Our author poses with his design prior to the Stunt season. Aerodynamically clean, it is destined to do well in the hands of the right pilot.

envoy

Borrowing from his own previous work and that of other notables, the author has produced a Control Line Precision Aerobatics machine capable of top-level performance.

Allen W. Brickhaus

MY MOST-FLOWN competition ship, the Buccaneer 5, had nearly reached the end of its useful career. The fuselage wood was oil-soaked. The ship gained over 6 oz. due to the oil and various repairs. The front end was literally coming apart, and I dearly needed a new Precision Aerobatics machine. Normally I would build a fresh Stunt plane every six months, but I was on a three-year hiatus from building due to job pressures and other needs.

My new design planning included reading of both old and new articles from magazines on Stunt concepts and designs. The engine/tank combination and operation concept was adopted from my successful Buccaneer 5. Since I wanted to experiment with other engine and tank combinations, I designed the nose of the new Envoy to receive not only the most-favored engine of mine but also two others and one other tank design. Originally the Supertigre .46 (with Sullivan RST 6-oz. tank) was to be the power source. By providing for needle valve and exhaust holes in the building process, it was possible to use the ST .40 and O.S. Max .40H with the standard 1-in.-high metal tank from Carolina-Taffinder.

Builing this way, I could try different combinations without having unsightly modifications after the plane was finished and painted. The outboard needle valve holes were cut for running plastic tanks; Jim Lynch has made me a firm believer in this system. Don't be afraid to route the fuel line to the inboard side of the engine when using a plastic tank. This also keeps the needle valve away from the hot muffler. When using the customary metal tank, the needle valve should be on the inboard side.

The overall design concept of the Envoy first came from my three most-read older articles: the Olympic Mk VI and Sting Ray by Bob Gialdini and the Stunt Machine by Gene Schaffer. Further refinement of the design specifications came from articles by Ted Fancher and his "... tion" developments. Gialdini and Schaffer highly influenced my earlier Scimitar profile Stunter, and Gialdini's discussion of the Sting Ray

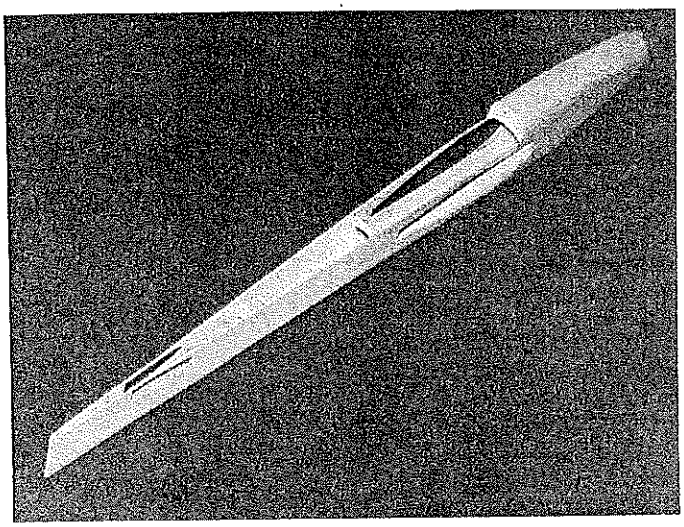
led to the Envoy.

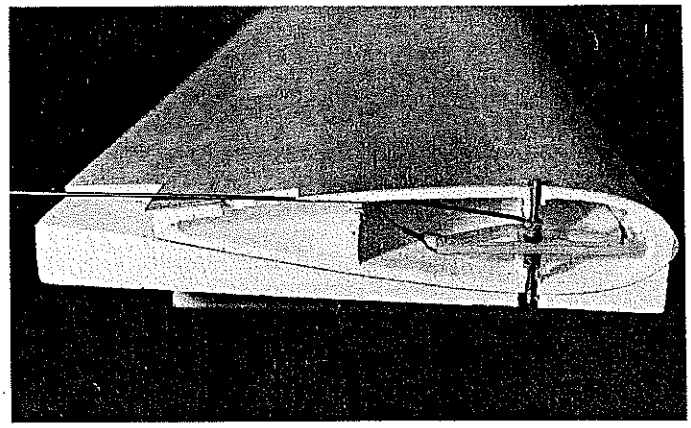
I decided that the new Envoy wing needed to be thicker for better lift. It should also have a blunt leading edge to prevent early separation of the airflow over the wing. The tip airfoil should be thicker than the root airfoil, and it should be placed more forward than the thickest section of the root. This concept delays tip stalls and adds more stability both to the turns and level-flight tracking.

