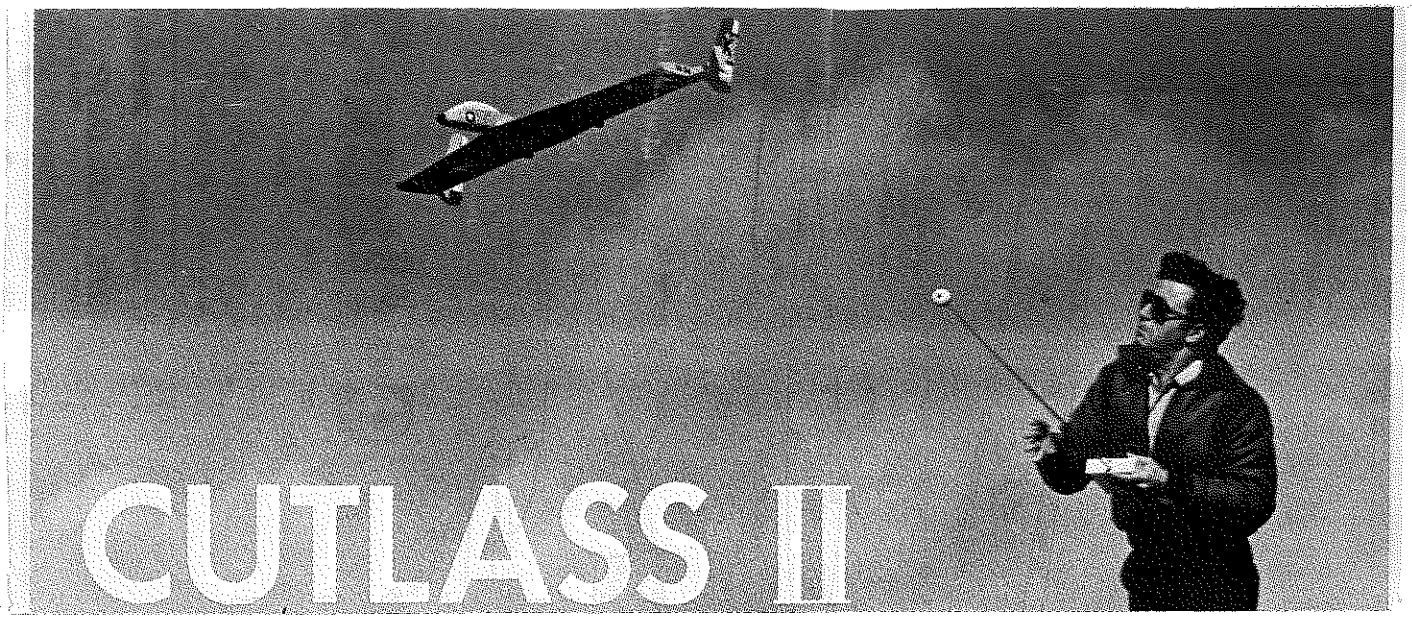


CUTLASS II

By LARRY RENGER . . . If flying wings are your thing, you'll love this very inexpensive, almost all foam slope glider. The Cutlass II was designed to resemble the Navy's first flying wing fighter, the F7U Cutlass.

