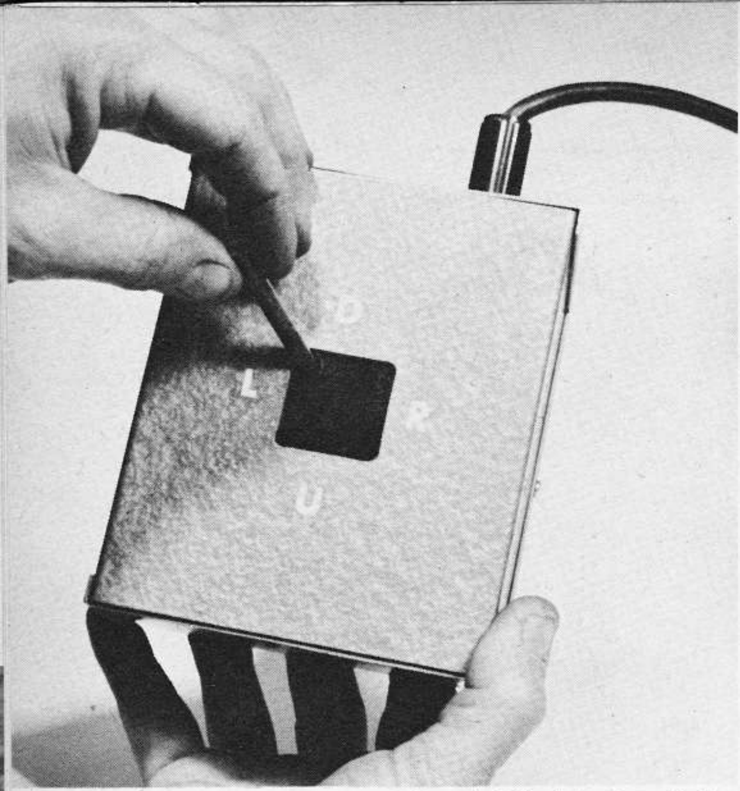
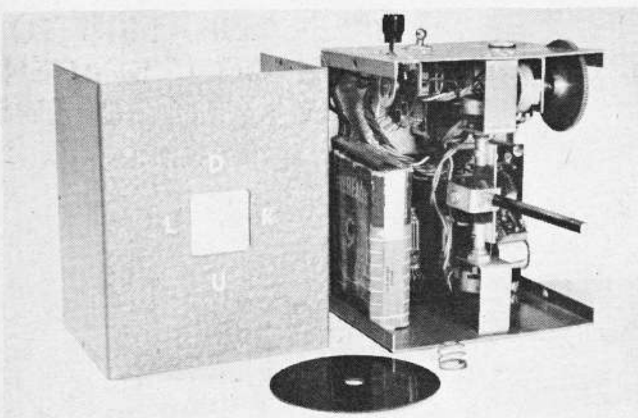


Good control box—this month's subject, is 90% of the story. It plugs into transmitter like keying lead. Control surfaces slave to the stick.

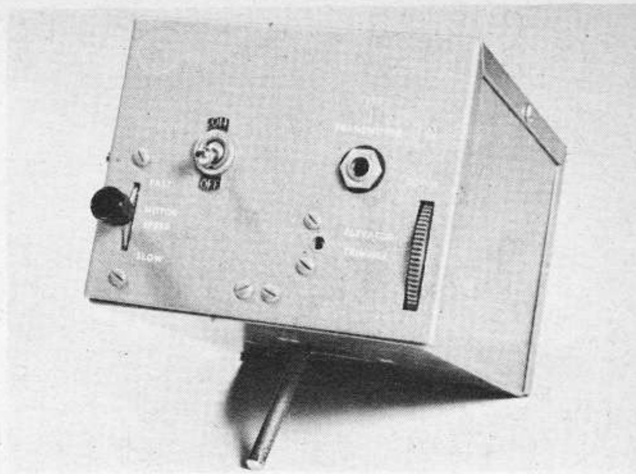


Cover, dust plate, removed to show innards of electronic pulser. Latest techniques have eliminated unsightly "wiggles" of planes.

simpl-simul

by JOHN WORTH

Simultaneous and proportional elevator and rudder control—thoroughly de-bugged system offering matchless smoothness in flight at a reasonable cost. The first of three well detailed articles.

