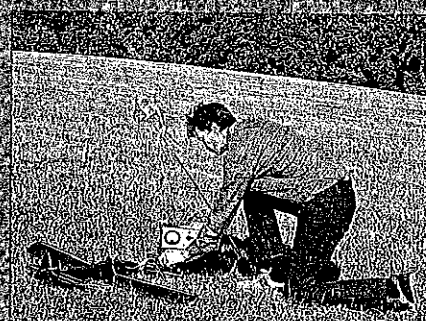
**A lightly loaded wing that will fly the plane through maneuvers combined with rock-steady flying even when inverted give this model "high potential." For a two-channel micro radio and 035-size electric motors.**

**■ Ken Marron**

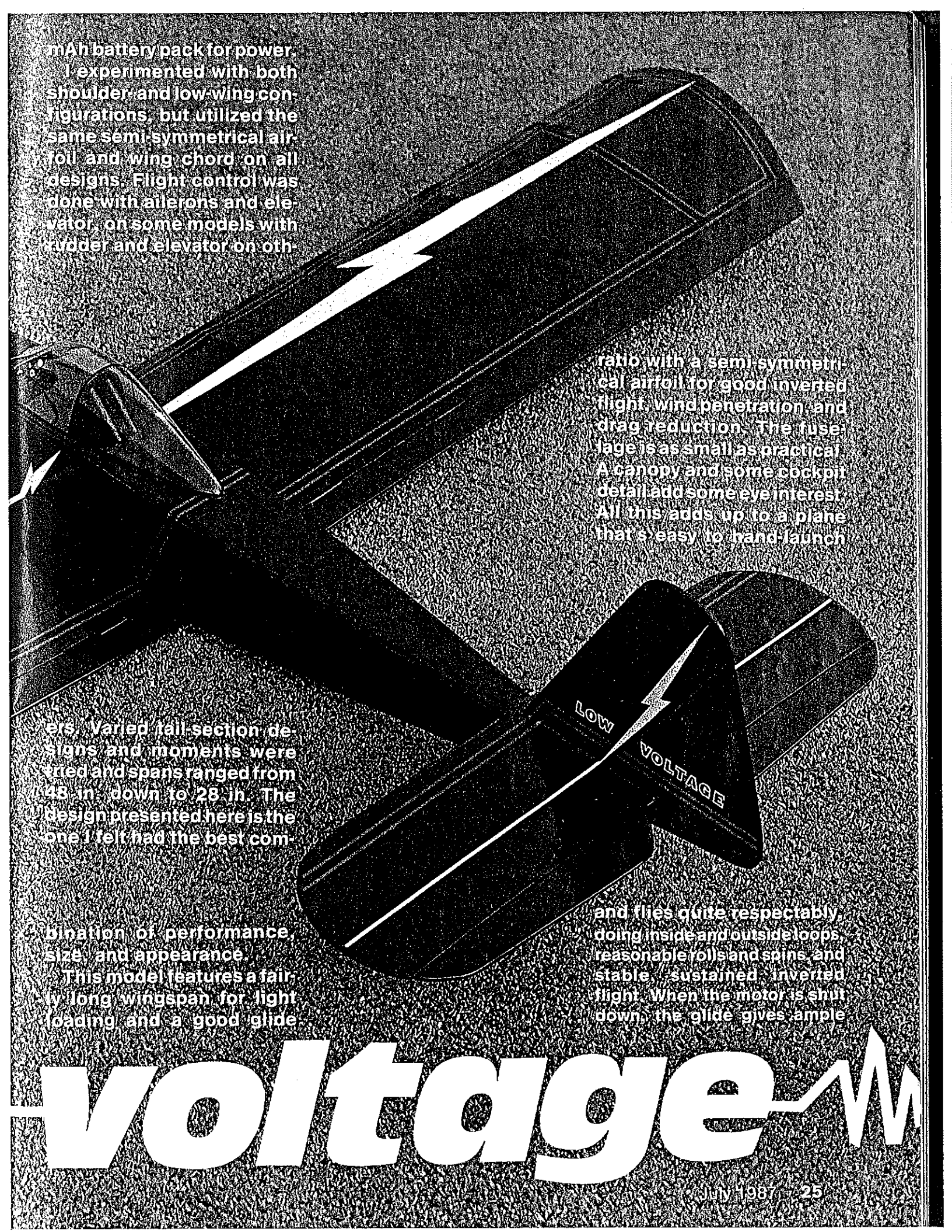


Big Picture: With only a 44-in span, this model is stored and transported completely assembled. A snazzy paint scheme, sporty lines, cockpit details, and almost invisible Mono-Kote hinge lines make this an attractive model. Above: Recharging requires only a motorcycle battery and a quick charger. The expanded-scale voltmeter is a nice accessory for checking receiver battery voltage.

DID I HEAR you say that you want a change of pace from those noisy fuel-guzzling buzz bombs? And that by the time you hustle out to the club field after work and wait your turn for a frequency pin, you barely have time to start your engine before it's too dark to find your way back to the car. What you've really been looking for is something quiet, but not tame, to fly at the local high school athletic field. Is that what I hear you saying? Then read on. Perhaps Low Voltage will give you a jolt.

I first began using the Astro Flight 035 motor to power my motorized Gliders and have always been impressed with the amount of power it puts out for its small size. It is currently being marketed with a five-cell 800 mAh Sanyo battery pack, and I couldn't wait to try out this package in a power-plane type design with some degree of aerobatic ability. Because eliminating excess weight is one of the most important design criterion for a small Electric model, I chose a Tower Hobbies mini-radio system which weighs less than 5 oz. for the three servos and a 100

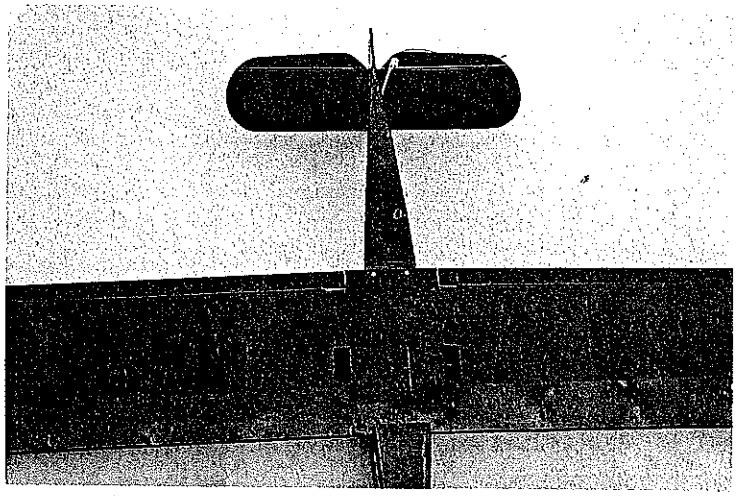
# LOW



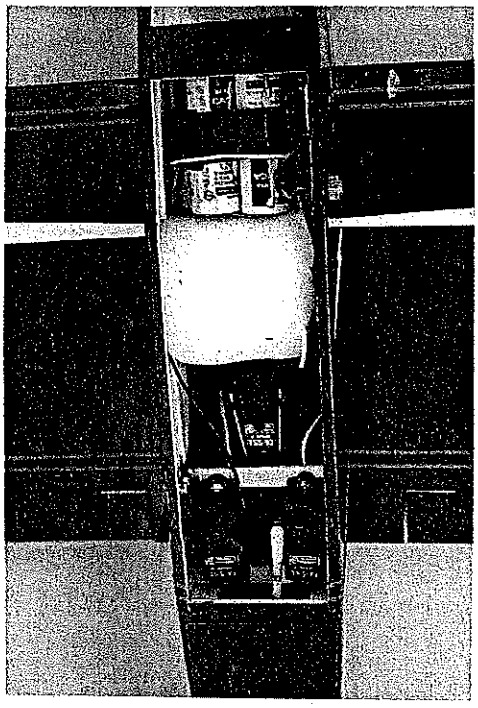

mAh battery pack for power. I experimented with both shoulder and low-wing configurations, but utilized the same semi-symmetrical airfoil and wing chord on all designs. Flight control was done with ailerons and elevator on some models with rudder and elevator on others. Varied tail section designs and moments were tried and spans ranged from 48 in. down to 28 in. The design presented here is the one I felt had the best combination of performance, size, and appearance.