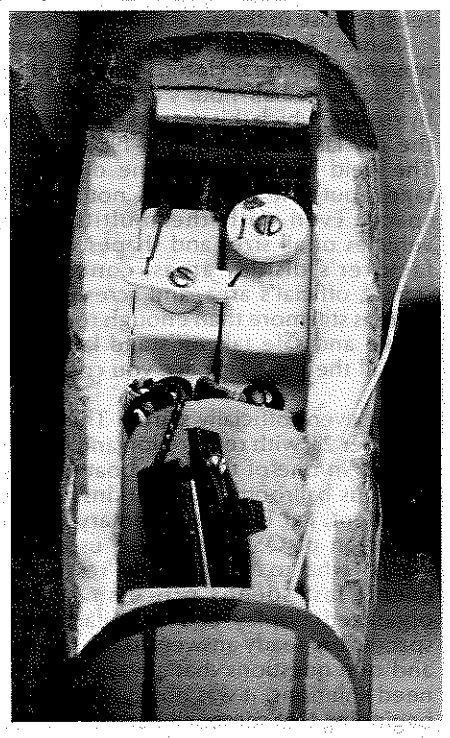
• One of the most visually interesting of the early jet fighters was the Chance Vought Cutlass. This carrier-based Navy fighter had an impressive list of "firsts" to its credit. It was the first U.S. jet fighter designed from the outset to use afterburner, the first swept wing jet aircraft in the Navy, and first such to fly from a carrier. It was the fastest Navy aircraft of its time, and the first tailless airplane to go into production for U.S. service use.

I have always loved the look of the Cutlass, and flying wings in general. The Cutlass II is an attempt to capture the style of the original Cutlass without sacrificing the performance I want in a slope soaring glider. The Cutlass II has a comparatively high aspect ratio wing with a very modest sweep angle. The tip-mounted, toed-in vertical tails are more effective than the mid-wing verticals would have been. Control is by separate elevator and aileron rather than mixed elevons to avoid the problems of separating control sensitivities and neutral.

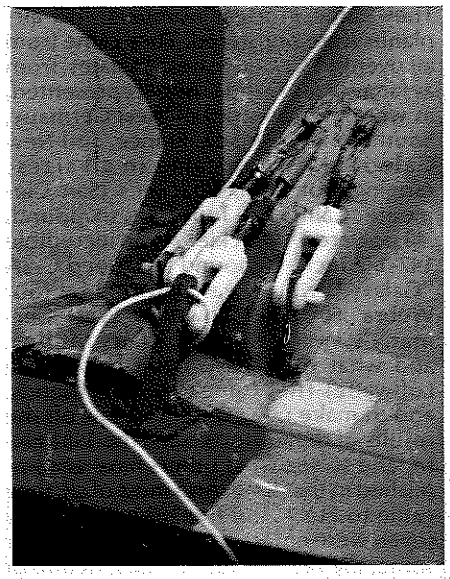
The engine configuration of the original Cutlass makes good sense for a full scale aircraft, but would produce high drag in a glider. As a result, I simulated wing-buried engines on the "II" to hint at jet power. The exhausts pivot up and down with the elevator, by the way. Consider what that would do for low speed control on a real aircraft! Lots of little touches such as fillets between fuselage and wing, and the paint scheme add to the air of authenticity. I have even had a few people think it was a true scale model of a full-scale aircraft. (If Grumman wants to use the design, I would be happy to settle for only a small royalty.)

One thing that flying wings won't do is compete directly in performance with conventional aircraft. The drag caused by use of an airfoil with inherent aerodynamic stability, or the short coupled stabilizing tips of the swept wing models causes a significant reduction in performance compared to a standard aircraft of the same wing area (total including stabilizer, to be fair). However! A flying wing, and especially this jazzy, military flying wing, will get you center stage attention at any flying site where you take it. In addition, Cutlass II is smooth, fast, and maneuverable.

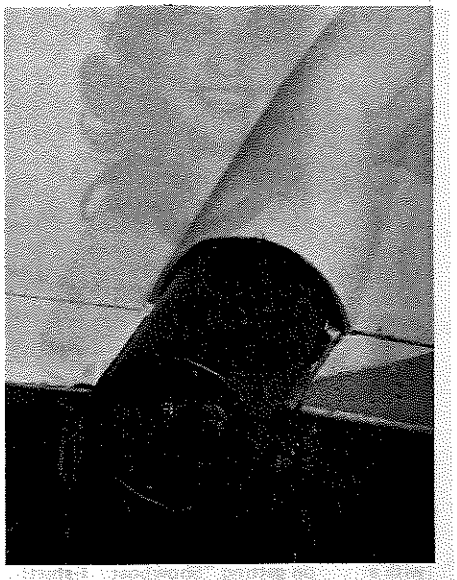
The model presented here has some interesting construction features which resulted in a completed flying weight of 10 ounces. Despite this light weight, the aircraft has excellent penetration, and flies smoothly and stably when balanced



Cockpit details. Note: balsa canopy guides, long aileron output arms, foam construction.