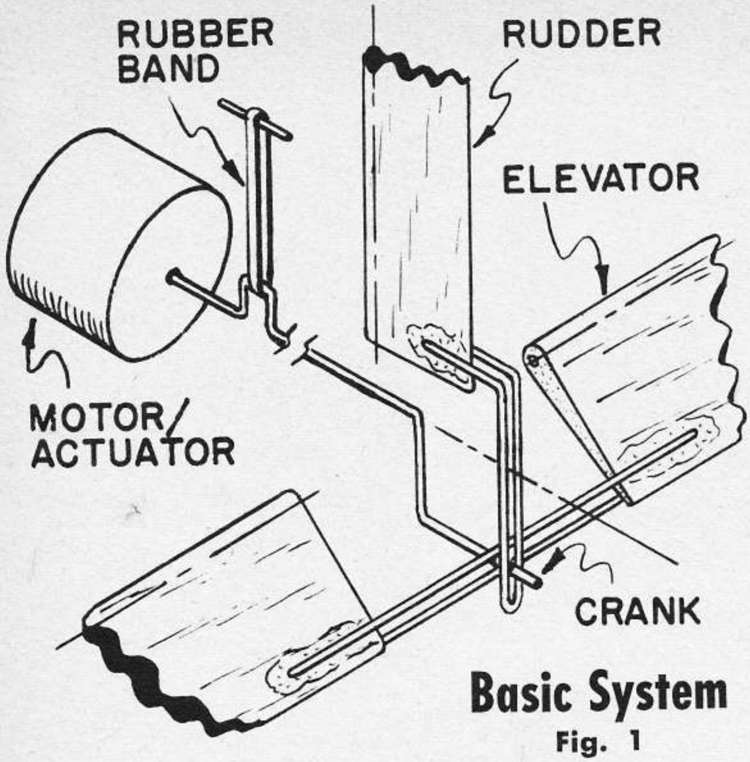


Additional controls on side of box provide, left, high-low motor, and, right, elevator trim. Equal to seven channels. But smoother, precise.

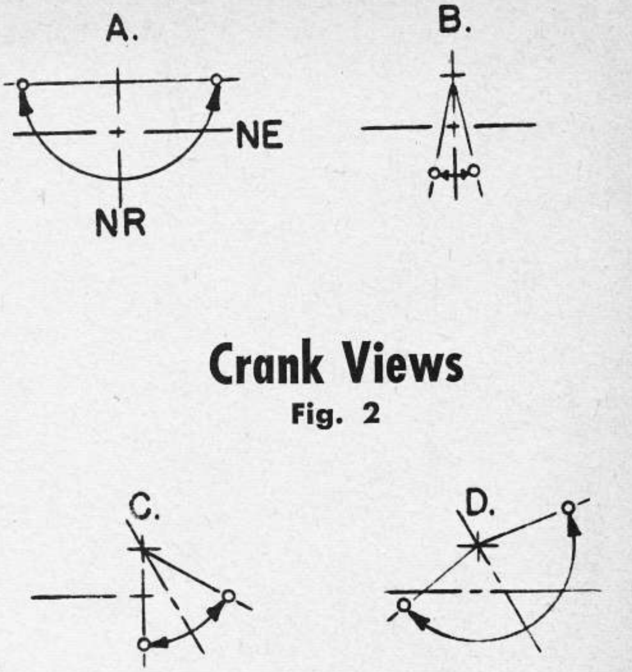
Small sport job, Capt. M. McGuinn, typical type ideally suited to Simpl/Simul. System can handle the bigger, high powered jobs too.

► Between eight-channel reed developments and Walt Good's ultra dual proportional tone system, it may seem that a fat wallet is needed to obtain top RC performance. But the poor man is not left out as a result of the proving of a fabulously simple control system that provides great performance at a cost so low it's almost embarrassing. Now dubbed the Simpl/Simul, this system has gotten a very thorough shakedown and is ready to breathe new life into old single-channel equipment and models. Providing simultaneous proportional rudder and elevator control, the S/S soups up old crates with aerobatic performance and, in airplanes specifically designed for the system, promises respectable competition even against the big money ships.