I also wanted to try a swept-forward flap configuration to see how well it would work. In theory it is claimed to keep the center of lift on the wing from moving too far aft in relation to the center of gravity. Various sweep angles were drawn out and thought over, and 1 in. forward sweep was finally chosen. The Olympic Mk VI's flaps were designed to be 12% of the total wing area to give maximum lift and not induce an extreme amount of drag during the square and triangular corners of the pattern. The Envoy flaps were designed with this in mind, but they were increased slightly to 13.5% due to the heavier model weight I expected.

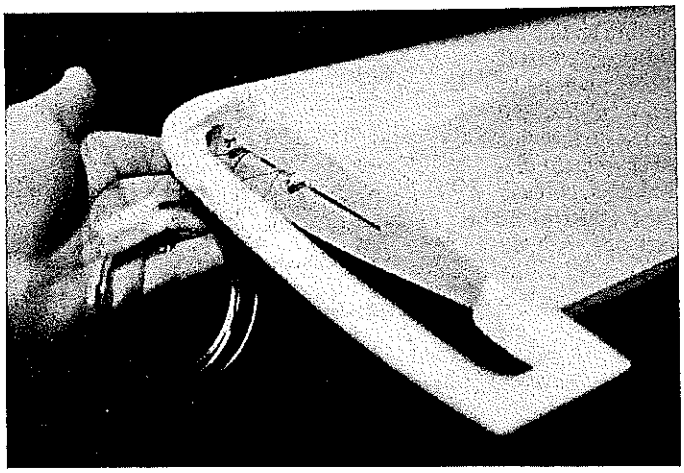
I wanted to use foam for the wing and flaps. I looked over many recent Stunt designs to find the wing and flaps most suiting the needs of the new plane. Ted Fancher's Excitation seemed to be the one, and it was of the 650 sq. in. size I wanted.

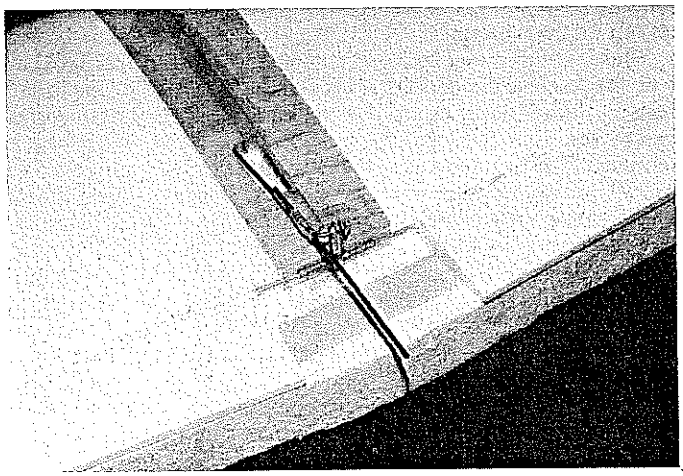
Small changes in flap length were made from the original, and they are noted on the plans. The stab/elevator is 23.5% of the