Control horns are kept in the center to reduce drag. Testing revealed need for tail weight.



Simulated "exhausts" move with elevator. Help create that scale-like appearance.

and trimmed carefully. As with all flying wings, correct CG location falls in a very narrow range. Balance points outside that region result in either a "Flying pig" or an unstable terror. More on trim technique later!

The keys to Cutlass II's light weight are foam wing cores covered with light-weight brown wrapping paper, a foam fuselage skinned with ladies' nylon stocking material, white glue, and, of course, a Cannon Super-Micro two-channel airborne radio system. The brown wrapping paper covering sounds strange, but was the ultimate selection after extensive search and weighing of potential wing skin materials. It proved to be half the weight per square inch of the next best material, 1/32 balsa! Wing rigidity is excellent, and the paper took very little filling to give a good finish.

WING

Construction starts with your foam wing cores. You can either cut them or buy them. I cut mine according to the methods described in the book, *Foam Wings*, by J. Alexander (RCM Press, P.O. Box 487, Sierra Madre, CA, $4.95). An easy alternative is to have your cores custom cut by an expert company such as Hi Johnson Model Products (11015 Glen Oaks Blvd., Pacoima, CA 91331) who, at last catalog, charged about $8 per wing panel. You supply the templates to their specifications as set forth in the catalog.

Please be sure to use the airfoils presented in the plans. The camber line used yields a stable, but low drag section. Any other section will cause drastic changes in balance location, stability characteristics, drag, etc. You may know, or find a better airfoil, but do so at your own risk. Flying wings are much more sensitive to airfoil changes than conventional models.

Once you have the basic cores cut and the surfaces sanded, trim the leading and trailing edges to fit the wood strips, and carve a groove in the upper surfaces to accept the spar. Epoxy all three pieces of wood to each wing panel. Add a stripe of fiber-reinforced package strapping tape top and bottom of each panel, and then sand the leading and trailing edges to shape.

Cover both panels with brown wrapping paper using 3M's "77" spray cement. The can has the instructions, read both them and the cautionary warnings! I covered each panel with a single piece of paper wrapped from the trailing edge, under the bottom, around the leading edge and over the top. Be especially careful here not to twist the wing panels. Once covered, you can't straighten foam wings. Also, note that there is a smooth and a rough side to the paper. Cover with the smooth side out for easy finishing. A nice feature of the brown wrapping paper is that it will both water shrink and heat shrink! You can easily get out any ripples left after covering. Painting the material then stabilizes it.

You are ready to cut the root and tip angles into each panel. Once the fit is perfect, epoxy the two panels together. The top surface of the wing should be flat; the taper comes from the bottom. Dihedral is not needed, but a couple of degrees and a nice visual effect. Reinforce the center joint with a one inch wide strip of fiberglass and epoxy. At this time, you make the aileron torque links from 1/16 piano wire and 3/32 brass tubing and epoxy it to the center trailing edge of the wing. Behind that goes the filler strip to provide a straight hinge surface for the elevator. The basic wing structure is now complete, so set it aside and make the other components to add to it in final assembly. Be sure to make right and left vertical tails, two on the same side won't work very well!