Bill Sydnor appears to have been the first to fly with the S/S, in Pa. back around 1950, but development lagged for lack of a satisfactory ground control unit and a suitable actuator. Around 1953 in N.J., Don Brown and Bill Gilkey made the system perk by adapting to it a multivibrator type electronic pulser and the now well known Mighty Midget motor. Don also contributed a universally mounted control stick to operate the pulser with natural piloting action. Tagged as the "Crank", the system was flown successfully in N.J. for quite awhile before being taken up elsewhere. In mid-'56, at Langley Field, Va., under the name of the "Galloping Ghost", the S/S caught on like wildfire. Within a year, 12 S/S airplanes were flying within the S. E. Va. RC Group and well over 500 flights were racked up. The group learned to trim the gallop out of the model, came up with several ingenious auxiliary controls and provided a concentrated proving ground which established the S/S as ready for the rank and file. Among those who contributed most to the Va. activity are: Nate Rambo, Ivan Beckwith, John Moore, (*Continued on page* 28)

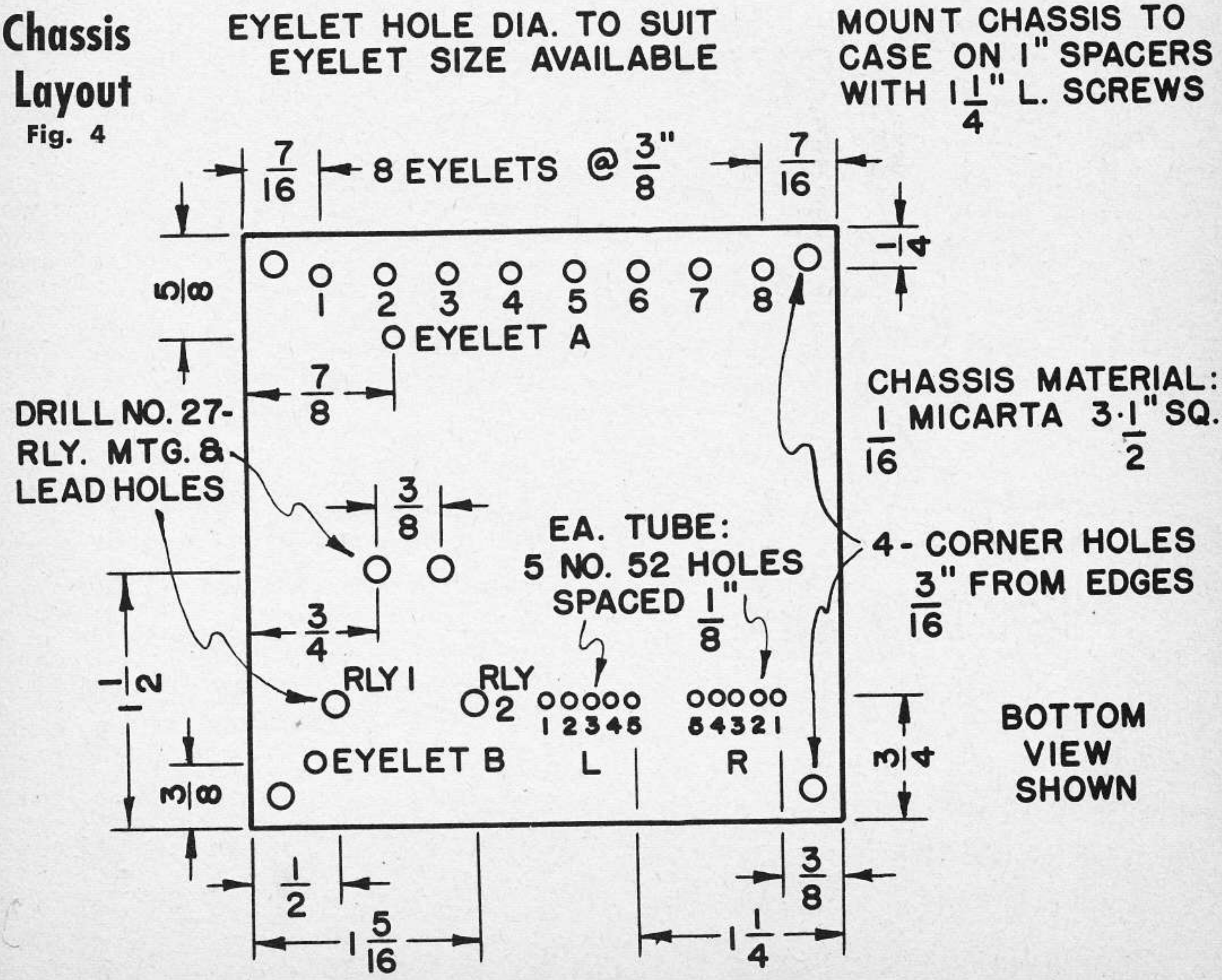


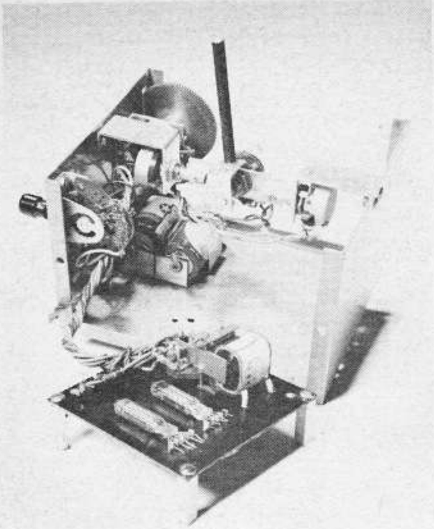
Basic System
Fig. 1



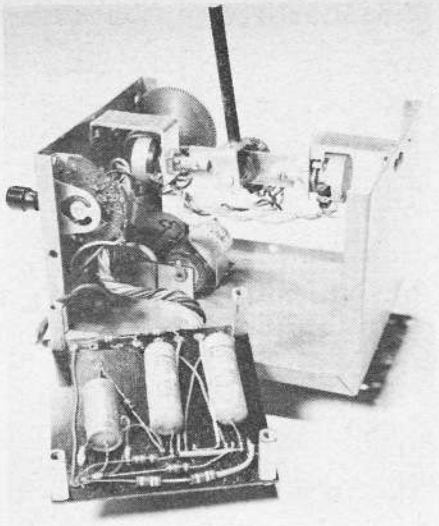
Crank Views
Fig. 2

Chassis Layout
Fig. 4





Pulser removed, showing Sigma relay mounting, two tubes. Stick assembly simple practical.



Same view but with pulser inverted to show how wired. Makes schematic translation easy.

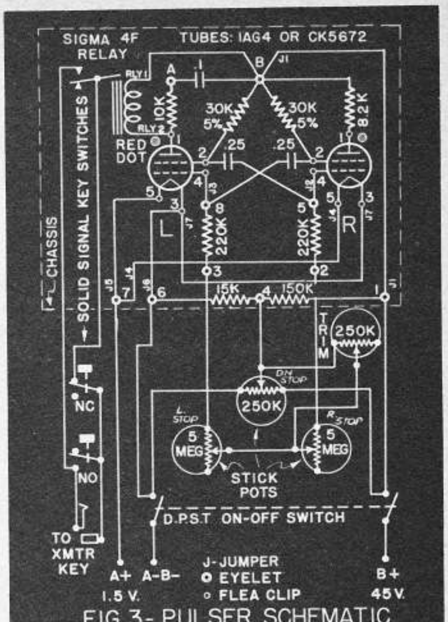


FIG. 3- PULSER SCHEMATIC

Simpl-Simul—*continued*

Don Hewes, John Worth.

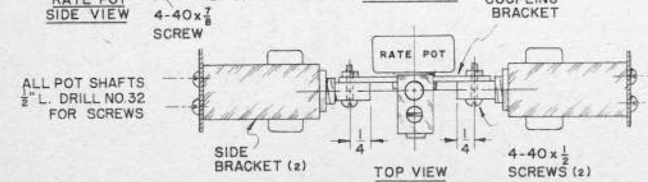
Description of system: Simpl/Simul is short for simple, simultaneous, dual-proportional control. As a pulse system, it is like others in that variation of pulse length is used for rudder control and pulse-rate variation is used for elevator control, but it differs in that the separation of control signals in the model is accomplished mechanically rather than electrically. Also, only one actuator is required to operate both control surfaces.