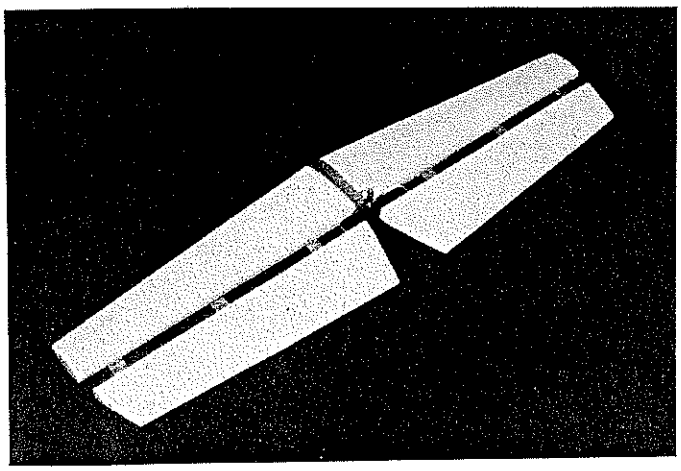


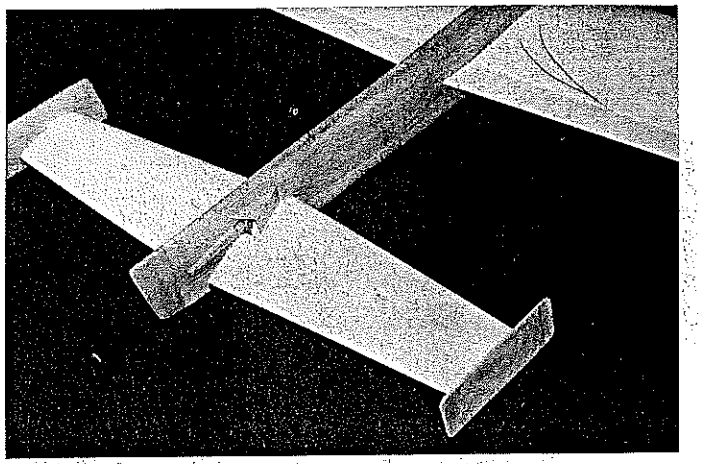
Left: The fuselage must be completed to this point before gluing on the wing and stab. Rigidity is a must. Above: A 3½-in. bellcrank is shown in the inboard wing panel. Handle line spacing must be wider with this setup. A standard 3-in. bellcrank also works well.





Left: Lead-out spacing is adjustable for fine-tuning, and the false rib shown here is used to hold the airfoil shape prior to covering. Right: At this point the wing is ready to be glued to the fuselage. Flap neutral adjustment is easier to set up when using the foam cradle as a jig.





Left: Tail assemblies are finished (except for gluing in the hinges) and MonoKoted before they are glued to the fuselage. Right: Take particular note here of the opening for the elevator control horn in the narrow fuselage. Open shield provides a small amount of rudder offset.

wing area. Note that 53% of the horizontal tail area is in the elevator, 47% in the stabilizer. The thickness and percentages were taken from Norm Whittle's Eagle V design. I modified the airfoil to the wedge shape for ease of construction.

The Envoy wing, flaps, stab, and elevators made of foam can be purchased from Par Troy Sound. Write them in care of Mark Salvador at the Sussex Co. Mall, Rt. 94, Newton, NJ 07860. Ask for the Excitation wing and flaps plus the stab and elevators of Norm Whittle's Eagle V. (The Eagle V tail assembly has more of a true airfoil than the wedge-shaped tail drawn on the plans. Both work well, so use whichever one best serves your building and flying needs.)

Although the Envoy can be built with all-foam flying surfaces, the plans also show built-up structures for those who prefer framework construction.

My original foam assemblies were cut with a spar glued in place and false plywood ribs for attaching wing-mounted landing gear blocks. Both the wing and tail gear are removable. I do much of my practice flying over grass (but compete over asphalt or concrete). For the rougher grass areas I need large lightweight wheels placed a bit more forward than usual and a very short tail gear. For hard surfaces, I bolt on a set of smaller wheels with nice gear fairings and a longer tail gear. Both of these gear types are shown on the plans.

