 1" x 2½" x 33" soft balsa fuselage top block in place, and carve to shape. Remove and hollow to ⅛". Insert the flaps in the fuselage, slide the wing in place, and cement thoroughly. Install flap hinges to the wing, cement stabilizer in place, hooking up the pushrod as shown, recement the top into place, and plank across the bottom. Cement the rudder on, and the flap and elevator fillets.

The cowling is made from a 1" x 2½" soft balsa block, and a ½" x 2½" block, which are cemented together to make the required depth. Carve to shape, and hollow to ⅛". Plastic balsa fillets are formed around the wing and flap fillets, and stabilizer elevator fillets, working to shape with your finger.

Cover the wing with silk and clear dope until all the pores are filled. The rudder, stabilizer and elevator are covered with Silkspan, as this will pick up less weight in finishing.

Brush two heavy coats of wood filler on all exposed wood parts, and then sand back down to the wood. Apply two or three coats of clear dope to the rest of the model and sand lightly. The whole model can now be color doped and trimmed to your taste. When finished, cut the bubble canopy to fit and, using a few pieces of masking tape, stick to fuselage, running a fine ribbon of cement around the edge. If you wish, dummy exhaust stacks may be added to dress up the nose.

Pick a fairly calm day to test fly, and for the first flight use only ¾ power. Don't try to be fancy until you are familiar with how the model responds. You will find it to be extremely groovy, and very easy to handle, but it can also make square corners really square.

I like a fast flight with plenty of pull on the lines, so I use the silver restrictor in my Torp, but if this is too fast for you, change to the green restrictor.

A word of caution. If you are flying in a strong wind, open up those maneuvers because this model really moves.

Foreign Notes

(*Continued from page 7*)

layer control and one solution here is surface spars to intercept the covering sag behind the leading edge. Australia's Jim Fullarton used them on his 1958 Australian Nationals winning Wakefield and gives them the credit for the model's excellent glide. For the benefit of the sceptics, Jim quotes the example of the dimples on a golf ball . . . put there for the same purpose because manufacturers discovered that the dimpled ball could be driven farther than a smooth one. . .

CZECHOSLOVAKIA

Czechoslovakia is expected to present a really strong challenge in the FAI free-flight gas World Championship event this August at Cranfield, England. For this and other FAI f/f and teamrace events, the State sponsored Model Research Center at Brno which was responsible for the last year's World Champion speed engine, is producing appreciable numbers of a high-performance Diesel known as the MVVS type 2.5/1958.

The engine shows some changes from the prototype unit described in our May column and the exhaust stack is now at the side instead of behind the cylinder. Claimed output is .310 brake horsepower at 15,800 rpm which, if generally representative of stock models, would definitely put the MVVS on a par with the Oliver. The motor has a bore and stroke of 15 x 14 mm. (.5905) x .5512 in.) giving a displacement of 2.47 c.c. or .151 cu. in. and weighs 5 oz. It is of the front rotary type with twin ball-bearing shaft.

SWEDEN

Winter flying on frozen lakes is quite the thing in Northern Europe. Times are often surprisingly high. In the Annual Swedish Wintercontest held at Norrtalje there were 120 entrants and the top two in Wakefield both exceeded the five-flight maximum score. Winner in A2 was well-known Rolf Hagel, also with a perfect five-flight score of 900 sec. Gas event went to free-flight expert Hans Friis with 845 sec.

WEST GERMANY

We hear that the German OMU radio-control manufacturers have taken over production of Stegmaier's 8-channel vacuum-actuated radio-control equipment. . .

Rumored from Webra: two new motors in the .15 and .20 cu. in. classes named, respectively, Comet and Bully. . . . Hobby shops are now accepting orders for the Webra-built Ruppert Twin, latest provisional price of which is approx. $60.00. . .

The German RC Nationals, separate from the free flight and control-line contests, was to be held at Darmstadt, July 1-2.

Simpl-Simul

(*Continued from page 23*)

ing the centering crank to 1/4" or less permits high rubber tension to be used for snappy action yet does not excessively limit actuator motion. A pulley on the centering crank helps to hold the rubber band in place and reduces friction to prolong rubber life.