For rudder control, operation resembles conventional pulse practice, since switching the transmitter on and off rapidly results in the actuator flapping the rudder from side to side while providing an average position proportional to the ratio of the on/off segments in each pulse cycle. For elevator control, the variation in amount, or amplitude, of actuator crank throw which occurs at different pulse rates is used to flap the elevator up and down about an average position proportional to the number of pulse cycles per second. The basic actuator and linkage is shown by Fig. 1.

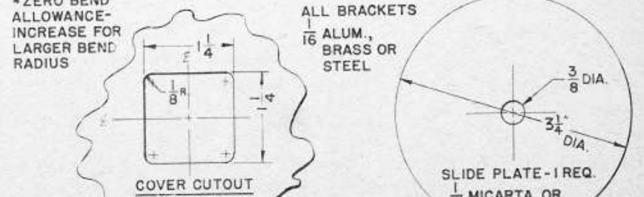
Crank travel is normally limited to an arc of about 270 degrees. Within that range, crank oscillation may assume many variations of amplitude and mean position. As seen from the rear (Fig. 2a), with equal on and off pulses at a rate of about five cps (cycles per second), the crank describes equal arcs on each side of center to produce an effectively neutral rudder while oscillating through a total arc of about 180 degrees to produce an up elevator condition. Without changing the pulse-length relationship, neutral rudder can be maintained while shifting to down elevator by simply speeding up the pulse rate. As shown (Fig. 2b), a pulse rate of about eight cps shrinks the arc to about 20 degrees, producing a practically solid down elevator. The action is proportional on a time basis; the elevator stays longer on the up side of neutral at low rates while at high rates it stays longer on the down side.

For any crank amplitude the rudder position corresponds to a mean line dividing the crank arc into equal halves. For neutral rudder the arc straddles the model centerline, but for unbalanced pulse-length ratios the arc shifts proportionally to the corresponding side. Yet, for any given rudder position, the elevator position can be changed by fanning out or shrinking the arc through pulse rate variation (Fig. 2c & d). Due to effects of spring centering and motor acceleration, rudder and elevator responses are not linear, yet interaction between controls is negligible in flight. The full freedom of control stick movement provided by S/S makes rudder and elevator coordination completely natural, with any available amount of either control subject to stick position.

Stick response is immediate and permits constant altitude turns into or out of the wind, true crabbing for straight cross-wind flying, flat pull-outs from loops, nose-down trim for wind penetration, etc. Of course, skill is involved, but with the universally mounted control stick it is an instinctive piloting action. (*Continued on page 46*)



CONTROL STICK & POT ASSEMBLY



CONSTRUCTION DETAILS

semble the horizontal tail and cement in place, completing the control system before the top and bottom of the fuselage are covered. Construct and install the fuel tank and nose gear. The fuselage may now be completed.

The windshield is not difficult to get neatly in place if care is taken. Dope the cabin floor to your liking. We chose a cream trim and used the same on the cabin floor. After this is doped, bend two wire cabin forms to shape and cement these in place in the fuselage. Cut out the celluloid windshield and stick in place with Testors hot fuel proofer or a good plastic glue.

Cut out and install the twin rudders and rudder fillets. Cement rudders well as they are very vulnerable to clumsy handling. Cover the wing with Silkspan and your model should be complete.

For a reasonably good and light finish the following procedure may be used. Brush several thin coats of fuelproof dope on the wings and one on the fuselage. Use Aero Gloss plastic balsa as a filler around the windshield and anywhere else it is needed.

To finish the wood areas, mix talcum powder in thin clear dope and apply three coats, sanding after the first and last coats. Apply another thin coat of clear over the wood areas. The original model was finished with two or three coats of metallic blue fuelproof dope and trimmed with cream. This made for a pleasing color combination and model. Check the CG location and you're ready to test hop your Sportcoupe.

Hook up a set of 42 or 44 foot .010" lines and you're ready to go. A handle with lines 2"-2½" apart works quite well.

If you are new at flying U-C models, you may want to run the engine a little slower on your first few flights. With a Torp .09 and Thermal Hopper fuel this model is surprisingly fast. It gives a good firm tug on the lines when flying through maneuvers and is quick to react. When using full power, don't expect this model to hesitate once it is released!