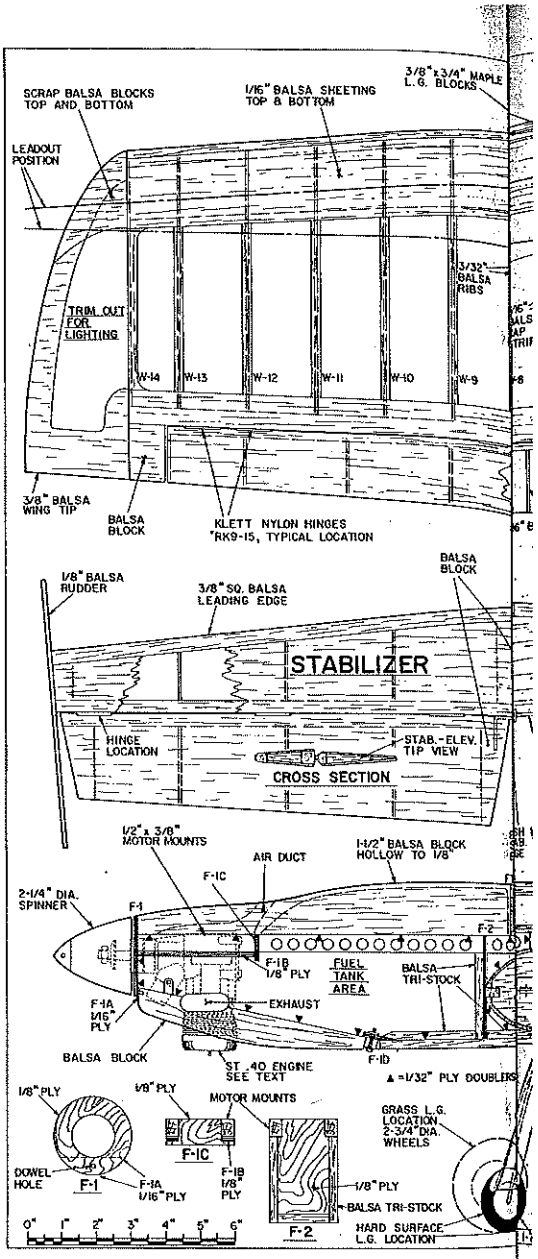
These flying surfaces were combined with the fuselage dimensions of the Buccaneer V, though many sketches were made before the final fuselage shape was determined. The twin rudders of the Olympic Mk VI and the Scimitar were used instead of the single vertical stab of my previous design. The twin-rudder concept was chosen to keep the air from slipping over the tips; the rudders channel the air directly over the airfoil and make the stab/elevator more effective. Also, I like the appearance provided by the twin rudders.

Construction. This model is easy to build, and I will comment only on a few fine points. The wing and flap foam cores will come as left and right panels. I suggest that you purchase the wing with the spar and the two front ribs in each panel for putting on the landing gear securely. If you wish to mount the main gear in the fuselage, bolt the 5/32-in. music wire on the back side of the former at the wing/fuselage joint. Then cut away a necessary part of the wing leading edge in order to put the landing gear in as close a relationship to the wing as possible.

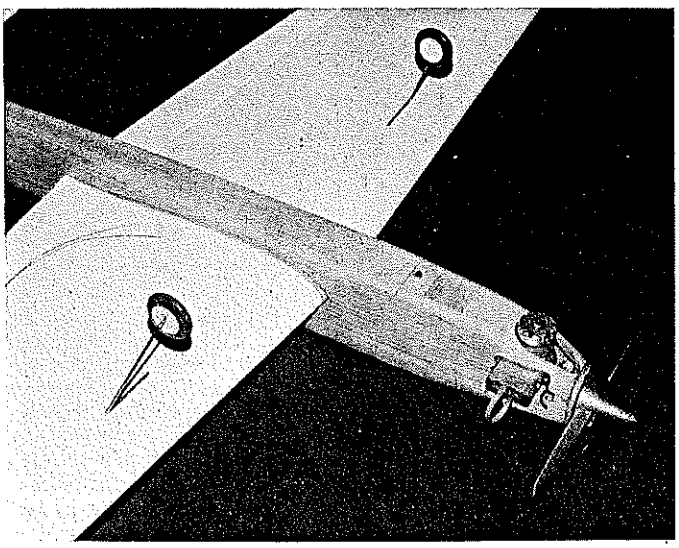
When gluing your wing sheeting together, run the grain of the sheeting parallel to the leading edge of the wing until near the aft portion of the sheeting that will cover the flap hinge line. Then the sheeting should be cut and glued to run parallel to the hinge line. Thus, when you are cutting the flaps loose from the completely-sheeted wing, you will not be cutting across the grain.

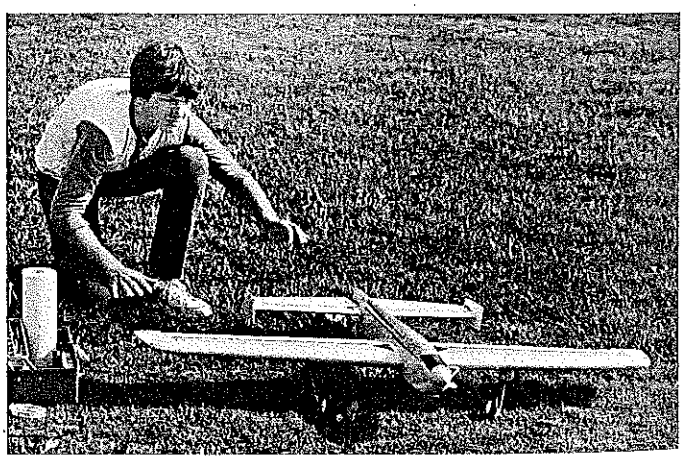
Determine where the flap hinge line will be. Draw a line over this point on both the top and bottom of the wing. Then draw parallel lines ¼ in. to the front of the original line and ¼ in. aft. Cut away the flaps at the fore and aft pencil lines. Then glue ¼-in. balsa to the trailing edge of the wing and to the leading edge of the flaps. After fully finishing the sheeting and shaping the wing cores and flaps, install a well-bushed control system.