This model features a fairly long wingspan for light loading and a good glide ratio with a semi-symmetrical airfoil for good inverted flight, wind penetration and drag reduction. The fuselage is as small as practical. A canopy and some cockpit detail add some eye interest. All this adds up to a plane that's easy to hand-launch and flies quite respectably, doing inside and outside loops, reasonable rolls and spins, and stable, sustained inverted flight. When the motor is shut down, the glide gives ample

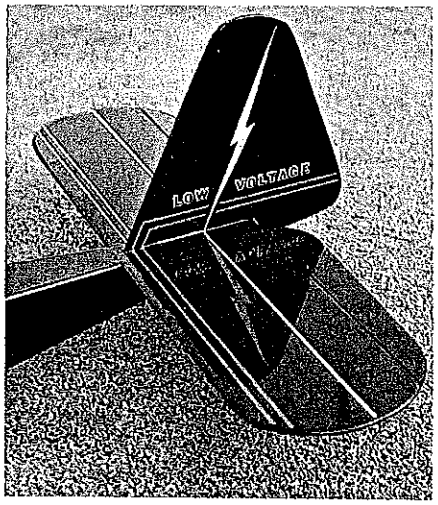
# Voltage



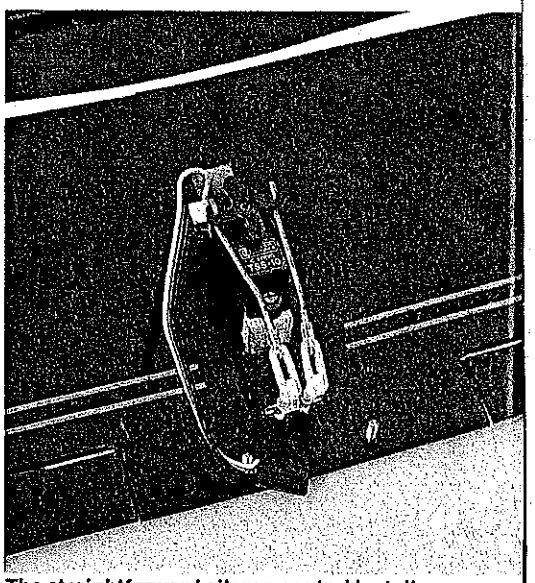
Above: Canopy and cockpit details help ward off the "boxy look" and are easily made. See text for details on securing canopy. Right: The finger grips greatly simplify gripping for hand-launches. For a slicker look, the antenna runs through the fuselage before exiting.



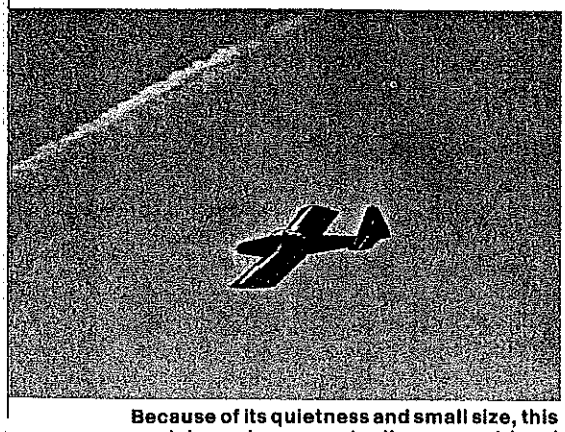
The Radio Shack microswitch on the left provides motor on/off control through the radio, but it is very important to also install the manual motor kill switch as well. The battery's hard-wired (not plugged) into this circuit, and the manual switch is a safety feature that should not be overlooked.



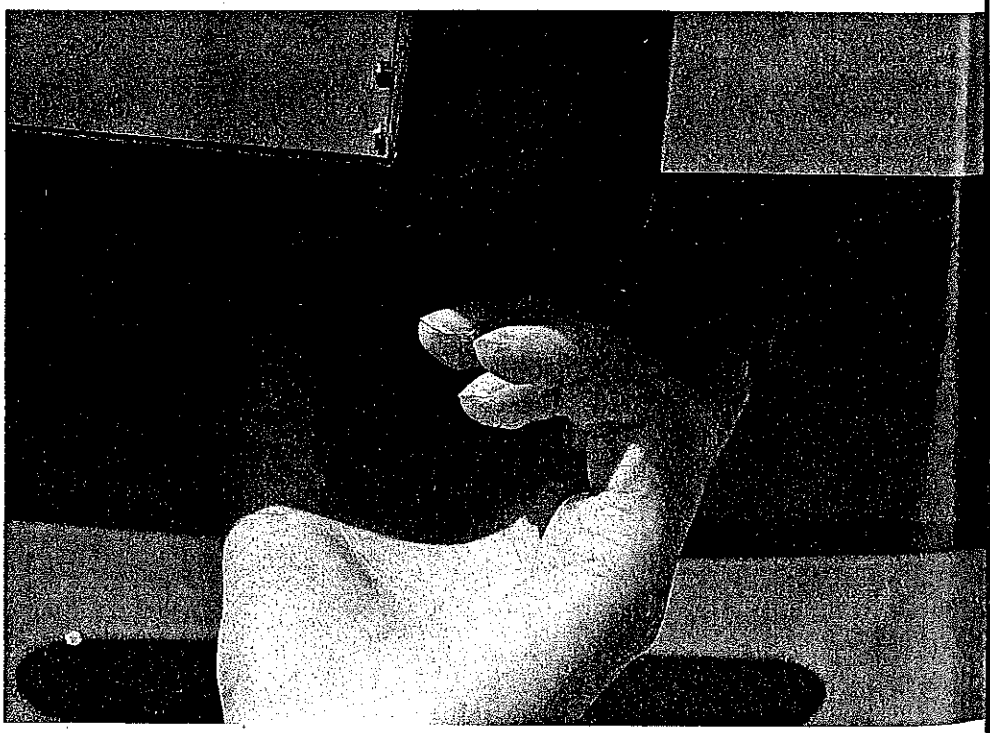

Graphic details personalize your your airplane. In this case the lettering is pressure-sensitive vinyl applied on top of MonoKote trim sheet. The lightening bolt is MonoKote trim, and the striping tape is from Goldberg.