Simpl-Simul

(*Continued from page* 28)

Loops, wingovers, Immelmans, vertical banks, low level buzz jobs, etc., are all ordinary maneuvers with the S/S and the system is ideal for the AMA Pylon Racing Event. Inverted flying and vertical dives are also possible, though they do require careful matching of model design, power, control surfaces and model trim. The right model in the right hands is all it takes to compete with the best. Don Brown, with S/S in a Live Wire Trainer, placed first in the Intermediate class at the 1957 Nationals.

PULSER CONSTRUCTION

General: If you're ready for Simpl/Simul, it's best that you start by building a pulser. Only the electronic types have been satisfactory and the multivibrator circuit has been the most popular. Since off-the-shelf units are not generally commercially available, construction is required. The design shown has evolved from several proved versions. Construction is simpler since no pot drive gears or special pots are required and metal work is kept to a minimum. As it may take some time to obtain the parts and to construct the unit, it is recommended that this chore be gotten out of the way first. Then, when the next article is released, with the model installation details, the pulser will be ready to operate. The model gear takes only a

(*Continued on page* 48)

few hours so you won't be delayed much if the pulser is ready to go.

Components: Study the schematic (Fig. 3) and the Bill of Materials for identification. Aside from two resistors which should match within 5%, the only critical components in the pulser are the grid condensers. These must be matched on a capacitance tester adjusted for test at 50 working volts, to match within .01 mf of each other. The actual value may be anywhere between .22 and .3 mf, just so both condensers are as close as possible to each other. (Note: capacitance may vary with voltage—a condenser rated for .3 mf at 200 working volts may check only .2 at 50 volts). Most parts suppliers can match these condensers for you; if not, try a "ham" operator as many have such a tester. Other than the fact that the condensers should be of the paper type (not electrolytic), it doesn't matter what brand or physical size is involved. No particular pots are required, except that all should have linear taper (equal variation of resistance throughout rotation range), body diameter should not be greater than 1⅛" and pot shafts should be ¼" diameter.

Fabrication: Hold case and bracket dimensions as close as possible since many are interdependent for proper stick movement without interference. Accurate forming of sheet metal pieces will be assisted by sharp bends, which do not require allowing extra metal for the bend, but the material must be very soft to prevent cracking; otherwise be generous with bend radius. Try a test strip in a vise: use a wood block and a hammer to fold the metal sharply. If it cracks, back up the metal with a wood block in the vise, with a rounded corner to fold the metal over. Allow extra length so that when bent, the bracket dimensions come out as shown. Cutting and drilling of pot shafts is simpler if they are held in a vise. Before drilling, center the shaft in approximately mid-range of pot travel. A cut off shaft makes a good control stick if it is of ¼" dia. solid rod.

Stick assembly: Mount coupling bracket to the 250k pot body, then stick and stick bracket to shaft. Install side brackets to case, then 5 megohm pots to these brackets. Join 250k pot and stick assembly to the 5 meg. pot shafts. Cut the stick hole in exactly the center of the case cover. With cover in place note the stick position relative to hole center when the stick is perpendicular to the cover surface. If not exactly centered, shim the 5 meg. pots and /or side brackets with washers, or enlarge the side bracket mounting holes and shift the assembly as necessary. Note that the ⅞" distance from pot centers to the inside of the top cover is very important for proper slide plate operation.

PRELIMINARY ADJUSTMENTS

Next, adjust each 5 meg. pot for proper stick side travel. The stick should hit one pot stop on the left extreme and the other pot stop on the right. Adjust each so that the stick hits the pot stop just as it contacts the side of the hole in the case cover. If it is necessary to have the pot terminals clear the side brackets (for easier wiring later), disconnect either or both pot shafts from the coupling bracket and rotate 180 degrees. Rotate the rate pot so that when the stick is in full down elevator position (and against the forward edge of the stick hole cutout) it just hits the internal pot stop. No stop other than the case is needed for rear stick motion. Next, slip the spring and slide plate over the stick, followed by the case cover. The spring should hold the plate up against the cover through all stick motions, to provide a dust seal. If necessary, squeeze or stretch the spring, or make another from heavier wire, to obtain a smooth sliding action without binding or dropping of the plate.