Measure and mark your lead-out lines. This determines where the neutral setting of the bellcrank will be after the wing cores are trued up and glued together. Glue ⅛-in. balsa ribs to the wing tips before adding the actual tips. This balsa rib will help keep the airfoil shape true when the covering is applied. Glue the actual tips, lead-out guide, weight box, and flap horn to the wing after joining the cores together with 15-min. epoxy. Treat the tail surface foam cores in the same manner, and then you will be ready to proceed to the next step. A Klett PEG-1 pushrod exit guide is glued to the wing tip at the lead-out slot to strengthen the slot after the covering is applied.



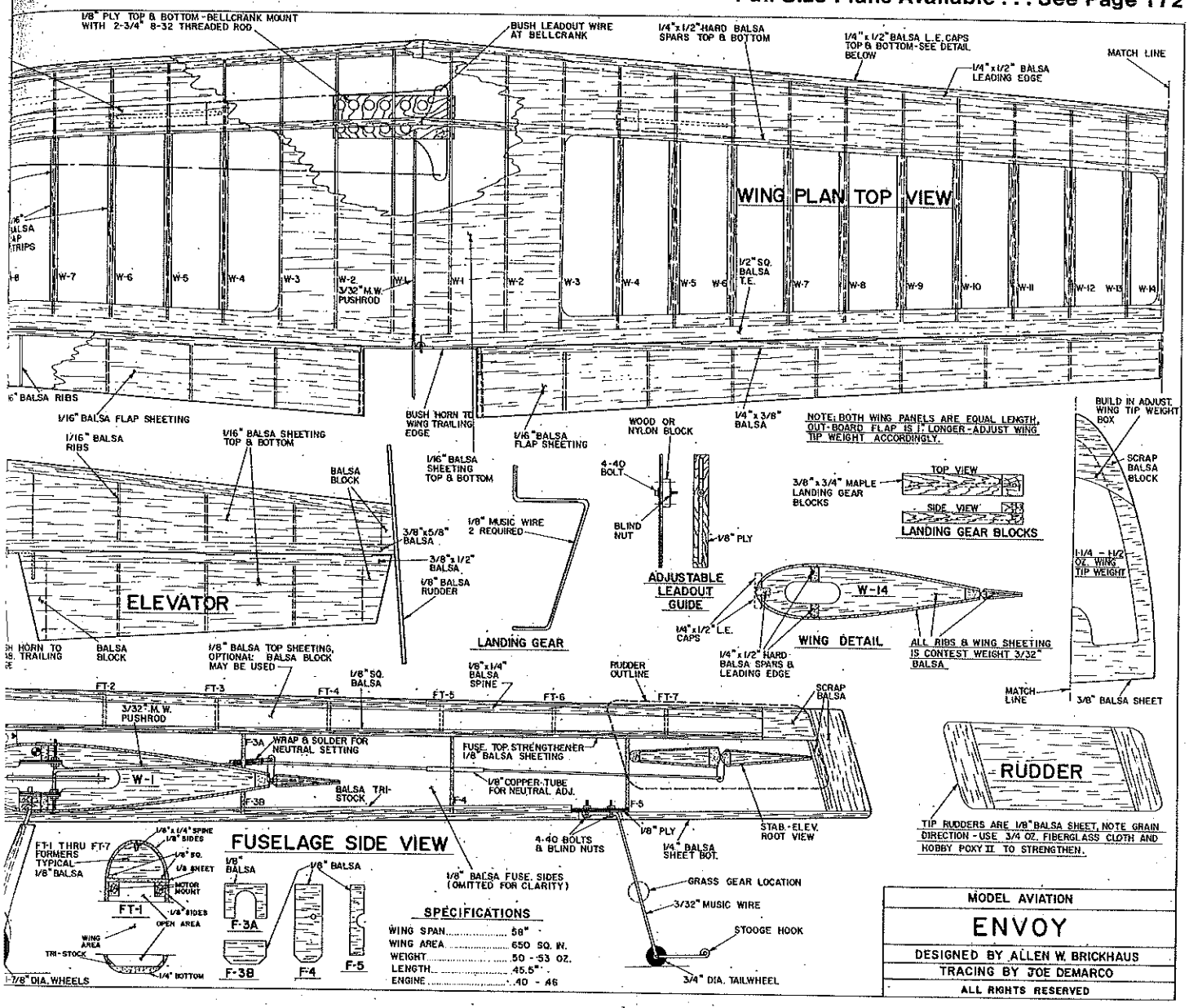
Fuselage. Mark reference lines on your building board to align the sides and formers while gluing them together. The fuselage doublers are glued to the sides with 5-min. epoxy. The engine mount blocks are glued with slow-setting cyanoacrylate (CyA) to the fuselage doublers. Then F-1 and F-2 are set in place, and the sides are pinned down to the building board. Align these components, and glue them together. Glue the aft end of the fuselage together,