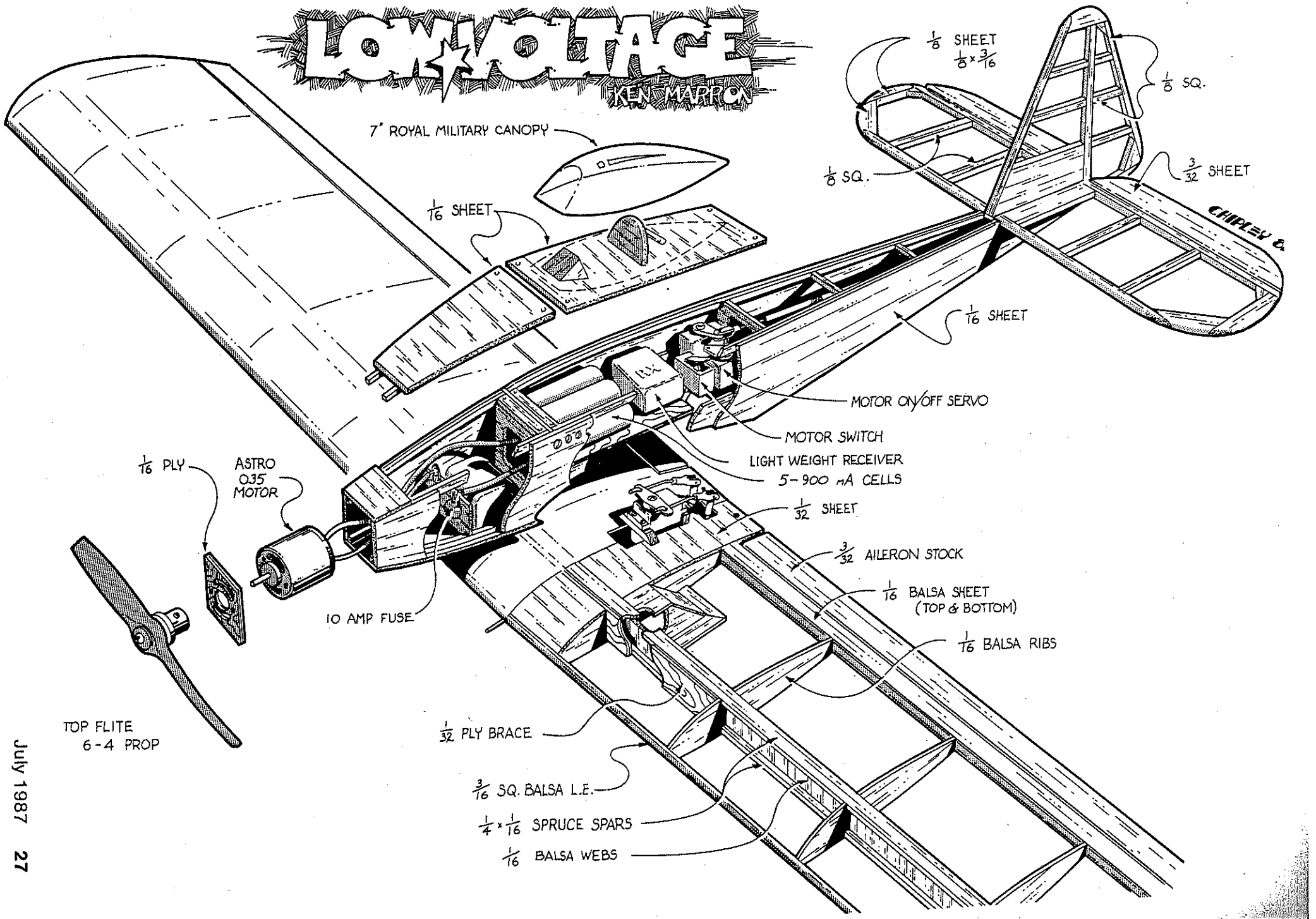
The straightforward aileron control installation uses the Du-Bro ½A aileron package.

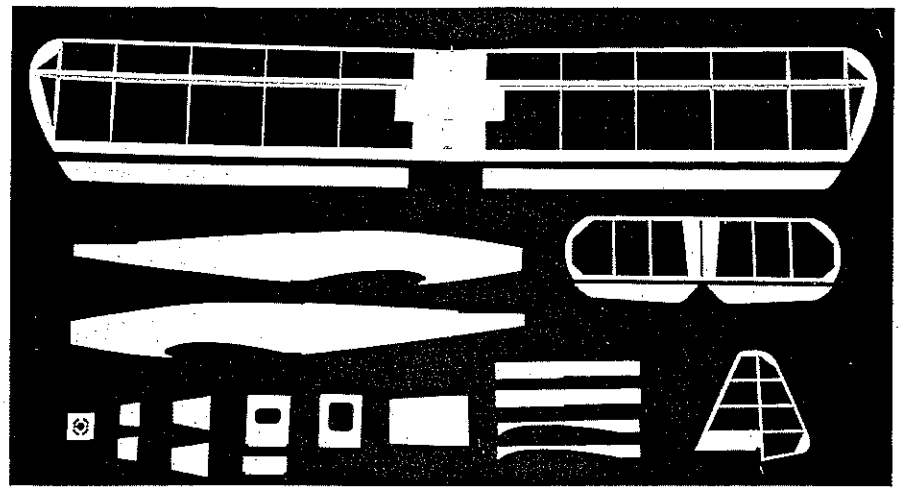


Because of its quietness and small size, this model can have you tooling around local sports fields, or any open area, in impromptu flying sessions that are almost hassle-free. The model grooves well, but don't expect vertical performance from takeoff.

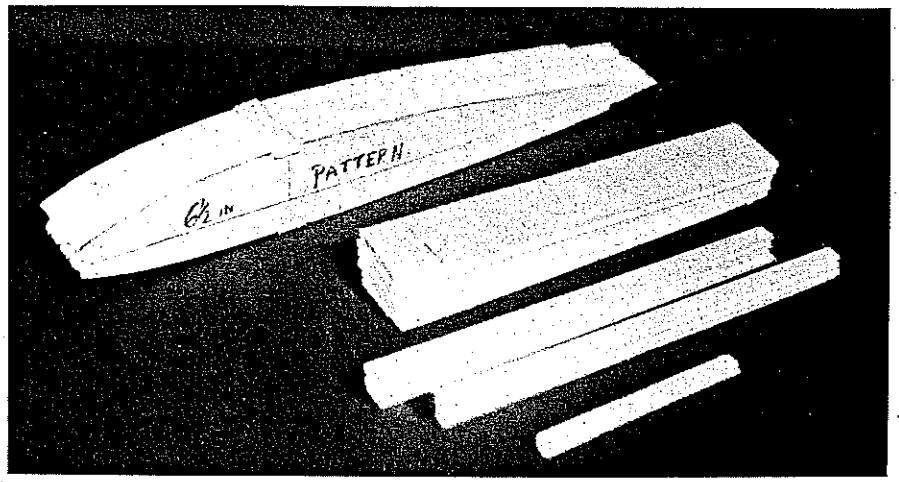


Finger grips in the wing make it easier and safer to hold onto the airplane. Balanced comfortably between the thumb and index finger, there is positive control for launching.