Case mounted components: Installation of these is not specified. Layout may be varied to suit individual preferences, though the arrangement shown by the photos is recommended for easy construction, good access and natural operation. The rate trim pot shown uses a large gear projecting through the case as a convenient trim tab type wheel for immediate in flight elevator correction at any time. A simpler arrangement would be to let the pot shaft project through the case and use an ordinary knob. Similarly, the lever type of switch shown, used for full signal on and off, is more simply replaced by two separate switches, as indicated in the schematic: one normally closed (for signal off) and one normally open (for signal on). In place of the keying cable jack, which makes pulser handling and storage easier, a permanently fixed cable can be used and simply wrapped around the pulser when not in use. Caution: if the keying jack is used, be sure it is insulated from the case as neither key lead should be grounded. Note that installing components on one end of the case makes for simpler wiring and aids an immediate external visual check (Sometimes important in flight emergencies—pulser cables have been pulled out and switches knocked off accidentally; though never with the front panel arrangement shown). Ample space is available for variation in battery choice, but capacity should not be less than the equivalent of two medium cells for A supply and one Burgess XX30 for B power.

Chassis and wiring: Chassis layout is shown by Fig. 4. Use the photos as a guide to component placement and double check connections by both the schematic and the Chassis Connection Chart. Note the features of the original layout: all but case mounted components are installed on the chassis so that only minimum additional wiring is needed; cabling wires together and connecting to chassis through terminal lugs or eyelets avoids a rat's nest of scattered wires; ample room provides individual accessibility for each component for simplified troubleshooting or replacement; relay adjustment screws are not blocked and contact points are clearly visible; different colored wires make hook-up and circuit tracing easier. Only stranded hook-up wire of at least 1/16" o.d. (outside diameter) is used, together with good model installation practice to prevent fatigued or broken wires. This is just as important on the ground as in the model. Note that the relay is shown mounted on the micarta chassis—if mounted elsewhere, the frame must be insulated from the case.

Note also that one side of the on-off switch is shown in the A minus lead. This is satisfactory if the pulser wiring is exactly like the original, but if construction is changed so that the case is used as a ground connection then the switch must be changed to the A-plus lead. Allow plenty of slack for the rate pot wires to move freely without stretching or excessive flexing. Hook up the outer terminal wires to the 5 meg. pots to those terminals which are used as the stick-travel stops. No connection is made to the opposite outer terminals of these pots. Make sure of correct polarity of the rate pot outer terminal hook-up. Finally, allow enough slack in the cable for the chassis to be pulled completely out of the case for inspection. The lead which connects to B plus must be at the terminal which is used as the down elevator stick stop.

OPERATIONAL CHECK AND ADJUSTMENT

After wiring is complete, install A batteries and one tube. Flip the switch on and check the tube for filament glow. If no glow, recheck wiring. If tube glows, cut switch off and insert other tube; check for glow again. When both tubes glow, shut down again, connect B battery and center the stick. Flip switch on to see if the relay pulses. If not, vary spring tension and/or contact clearances broadly to start pulsing, then finely for most solid and snappy action. Check rate-trim pot to see if it speeds up pulsing when rotated in the natural direction to obtain down elevator. If not, change the outer terminal pot lead to the opposite terminal.

The fixed position of the 5 meg. pots controls both pulse-rate and pulse-length limits. One section of each pot and the grid resistor (220k) connected to it together make up a total resistance leg which must be matched against the opposite pot and grid resistor. Equal leg resistances produce a neutral rudder pulse signal: signal on time equals signal off time. Both pots are linked together so that moving the stick sideways increases the resistance of one pot while decreasing the resistance of the other pot. This upsets the resistance balance to the tube grids and stretches either the on time as compared with the off, or vice versa depending upon the direction of stick movement. When initially adjusted as described, with the stick contacting the internal stop of each 5 meg. pot just as it hits the case side limit, a starting point is set up for further adjustment.