Crank Stops: Positive limiting of crank throw makes centering tension and actuator voltage non-critical. With fresh batteries, the crank drives quickly and provides very effective up elevator since the crank dwells momentarily on the stops between pulse reversals. As the batteries taper off, crank swing slows up and limiting is accomplished more by the rubber tension than by the stops. Up elevator becomes less effective, but the transition is gradual. Ample warning is given over a period of several flights; in fact, many fliers obtain extra flights by simply reducing rubber tension slightly to loosen crank action. Good system voltage tolerance is indicated by the fact that with three volts nominal actuator power reliable operation down to almost two volts is normal.

Tail Crank: Details of a deBolt Champion model installation are given (Fig. 5), but crank shape and size will vary with different models according to the factors of: distance between torque rod and elevator centerlines, location of torque rod above or below the stabilizer, the amount of control movement desired. In any case, the crank throw should provide neutral elevator when the crank is displaced 40 to 50 degrees from the center or neutral rudder position. In different models, this may require an elevator yoke above, in line with or below the elevator trailing edge. After bending the elevator yoke to obtain neutral elevator with the crank at approximately 45 degrees from center, correct proportional action is automatically provided and more or less elevator throw is then obtained by adjusting the elevator yoke to ride the crank nearer or further away from the elevator pivot. Rudder yoke may be either ahead of or aft of the elevator yoke, but allow for the fact that the latter slides slightly fore and aft on the crank during operation. Avoid using wire heavier than .040" for yokes as too much mass requires a lot of power to drive and exaggerates vibrations.

Linkage Freedom: There must be no binding in the system. Avoid close tolerances on yokes, bearings and hinges. It's a good idea not to anchor yokes too well until final linkage construction is approved; pulsing may reveal problems that require changes to be made. Lots of play in the system is not harmful as the wide range of control available compensates for loss through slop. The linkage should work perfectly without lubrication and with the model held in all attitudes. Once the system works perfectly while dry, light oil can be added sparingly at friction points to hold down wear and corrosion. Don't depend on solder alone for music wire joints. Wrap before soldering with stands from hook-up wire to aid fatigue resistance. Finally, go over all glue joints several times to make sure they will hold up under the punishment of continuous flapping.

Control Surfaces: Great control effectiveness is provided by large rudders and narrow-chord elevators. In comparison with a typical escapement rudder, half again or even twice the area has worked out well. But elevators seem best with an average chord less than 1", even on a Live Wire Cruiser size airplane. This is not to say that conventional elevators, such as those used on the Champion, are not satisfactory, but that more effectiveness can be obtained with less surface area. Don Brown's .15-powered Esquire flew inverted with elevators of only 1/4" chord! Narrow-chord elevators reduce hinge moments and allow the actuator to put more of its power directly to work, without being wasted in lifting large floppy surfaces. Elevators are best if full span and are very effective if simply hung on the straight trailing edge of a conventional stabilizer. Angular travel of surfaces is desired to be at least 20 degrees each side of neutral, with up to 45 degrees acceptable. With large rudders, less throw is needed; likewise, narrow-chord elevators should use maximum throw. Hinges should be very free and simple fabric or cross-thread types have proved to be excellent. Static and/or aerodynamic balancing of elevators will help to increase effectiveness for maximum maneuverability without overloading the actuator and permits lower voltage.

COMPONENT RECOMMENDATIONS FOR RELIABILITY

Actuator: Practically all S/S flying to date has been done with the Mighty Midget motor, including the commercial Robot Jr. actuator which does the same job with different linkage. The M-M motor has good torque, low current drain, positive starting and reversal, plus a built-in reduction gear just right for the S/S. However, the M-M is plagued by fragile construction and has become reliable and rugged only through modification. Brush blocks should be secured against vibration loosening by applying a generous coating of Goo or Pliobond type cements. Simply coat the cement over the brush terminals (after wires are attached), covering them completely and also the adjacent portions of the plastic motor case. Reinforce the motor mounting lugs and the case by extending a 1/2" wide strip of .010" thick aluminum or brass from one lug, across the top of the motor (under the reduction gear shaft), then down to the other lug. Less necessary, but still worthwhile, is another strip underneath the motor from lug to lug. A balsa block cemented to the floor and butted against the forward end of the motor is also recommended to take impact loads.