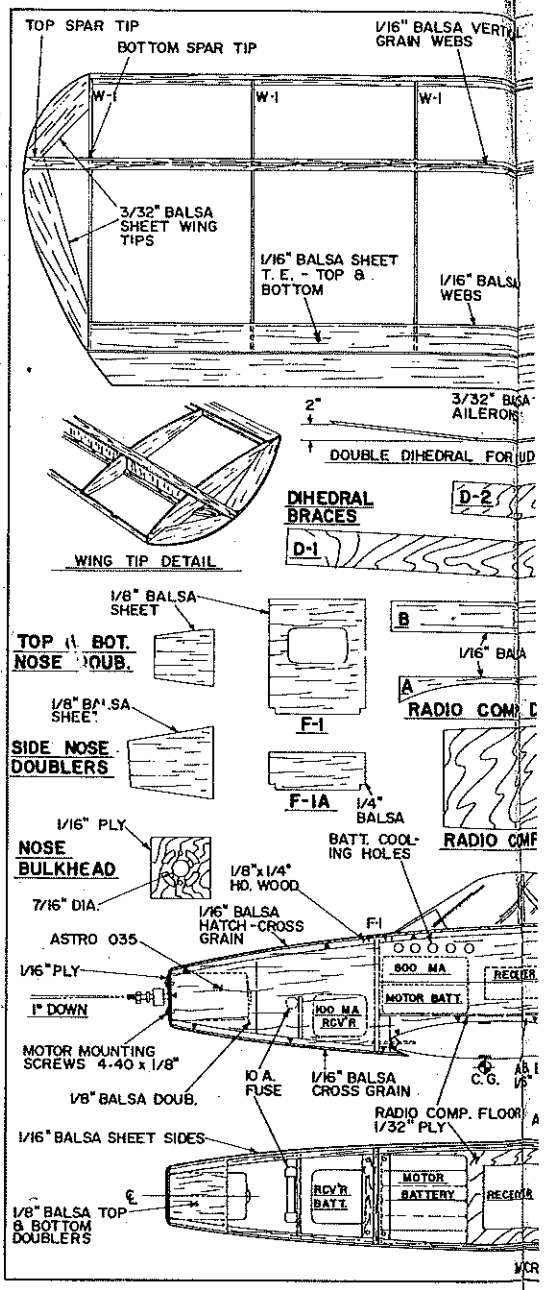

LOW VOLTAGE
KEN MARRON
7" ROYAL MILITARY CANOPY
1/16 SHEET
1/8 SHEET 1/8 x 3/16
1/8 SQ.
1/8 SQ.
3/32 SHEET
1/16 SHEET
MOTOR ON/OFF SERVO
MOTOR SWITCH
LIGHT WEIGHT RECEIVER
5-900 mA CELLS
1/32 SHEET
3/32 AILERON STOCK
1/16 BALSA SHEET (TOP & BOTTOM)
1/16 BALSA RIBS
1/16 PLY
ASTRO 035 MOTOR
10 AMP FUSE
TOP FLITE 6-4 PROP
1/32 PLY BRACE
3/16 SQ. BALSA L.E.
1/4 x 1/16 SPRUCE SPARS
1/16 BALSA WEBS



The completed prototype wing, horizontal and vertical stabilizers, and the main fuselage parts ready for assembly. This wing has the tip rib spaced closer than shown in the plans.



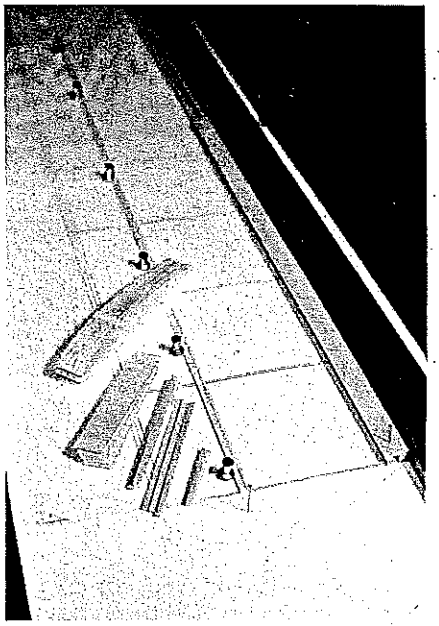

With scrap pieces of spar material in the notches, stack the ribs for alignment and then sand to match the pattern. The spar and trailing edge shear webs are cut from 4-in.-wide balsa.



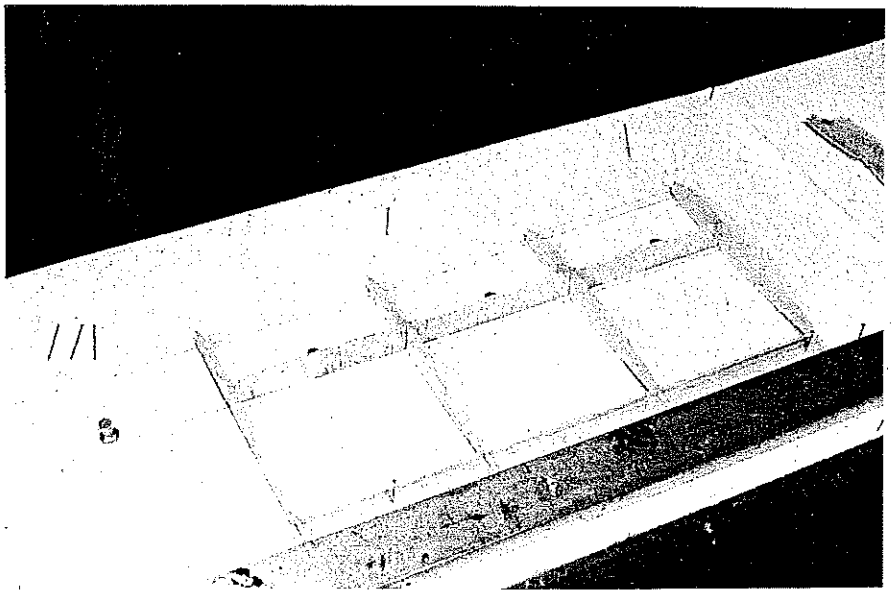

time for setting up an approach.

The model is easily flown by anyone with average sport flying capabilities—being maneuverable, stable, and predictable without being fast. The simple design keeps construction time to a minimum—and holds the weight down. The completed, ready-to-fly model should weigh between 20 and 23 oz.