Check the pulse rate with the stick in the rear position (up elevator) and the rate trim pot set at slowest pulse rate. Do this by counting the number of pulses in a ten-second period, then divide by ten—up to six cycles per second can be easily counted this way. If the rate checks to be higher than four cps, each pot resistance should be increased by rotating the 5 meg. pots so that the stick no longer contacts the internal stops at the side limits. Moving each pot stop further away increases the resistance in each leg to increase the total resistance in the grid circuit to lower the rate. When the lowest rate is adjusted to about three cps, check pulse-length variation by listening to the relay action while moving the stick from side to side. Make minor 5 meg. pot adjustments to obtain what sounds like neutral pulsing with the stick centered and an equally progressive unbalance as the stick is moved to each side. Keep in mind that increasing both pot resistances together changes the rate while increasing one pot resistance and decreasing the other changes the pulse length ratio. At some compromise adjustment of the 5 meg. pots the low pulse rate may be obtained as desired while also maintaining equal pulse length variation to each side.

Check for equal unbalance at forward, aft and neutral elevator stick positions. It may be noted that with the stick centered the rate may be higher than at the side extremes, for any given fore-aft stick position. This is not objectionable so long as each side is similar. Symmetry of action is what is desired, rather than an exact linear response. At extreme high rates, with stick full forward and rate trim pot at maximum down elevator, symmetry may be lost but this is also acceptable. Just very slight rudder movement at full down elevator is

very effective so that full side stick motion in this condition is rarely used.

Final pulser check-out is done with the model installation in operation. For now it is enough to get a close approximation by adjusting as well as possible by ear. Actually, this is more accurate than it might seem, for most fliers soon learn to estimate closely pulse rate and percentage of length change simply by listening. Between the ears and the eyes (by watching the model linkage response) pulser adjustment needs no special devices.

The next article will present actuator, linkage and control surface details for both a specific installation and for adaptations to practically all models. The model set-up is extremely simple and offsets the comparative complexity of the pulser. Don't let the latter scare you off—once built, the pulser opens the door to a new world of single-channel flying. You haven't really gotten the most kick out of radio control until you've flown with simultaneous proportional control and no system provides it with as much satisfaction for so little investment as does the Simpl/Simul!

BILL OF MATERIALS

Pots: all linear resistance taper, IRC PQ type or equiv. 2–5 megohm, 2–250,000 ohms.

Resistors: all ½ watt, 10% tolerance unless specified. 2–30k (5%), 2–220k, 1–8.2k, 1–10k, 1–15k, 1–150k.

Condensers: 2–.25 mf, 50 working volts minimum (may be from .22 to .3 mf, but must be matched within .01 mf). 1–.1 mf, 200 working volts minimum.

Tubes: 2–1AG4 or CK 5672.

Chassis: 1–1/16" micarta, 3½" square, 10 eyelets, 10 flea clips.

Relay: Sigma 4F 8000 ohms (or Sigma 5F).

Case: 4 x 5 x 6 Alum., ICA type 29442 or equiv.

Components of personal preference: 8 ft. of 2-conductor keying cable with plugs and jacks to connect pulser to transmitter; single or separate switches to provide full signal on and off, DPST on-off switch, Knob for trim pot.

Miscellaneous: 1/16" alum., steel or brass for brackets, ¼" dia. rod for control stick, 1/32" alum., brass or micarta for slide plate, slide plate spring, chassis stand-off spacers 1" long, screws and nuts.

Batteries: 2—medium cells in parallel for 1½ v. filament. 1—Burgess XX30 45 v. battery for B power.

CHASSIS CONNECTION CHART
Double Check with Fig. 3

Component	Connects From	Connects To
Jumper 1	Eyelet 1	Eyelet B
" 2	" 5	F. C. R4
" 3	" 8	F. C. L4
" 4	" 7	F. C. R5
" 5	" 7	F. C. L5
" 6	" 6	F. C. L3
" 7	F. C. L3	F. C. R3
Rly Lead	Rly 1	Eyelet B
Rly Lead	Rly 2	F. C. L1
150k Res.	Eyelet 1	Eyelet 4
15k "	" 4	" 6
30k "	" B	F. C. L2
30k "	" B	F. C. R2
8.2k "	" B	F. C. R1
10k "	" A	F. C. L1
220k "	" 8	Eyelet 3
220k "	" 5	" 2
.25 Cond.	" 5	F. C. L2
.25 Cond.	" 8	F. C. R2
.1 Cond.	" A	Eyelet B

Jumper: hookup wire; F. C.: Flea Clip