Another motor which looks very promising is known as the Minitone. It has good mechanical construction with electrical performance very similar to the M-M. This motor may eventually be preferred to the M-M for most proportional pulse actuator use since it appears to be built for more wear and tear. Meanwhile, the beefed up M-M is quite capable of more than a hundred flights before wear of its plastic bearings becomes excessive. Its low cost, however, suggests replacement when sloppy rather than stretching operation too far beyond the M-M's initial reliable performance period.

Relay/Receiver: If no more than a 2 ma current change is available, a Sigma 4F relay is recommended. With at least 3 ma swing, the subminiature Gem relay is completely reliable. The relay should be adjusted well within the middle of the receiver current change values; at least .5 ma should be available beyond the pull-in and drop-out current settings of the relay. What ever relay is used, spark suppressors should be wired across the contact points to prevent pitting and adjustment shift—the simple condenser-resistor hookup shown as part of Fig. 1 has worked very well. Ceramic condensers are recommended and the resistor can be a common 1/2 watt 10% tolerance carbon type.

Besides providing adequate current change, the receiver should pulse well. The old standby Lorenz two tube receiver in the original and later Gazistor variations

(*Continued on page* 50)

are fine for the S/S. But if diodes are used to couple a hard-tube second stage, the Lorenz may or may not be satisfactory—some versions have a lagging pulse response. Best bet is to try operation while pulsing at high rates; no skipping or erratic action is acceptable. The same goes for hard tube receivers since not all pulse well. Several which have worked well are the Controlaire Sm-1, the Citizenship 27, the Essco THT.

Batteries: Requirements may seem high, but remember the great control provided. For smallest ships, four pencells supply adequate power in two pairs for a dual 3-volt system. Above .15 powered ships, use four medium cells or eight pencells to supply longer life power for 3-volt systems. For Cruiser size ships, 4½ volts may be used if 3 volts is not enough for solid up action—this is more than adequately provided by 9 pencells or 6 mediums (at this stage, however, subminiature wet cells offer substantial savings in weight and size; 4 volts is ample for any installation). More than 3 volts is desired on large models if control surfaces or linkage loads up the actuator so that it drives through 270 degrees at low pulse rates only with very light centering tension. Also, if it is desired to operate at higher pulse rates to prevent model waggling, higher voltage may be necessary for faster actuator response.

FINAL CHECKOUT

Synchronization: First item to check is agreement of model equipment response to pulser stick movement. All linkage and tail surfaces should be installed and actuator batteries should match closely in load voltage; measure while momentarily stalling the motor. With the stick neutral and pulser clicking away, switch on the transmitter and then the receiver. Listen to the receiver relay—it should bang away cleanly and sound just like the pulser relay, with no skipping at extreme pulse widths and high rates. When satisfied that the relay sounds okay, switch on the actuator circuit. The crank should swing symmetrically on each side of neutral with the stick centered and should move to the right with right stick and left with left stick. If opposite, reverse actuator battery polarity.

Centering Tension: Adjust for the highest tension which will let the crank swing through a 270 degree arc at lowest pulse rate (about 3 cps), with neutral rudder signals. Then shift to high rate (at least 6 cps) to check for a crank swing of not more than 45 degrees total arc. Increase the maximum pulse rate by pulser readjustment, if necessary, to shrink the arc for positive down elevator—approximately 9 cps will shrink the arc to about 20-30 degrees. Final tension adjustment should be made after brand new batteries have eased down from their initial peak voltage.

Symmetry: Looking at the tail of the model, with the control stick centered, note if the crank oscillation is equally divided on each side of center. If uneven, see if the unbalance changes, more or less, when actuator battery sets are interchanged. If it does, the actuator battery voltages are excessively unmatched. Also, try switching actuator battery sets so that polarities are reversed. If unbalance then shifts to the opposite side but otherwise is similar to that previously noted, the receiver relay may need slight touching up to center the action. If unbalance persists despite balanced voltage, best relay adjustment and clean relay points (both pulser and receiver), the pulser probably needs finer trimming of the width pots. Juggle the control stick pots slightly from the positions obtained during the check-out procedure described in the previous article. Make pot adjustments in very small amounts, always noting previous pot position for comparison, until a fair compromise is reached. Check frequently by watching the surfaces flap and noting the crank swing pattern changes as the stick is moved.