One of the difficulties of hand-launching

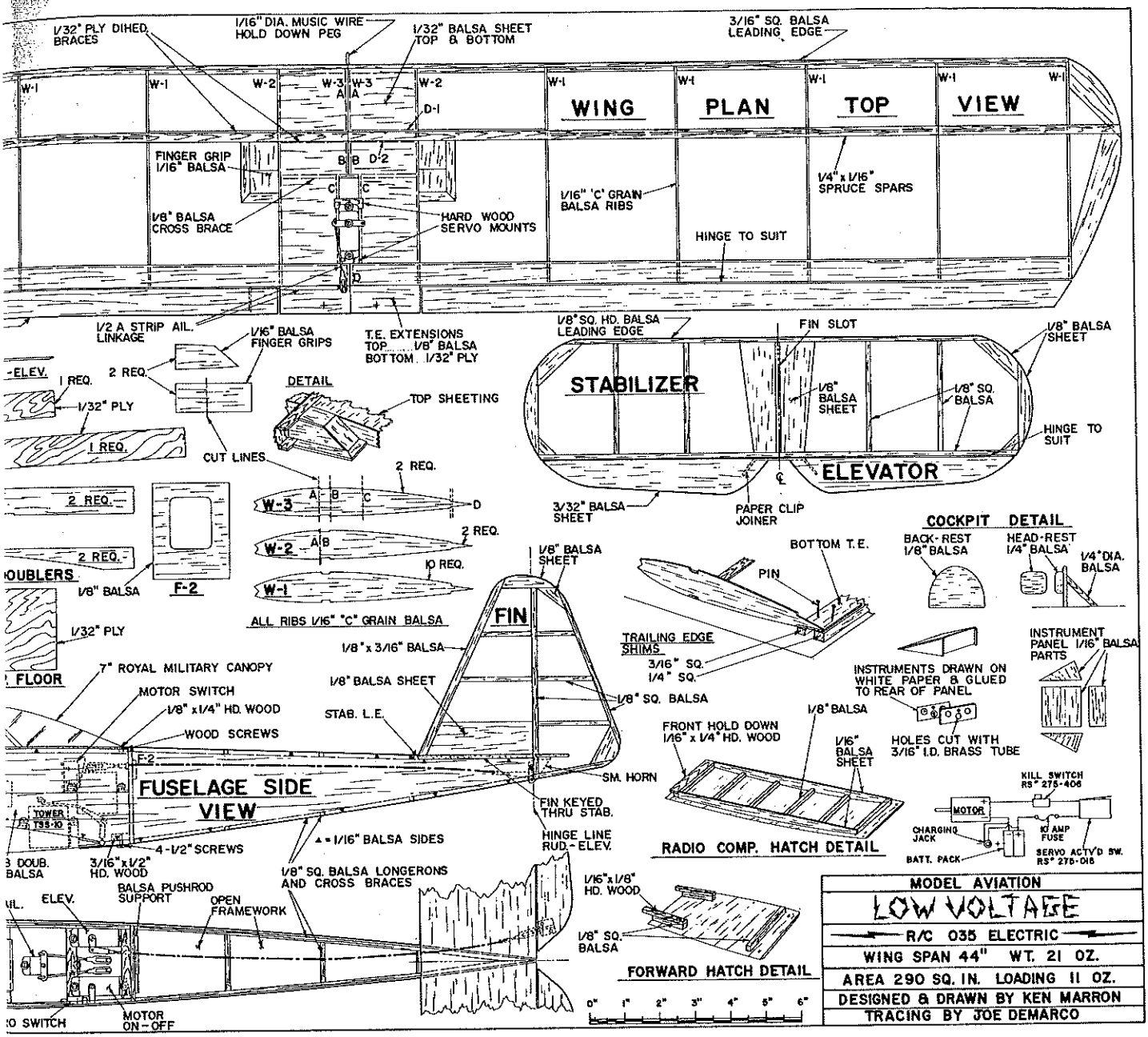


Spars are held to the plan with bulletin board push pins. The line along the top of the spar is a guide for aligning the shear webs while gluing them in place. The trailing edge is propped up on lengths of balsa.



After pinning down the spars and trailing edge, add the ribs and webs from tip to root. Adding the webs before the top spar is installed is much easier than wedging them in later.

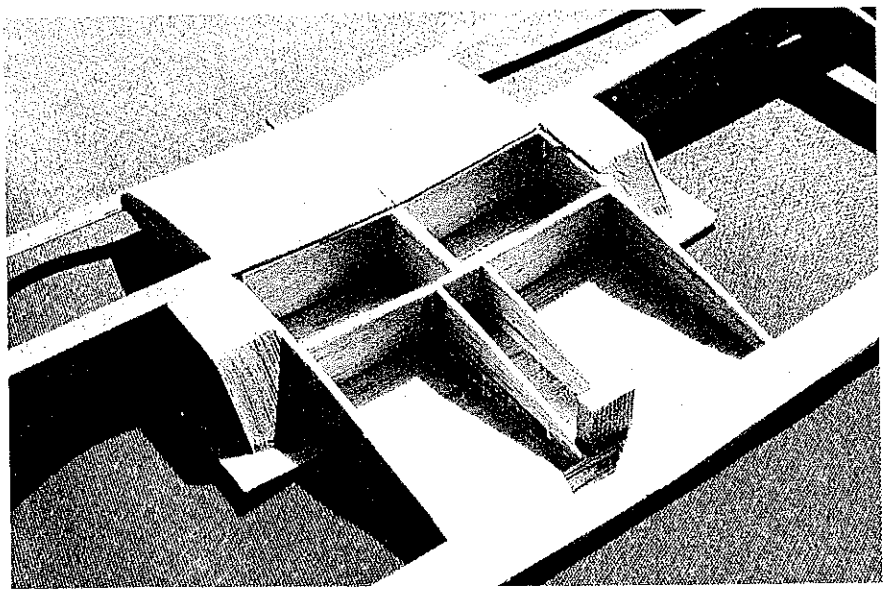
Full-Size Plans Available . . . See Page 178



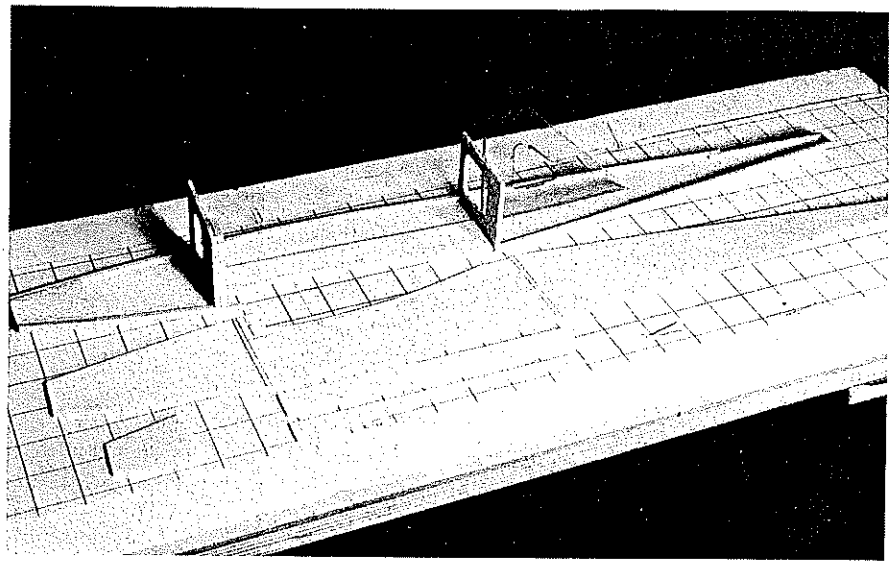

a low-wing design has always been gripping the model near the center-of-gravity (CG). The finger grips in the underside of the wing are an attempt to solve this problem. If you prefer, a rudder-and-elevator configuration can be made by doubling the dihedral angle to 12° and hinging the rudder along the dotted line as shown on the plan. Decide which way you want to build your model now—and let's begin building.

**Wing construction.** Make a rib template from 1/32 plywood and pin it to a sheet of 1/16 "C" grain or stiff straight-grain balsa, fastening both onto the cutting board. This method keeps the template from slipping and helps to ensure uniform results. Have two scrap pieces of 1/16 x 1/4-in. spruce spar stock handy; as each of the 14 ribs is cut out, place it between the two spar scraps to check for proper spar-notch fit.

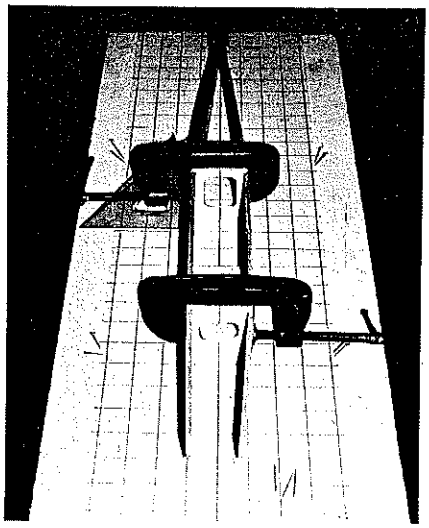
When all the ribs are stacked between the spar scraps, add the template to the front of the pile and sand the ribs to its exact



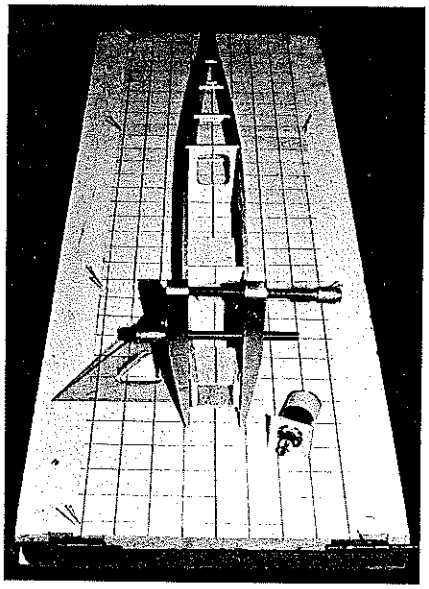
A last look at the center section before the sheeting hides it all. Things to note are the finger grips and the center rib spacing which should be adjusted now to suit your aileron servo.