FUSELAGE

The foam and stocking fuselage is easy to make, but unusual, so I will detail the construction techniques for it. Laminate the core from one piece of one-inch foam and two of 3/8. Cut out the center of the one-inch piece before adding the sides. The parts are bonded with spray adhesive. Carve the fuselage contour with a *very* sharp carving knife, and sand to final shape with 100 grit paper. Then spray a light coat of "77" adhesive on the outside to help the nylon stocking lie down and stay when you slip the fuselage into one of its legs (be sure there are no legs in the stocking at the time!). My wife informs me that I used a lightweight support stocking . . . specifically, L'eggs Sheer Energy. Pull both ends to stretch the material down against the foam surface. You can make one end of the stocking come out in the area under the fuselage where the wing will join it. The other seam is placed under the nose. Brush a coat of white glue over the entire fuselage except where you will have to seam the front end. After the glue has dried you can trim and lap the front seam and then glue it in place. I found that about three coats of white glue were necessary to fill the weave. After that, I mixed in cornstarch and a bit of water to make a filler for about three more coats. At this point you have a rigid skin over your foam and you can trim around the wing joint, and carefully cut the canopy opening with a large razor saw.

FINAL ASSEMBLY

The next step is to bond the fuselage and wing together. Slow setting epoxy is the ticket here. Wipe away all excess and drips as they will get in the way of your fillets. Once the basic bond is made, use a slurrey of epoxy and microballoons to fill any gaps left in the joint. The fillets start as 1/2 by 1/2 triangular strips of wing core foam. Spray adhesive on the backsides and press the strips into the intersection of the wing and fuselage on the topside. The smooth contour is achieved by sanding with paper wrapped around a half-inch dowel. The fillet surface and the small fillets under the wing are done with the epoxy/microballoon slurrey. Two thin coats with sanding between should give a perfectly smooth surface.

Now you can add the vertical tails, hinge the control surfaces, add your decorative exhausts and intakes, guns, etc. I used Econokote strips in an over-and-under hinge arrangement because the surfaces are quite thin and the elevator is so close to the torque rod tubes. Trial fit your radio and rig the pushrods.

FINISH

On this Cutlass II, a urethane finish was used from beginning to end. I made a filler of two parts clear, one part thinner, and one part cornstarch (it is lighter than baby powder). Apply two coats of this filler to the entire model except down in the control surface gaps which are left raw to minimize binding. Allow a minimum of 24 hours between coats and sand both with 400 grit paper. The fuselage may require a couple more coats to get rid of the weave of the nylon stocking material. I did not try to eliminate all of the grain marks in the balsa parts.

The color scheme on my Cutlass II was a pale blue, glossy finish for the canopy and windshields, flat sand and flat olive drab camouflage on the top, and a flat gray on the bottom. Decals were scrounged from old kits, specifically the Midwest A4 Skyhawk, Estes Industries Interceptor rocket, and a variety of Sig decal sheets. Use one of the decal setting liquids to get a good bond to the flat paint finish, and overspray with flat clear if you are so inclined. Exhausts and radar nose are flat black.

FLIGHT

Trim, as mentioned, is highly critical to the performance of a flying wing. My Cutlass II balanced at 2-3/4 inches from the leading edge point at the center of the wing. In the photographs you can see me doing a swing test to get the approximate trim for the model. The trick is to tether the model at the leading edge of a wing tip, and whip it around at a fair approximation of flying speed. When the model is correctly trimmed, it will fly right side up just below even with your hand, and just barely lower upside down. This differential is your measure of the margin of stability. If there is too much stability (height difference in the swing test is due to forward CG and excess reflex), the model will porpoise in Free Flight, too aft a CG and it tends to flop end-over-end. Ideally you would keep moving the CG back and reducing the reflex provided by *both* elevator and aileron until the model is dead neutral and right on the verge of instability. Then stabilize it just a bit by moving the CG forward and increasing the reflex slightly.

I found that I needed maximum elevator and aileron sensitivity with the small arms on Cannon servos. As the model is now, I can do both loops and rolls when there is reasonable lift available. Flight is definitely fast, and the model will never be accused of being a "balloon" or "gas bag". It looks mean and authentic in the air. One comment heard at the slopes last time out was "WOW, I want one!" Well, I have mine, how about getting started on yours? •