Occasionally, all efforts to balance the pulsing may not be successful. A few cases have occurred in which a slight pulser circuit change was necessary. Across the pulser relay was shown a .1 mf condenser and a 10k resistor in series to provide suppression of the inductive kick which results each time the relay coil is de-energized. The kick, which can interfere with circuit action, may get through one set of components and not another, though both are similar. If this rare condition is encountered, the condenser and resistor might better be replaced by a diode. One which has worked well is the Federal 1T1—wire the Cathode end (plus) to eyelet B and the other end to Flea Clip L1, eliminating the need for eyelet A.

Acceptable Performance: Don't be too fussy. Getting control action in the right direction is initially more important that getting any definite amount. Most likely it will be noted that in maximum down elevator position full rudder control will be obtained with very little stick motion on either side of center. Further side stick motion may in fact produce a rate slowdown which actually results in up elevator rather than down. This condition is not serious and is usually caused by having too much pulse-length variation available. Most fliers simply do not use full side stick deflection in full down elevator or merely block off the stick hole to prevent excessive side stick movement. The important thing at first is to get in the air with positive up, down, right, left and a roughly centered neutral. Later, the model and the pulser can be trimmed as needed for most control effectiveness. Even a crudely balanced pulser provides more control than is usually necessary for testing.

Initial Flying: Be alert from the instant of launch as the model responds immediately to every stick motion. In fact, for hand glide tests, it helps to have an experienced hand at the stick to fly the model through the heave. A poor launch is instantly correctable and a considerably out of trim model can be successfully flown. But make the S/S introduction easy on yourself by having the model in good trim before flying; if possible, let a practiced dual proportional flier get the ship to altitude before taking over; keep first flights short. Until you get to be in full command of the model, early S/S flights can be rough on the nervous system, particularly if you're used to escapements and their hands off rest periods between beeps.

A stable model will also make S/S flying easier since it will be less sensitive. The simplest assurance of stability is a center of gravity location between 25 and 30% of the wing chord, with between three and five degrees incidence difference between wing and stabilizer. Freedom from warps is also a great help. Use more power than you would for initial rudder-only flights, to help pull through stalls and to aid penetration. Spring centering on the control stick is not recommended for early flights since an out-of-trim model calls for offsetting the stick to compensate and this is easier to do if not opposed by spring forces. After landing, switch actuator circuit off before stopping the pulser. This prevents one set of batteries from getting more use on each flight as would happen with repeated stalling of the actuator motor before the model is retrieved.

The next article will cover hints of model trim and flying as applicable to the Simpl/Simul, besides providing details of system variations for additional control. Meanwhile, the system invites adaptation to existing models for maximum control at minimum cost. For most, the S/S needs no further elaboration to provide the greatest sport flying satisfaction. For others, the information to follow will indicate how to get more out of the S/S for hotter piloting.

The Orbit

(*Continued from page* 19)

build a Half A speed model. The Orbit A, B, and C flew so well that I decided to build the Half A using this design. There were two other Orbit Half A's built by two juniors, ages 11 and 15. The 11-year-old boy flew his model successfully the first flight without a mishap. He had never flown a speed model before. The 15-year-old boy is Hardy Lewis, Jr. He now has flown his model at the Southwest Model Airplane Championship and the '57 Nationals at Willow Grove. He won first place at both of these contests! He turned 90.60 mph at the Nationals. The success of these two boys with their Orbit Half A's should make the model worth your time to build.

I finished my Orbit Half A two days before we left Dallas for the Nationals and Leland test flew it twice, and turned speeds of 95 and 102 mph. So my hope of placing at the Nats seemed good. Hope became reality when I placed second at the Nats with a speed of 96 mph.

Leland said the Orbit Half A flew better than any such speed model he has flown and he has flown several different designs of models. He said it controlled and flew like a larger class of model.

The Half A weighed 5½ ounces, slightly more than most Half A's. I believe that an ounce or so more weight will not slow the speed down any when models get this small. I have found that a Half A that weighs a little more will fly more stable in the wind. I built one Half A that weighed 3½ ounces and I couldn't keep it out on the end of the lines when flown in the wind. At most contests that we go to the wind is flowing ten mph or more.

The engine I used was the Thermal Hopper, but you could use any Half A engine you want to. The Thermal Hopper has no exhaust stacks so I formed some stacks from shim stock and soldered them to the cylinder. You have to be really careful not to get solder inside the cylinder. Unless you are familiar with soldering I would recommend that you not risk ruining a cylinder. I believe that it helps a

(*Continued on page* 54)