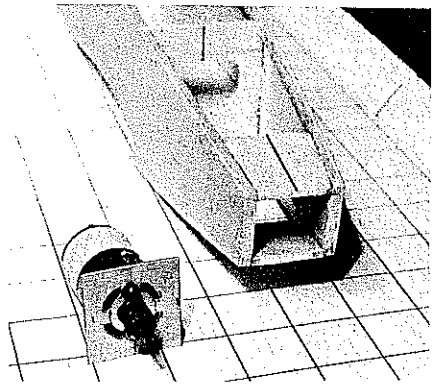
The positions of F1, F1A, and F2 are marked on the insides of the fuselage halves. After squaring the formers with a triangle, glue them to one half of the fuselage with CyA. Longerons and doublers are added before joining. Here is where everthing must be square.



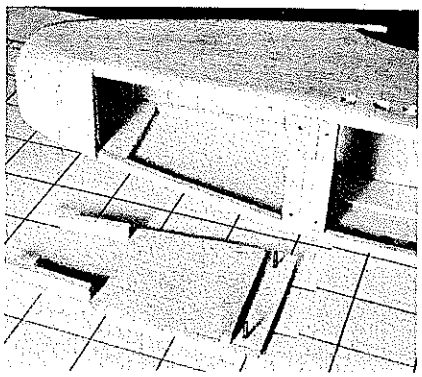
After a trial fit with the radio compartment floor in position, the fuselage halves are joined. Use centerlines on the formers and graph paper to make alignment easier and more accurate. Square up the sides with a triangle. When all is right, clamp in place.



After the white glue used to attach the radio compartment floor is thoroughly dry, pull in the nose and clamp the top and bottom doublers in place. Flood the joints with CyA.



Temporarily wrap tape around the body of the motor (do not forget to remove before running motor) to prevent sawdust from entering. With a half-round file, remove just enough material from the nose doublers to allow the motor to slip through the opening.



Nose details include locations of doublers, longerons, hatch hold-down blocks, radio compartment doublers, and forward hatch.

outline. Trim 1/32 in. from the top and bottom of four ribs to form the W2s and W3s. The eight 1/16 balsa vertical-grain shear webs are cut from 4-in.-wide stock, if available; otherwise, half-width pieces cut from 2- or 3-in.-wide stock butted tightly together will suffice.

The top and bottom trailing edge strips and T.E. webs are also cut from 1/16 balsa. Finally, make the dihedral braces, D1 and D2, from 1/32 plywood. The rear brace, D2, is 1/16 in. narrower than D1 to allow the 1/32-in. top and bottom sheeting to rest on it.

With the major parts made up in this way, wing construction will move along quickly. I like to use a building board that is hinged in the middle in order to eliminate the possibility of building a twist into the wing panels when they are joined.

Prop up both sides of the hinged board (or two separate boards butted together in the middle) so that dihedral brace D1 fits in the "V" flush with the surface of both sides, producing an angle of about 6°.

Cut the wing pattern from the plans sheet and fold it in half, creasing it along the wing centerline. Pin it to the board and cover it with plastic film. (Once the wing is finished, you can tape the wing pattern back in place, using clear, transparent tape.) The entire model is glued with cyanoacrylate (CyA), unless otherwise specified.

The wing is built in the following sequence. Bevel the ends of two pieces of 1/16 x 1/4-in. spruce spar material and then cut them to length. Note that the bottom spar is shorter than the top one, and that it extends only to the outer edge of the last W1 rib. Join the bevelled ends with white glue and pin the spars in place over the plan. Since it is hard to push straight pins through the hard spars, I use bulletin-board-type push-pins positioned along the length to hold the spars in place.

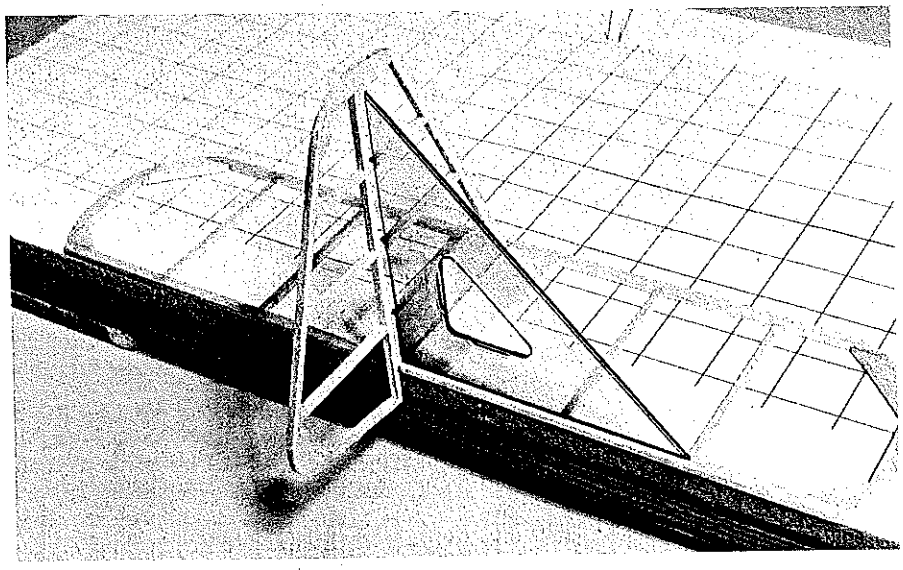
With a semi-symmetrical airfoil it's easier to build the wing if the bottom T.E. strips are propped up on shims that run the length of the T.E. A 3/16-sq. piece in the front and a 1/4-in.-sq. one toward the rear edge work well. Using a few ribs as spacers, pin the bottom T.E. strips in place through the shims and glue the butted edges together.

Starting at the tip of each wing panel, glue down a rib, a shear web, and then a T.E. web. Continue until all five W1 ribs on each wing half are in place. Add the top spars and 3/16-sq. L.E. and then, using white glue, install the front dihedral brace (D1) and clamp it in position with clothespins.

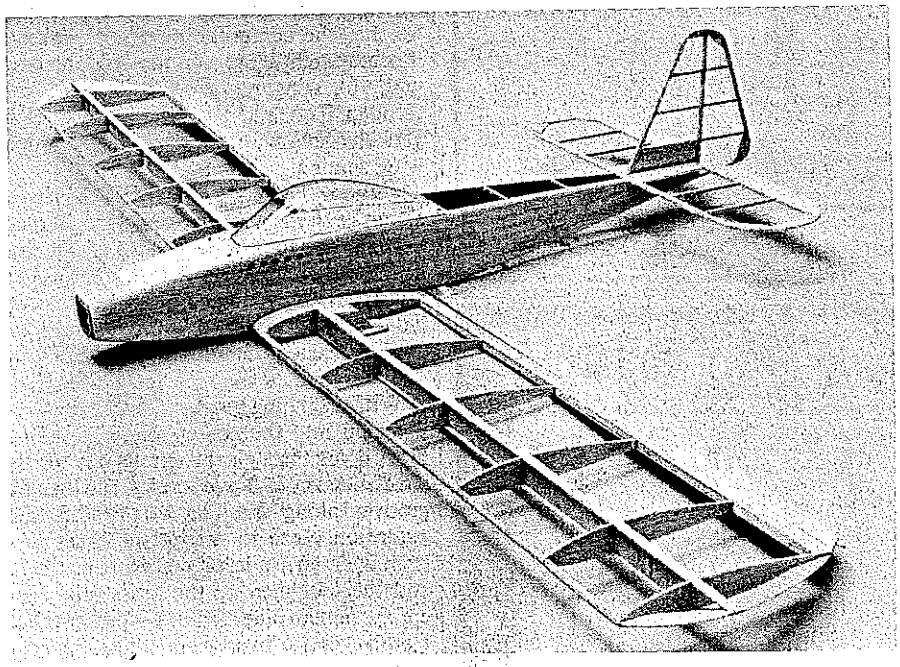
The remainder of the center-section pieces are shimmed up 1/32 in. and then installed in the following order: W2A, W2B, and D2 with white glue, the 1/8-in. cross brace between ribs W2B, and lastly all the sections of the W3 ribs. Space the W3C sections to suit your aileron servo.