Left: Cowl system is clean, effective, and easy to use. Vents help keep the engine cool. Above: Our author's son, James, launches the Envoy. Note that the model is equipped with the "grass" gear setup. Different gear setups are noted in the text and on the plans.

Full-Size Plans Available . . . See Page 172



and glue in the remaining formers.

Bolt your engine onto the fuselage, and place the wing into the fuselage cutout. Carefully align them; use an incidence meter and precise measurements. When you are satisfied with the alignment, glue the wing in place with CyA. Stiffen the wing and inside fuselage joint with small sections of balsa triangular stock. Then lay 2-in.-wide strips of 6-oz. fiberglass cloth inside the fuselage at the wing joint, and glue the cloth in place with quick-setting CyA. The length of the cloth should run fore and aft; the width should extend over the wing surface and flow upwards upon the fuselage sides for better strength. Both the top and bottom of the wing are done in this way.

Heavily bush the flap horn, as this item takes much abuse. Extend the pushrod for the elevators toward the back, and have fuselage-former bushings ready to glue in place. Finish constructing the fuselage bottom to the rear of the cowl. Include the ⅛-in. ply for the removable tail gear. Carve the outside dimensions of the canopy area, and tack-glue in place.

Carefully align the stab, and glue it in place. Close the open top section of the fuselage with a sheet of 3/32 balsa. Cut openings in this sheet for access to the flap horn and the ⅛-in. copper tubing neutral adjustment segment on the elevator pushrod. Now is the time to solder all flap and elevator neutral adjustments through these access holes.

Pop off the canopy block, and hollow it to the dotted lines as shown on the plans. Reglue it in place, and add the front blocks and ⅛-in. nose ring. Glue two ⅛ x ⅛-in. balsa stringers to the top of the fuselage sheeting. Rough-cut the top fuselage formers; glue them in place. Add the stringer to the top of the formers, and then add the final sheeting. Wet it on the outside of the bend so that the sheeting can be curved to the shape of the formers. Use of triangular stock in the corners of all the fuselage edges will add much strength, but use a Dremel tool with sanding drum to route out the triangular stock to lighten the pieces.

Rough-cut the cowling block so that mounting holes and bolts can be put in place. Bolt this semi-shaped piece in place, and carve it to a more final shape. Unbolt the cowl, and hollow it.

I don't hollow the entire block. I shape the inside to force the airflow tightly around the back of the cylinder head to a ¼-in.-wide slot in the rear of the engine hole. This narrow opening then widens quickly to force the hot air out of the holes in the bottom of the cowl. This is very similar to the ducting used by CL Speed fliers to cool their engines. A little extra balsa weight in the cowl used this way is well worth the good it does in ridding the engine cavity of unneeded heat.

Fill the small cracks and holes with the lightest and easiest-to-sand filler you know of. Final-sand the entire plane with 400 wet/dry sandpaper used dry, then remove all the dust and residue.

Covering, finishing, etc. All flying surfaces are covered with MonoKote. Run the covering to within ⅛ in. of the fuselage. Use Hobbypoxy II glue, slightly thinned, as a base coat on the fuselage. Sand with 400-grit paper (dry) when the glue has cured. Use Epoxolite fillets at all flying surface/

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