Finish installing the T.E. webs and the top T.E. sheeting. Add the top and bottom center-section sheeting. Round off the leading edge and add the wing tips and finger grips. The remainder of the wing will be completed after the fuselage is built.

**Fuselage.** Cut the sides from the two pieces of medium-weight, straight-grain 1/16 x 3 x 36-in. balsa of equal density, so that they will curve evenly. Clamp both halves together with clothespins, using balsa scraps to prevent the soft wood from denting, and sand them to identical shape.



With the rear of the vertical stab hanging over the edge of the building board and seated in the slot of the horizontal stab, CyA the two pieces together using a triangle for accuracy.



The finished framework ready for covering should weigh about 4½ oz. Pick one of the lighter covering materials to keep the overall weight down. After the model is covered, the canopy is then attached to the fuselage with a narrow strip of the iron-on covering material.

Cut out the radio compartment doublers A and B from the remaining scrap. Formers F1 and F2 are made from hard ⅛-in. balsa and F1A from either one piece of hard ¼-in. balsa or two pieces of ⅛-in. balsa glued together. The four nose doublers are cut from medium-density ⅛-in. balsa and the radio compartment floor from 1/32 plywood.

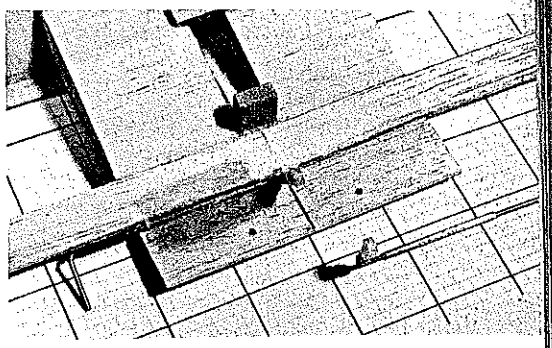
Although I cut out the motor battery vent holes after the fuselage was constructed, it's easier to do it with the sides flat on the cutting board. A sharpened piece of 3/16 I.D. brass tubing makes a good tool for this.

Carefully mark off the vertical centers of F1, F1A, and F2, and mark off their locations on the inside of the fuselage halves. Using a triangle to ensure accuracy, glue formers F1 and F2 to one half of the fuselage. Orient former F1A so that its centerline faces toward the rear. Glue it in place with white glue, and clamp together until dry.

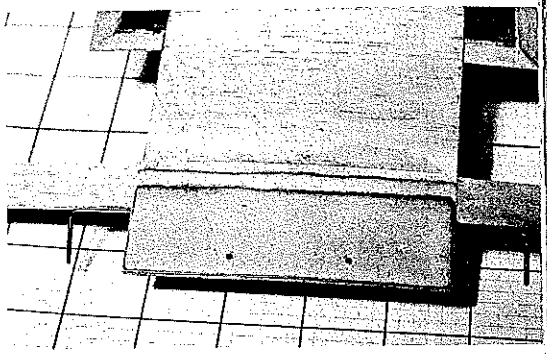
Glue doublers A and B between the formers, making sure that the slit between them is wide enough to accept the floor. Add the ⅛-in.-sq. balsa longerons and attach the ⅛-in. nose doublers with white glue. Prepare the other half of the fuselage by gluing on doublers A and B, the longerons (leaving spaces for formers F1 and F2 to slide into), and the nose doublers.

Trial-fit the sides together with the floor in position and sand down the inside rear of the fuselage halves so that when drawn together they taper to ⅛ in. When satisfied with the fit, disassemble the pieces and place a bead of white glue in the floor slots and on top of F1A.

Fit the sides and floor back together. Put C-clamps around the fuselage at F1 and F2 and, with the fuselage over the plan, or with the help of some other alignment aid, pull in the tail and clamp it in position with a clothespin. When everything is lined up properly, and a triangle shows that the sides are square with the building board, glue F1, F2, and the tail in place. Let the white glue dry thoroughly before continuing.



The strip aileron hardware is epoxied into a grove filed along the joint between the trailing edge and balsa extension. *Light* cloth epoxied over the brass tubing adds strength.



Additional strength is obtained by gluing a piece of 1/32 plywood to the underside of the T.E. and balsa T.E. extension. The ply is tapered to blend in with the sheeting.

Draw a line down the center of the top and bottom nose doublers to help in alignment. Pull in the nose, position the doublers and clamp them in place, and then liberally hit the joints with CyA glue. Finish the fuselage by adding the 1/16 balsa top and bottom nose area cross-grain sheeting and the ⅛-in. balsa cross braces. Use white glue on the three ⅛ x ¼-in. hardwood hatch-hold-down blocks and the 3/16 x ½-in. rear-wing-hold-down block. Finally, make up the hatches from 1/16 balsa.

**Nose Bulkhead.** Draw out the bulkhead on a sheet of 1/16 plywood stock. Cut all slots and drill all holes and then cut out the bulkhead itself. During construction, cover the motor vent holes with tape to prevent sawdust from getting in, but remember to remove the tape before running the motor.

Drill the 7/16-dia. center hole for the motor first, and then the ⅛-in.-dia. motor mounting holes. Check to see that the motor lines up properly.

The air inlets are formed by drilling a ⅛-in.-dia. hole on the corner of each inlet and then filing out the area between them with a rattail file. With a sanding block, sand down the front of the nose so that the bulkhead will seat flush against it. The front edges of the doublers must be filed down slightly to allow the motor to slip through the opening. *Continued on page 32*

Bolt the motor to the bulkhead and trial-fit it through the opening. Saturate the front of the nose with CyA glue, and then slip the motor and bulkhead back into position until the adhesive sets up. Unbolt the motor and round off the corners of the nose and fuselage to eliminate the boxy look.

**Tail Section.** Build the stabilizer and fin over the plan. Then, with the help of a square or triangle to assure a 90° alignment, glue the fin into its slot in the stab. Attach the assembled tail section to the fuselage using your favorite method of alignment, and round off the edges.

**Wing Mounting.** Check to see that the wing rests properly in its saddle and then add the hold-down peg by drilling a 1/16-dia. hole in the wing L.E. dihedral joint. Cut a 1-in. peg from 1/16-dia. music wire and roughen up half of it with a file. Drop some CyA glue in the hole and on the roughened wire, and then push the wire into the hole.

Center the wing in the saddle and slide it forward until the tip of the music wire touches the centerline on F1A. Make an indentation in F1A with the wire and then, with the wing removed, drill a 1/16 hole through F1A and F1. If necessary, elongate the hole with a rattail file for proper wing seating.

Cut out the two 1/8-in. balsa T.E. extensions. With the wing back in place, fit them between the rear of the wing and F2, then glue them to the wing. Cut out a 1½ x 4-in. piece of 1/32 plywood and attach it with white glue to the underside of the T.E. and balsa T.E. extension. Clamp it with clothespins while drying.

With a sanding block, taper the plywood to blend into the center-section sheeting. Drill holes through the extensions for the sheet metal hold-down screws, and then file grooves along the joint of the T.E. and extension piece to accept the brass tube from a ½A strip aileron set. Make up the set and then roughen up the brass tubes and epoxy them in place. Epoxy light fiberglass cloth or fabric over them for added reinforcement. Remember to think light when applying the epoxy. Align the wing perfectly and then drill holes through the hold-down block to accept the sheet metal screws.

**Covering.** Sand the entire model lightly and wipe it down with a tack rag before covering it with lightweight material. The model presented here is covered with Top Flite EconoKote, which has a weight of 1/3 oz. per sq. ft.

After the entire plane is covered, the ailerons and elevators are hinged with EconoKote as follows. Cut two strips of covering material 5/16 x 12 in. each. Peel off the backing and overlap them about 1/8 in., adhesive sides facing each other, and heat-seal them together. Cut them into 1-in. widths for the ailerons and ¾-in. widths for the elevator, and apply them to the surfaces in an over-and-under pattern.

*Continued on page 34*

# FUN FLY

## 4 - CYCLE EXTRAVAGANZA

**(2 - cycle sport scale welcome)**

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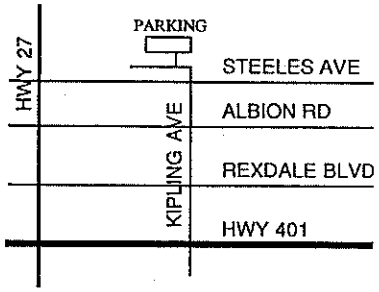


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**Canopy.** I hope you take the time to install the headrest and instrument panel as well as the canopy, since they add a lot to the appearance of the model. With the radio compartment hatch screwed in place, trim the bottom of the canopy to conform to its shape. Cut away the hatch covering where the interior details will be placed before attaching them. After attaching the interior details, have someone hold the canopy in place while you attach it to the hatch with strips of 1/16-in.-wide tape made from the covering material—first making sure there's no dust trapped inside. Position the tape carefully before applying heat. This method makes a much stronger bond than can be achieved with commercial trim stripping tape.

**Radio installation.** The elevator and motor control servos are mounted on strips of 1/16 plywood which rest on top of the doublers. The motor on-off microswitch (Radio Shack #275-016) is positioned on the left wall so that it is turned on when the transmitter control stick and trim tab are in the full-throttle position. Mark the location and attach the switch with epoxy. Do not use CyA glue, as there is a chance that it will run inside the switch and render it useless.

**Motor installation.** Because the battery pack is permanently soldered to the motor and cannot be unplugged for safety, a kill switch must be installed in the system to prevent accidental motor turn-on and possible injury from the prop during transporting, range checking, and while making adjustments. Please do not eliminate it, as it is an important safety feature. The constant torque of even a small electric motor such as this one should not be underestimated. As a further aid to safety, remove the prop when the plane is away from the flying field.

After the charging jacks and switches are installed and wired, position the receiver and run its antenna back through the fuselage and out a hole near the pushrod exit. Position the receiver battery pack to get the model to balance at the correct CG. If the tail was built lightly, this shouldn't be a problem.

**Charging.** The vents on the fuselage sides above the motor battery pack are not so much for cooling the batteries in flight as they are for dissipating the heat during charging. A 6-amp 12-volt lead-acid starting battery in average condition has sufficient charging capacity for five or six flights. Little current is drawn by the flight system if there is no binding of control surfaces or pushrods, and 30 minutes of flight time should be expected from a 100 mAh battery when using the mini system. Checking its condition between flights is strongly advised, however.

**Trimming and flying.** Elevator throw should be about ⅛ in. each way and ailerons

*Continued on page 136*

## Safety/Preston

*Continued from page 22*

with, wear gloves, dust masks, safety goggles, special clothing, or respirators.

- Learn about the chemicals in your materials and what precautions should be taken while working with them. Study warning labels, and if you have questions, contact the manufacturer to ask for safety data sheets. If you can, replace hazardous materials with safer ones.
- Store all materials in their original containers and keep them covered.
- Keep the work area clean. Wipe up flammable liquid spills immediately, and put soaked rags in a tightly-covered trash container. Dispose of chemicals properly. If you have questions about disposal, contact your local health or fire department.
- Don't work with flammable materials near an ignition source such as an open flame heater, water heater, or cigarette.
- If you suffer from asthma, emphysema, allergies, or a heart condition, check with your doctor about the materials and processes you work with.
- If you are pregnant, ask your doctor about continuing your hobby (*also applies to wives of male hobbyists, JP*).
- Space out your sessions with your hobby to give your body time to recover between possible exposures."

I've previously mentioned a number of the above DuPont safety tips, but I don't think it can hurt to repeat them. We continue to see newcomers enter our hobby, and they may not be aware of some of the hazards associated with the products we use.

**Before leaving the subject** of potentially hazardous chemicals, I want to mention two that have seemingly similar names but have very different properties. These are methyl ethyl ketone (MEK) and methyl ethyl ketone peroxide (MEKP). MEK is a solvent commonly used to join styrene plastic products. Chemically it is closely related to acetone, which, in addition to being another common modeling solvent, may well be the principal ingredient of your wife's (or girlfriend's) nail polish remover. A recent letter claimed that the writer had been told never to allow MEK to come in contact with one's skin, since it is readily absorbed into one's system and will stay there until you die. The letter-writer also stated that he had been told that MEK will cause permanent blindness upon contact with the eyeball. It is this latter statement which leads me to believe that he is confusing MEK with MEKP.

Methyl ethyl ketone peroxide (MEKP) is the clear liquid hardener that accompanies polyester resin. It is a strong oxidizer, and **extreme care** should be taken to avoid getting a drop in one's eye. Such a mishap could well result in permanent eye damage or blindness. While I would rather not get a drop of methyl ethyl ketone (MEK) in my eye, it *does not* present anywhere near the same hazard to the eyes as does MEKP. If the eyes are immediately flushed with water upon contact with MEK, no lasting damage should result. Similarly, I am not aware that MEK presents a hazard due to skin contact.

Cyanoacrylate (CyA) glues have also been confused with MEKP by some letter-writers, in that the writers believed that a mere drop of CyA in the eye would result in instant blindness. This is not so. A drop of CyA glue in the eye may well cause your eyelids to become stuck together and most likely will be very uncomfortable. But it's not likely that it will result in any permanent damage. However, I would urge you to take precautions against getting *anything* in your eye.

One of these days, if I ever find the time, I would like to list all the various chemicals we use in our hobby together with any associated hazards and handling precautions. Meanwhile, I urge you all to take care.

*John Preston, 2812 Northampton, St., N.W., Washington, DC 20015.*

## Low Voltage/Marron

*Continued from page 34*

3/16 in. Make sure that the kill switch is in the off position, and check that all controls are working properly and in the right direction. Since the plane is light and glides well, it's easy to trim it out by standing on top of a small hill and firmly throwing it, without power and the nose level or slightly down, into the wind. Make whatever adjustments are necessary before attempting powered flight.

With a Top Flite nylon 6 x 4 prop installed, turn on the kill switch, check for proper control surface movement, and start the motor. Launch the model with a good shove, nose down to prevent a stall, and let it fly straight and level until it picks up speed. Start feeding in some up elevator, remembering that a small electric motor doesn't have as much power as a snarling glow engine.

When Low Voltage has gained some height and your heart starts beating normally again, put it through some maneuvers to get a feel for the control responses. Make mental notes of any adjustments that may be needed. After about 4½ to 5 min. you will hear the whine of the motor noticeably decrease in pitch, and the model won't climb any more. It's time to shut off the motor and prepare for a landing. The ailerons are effective down to stall speed. Those of you who are not experienced at landing planes without landing gear will be pleasantly surprised at the ease with which it is accomplished.



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