694

Airmaster

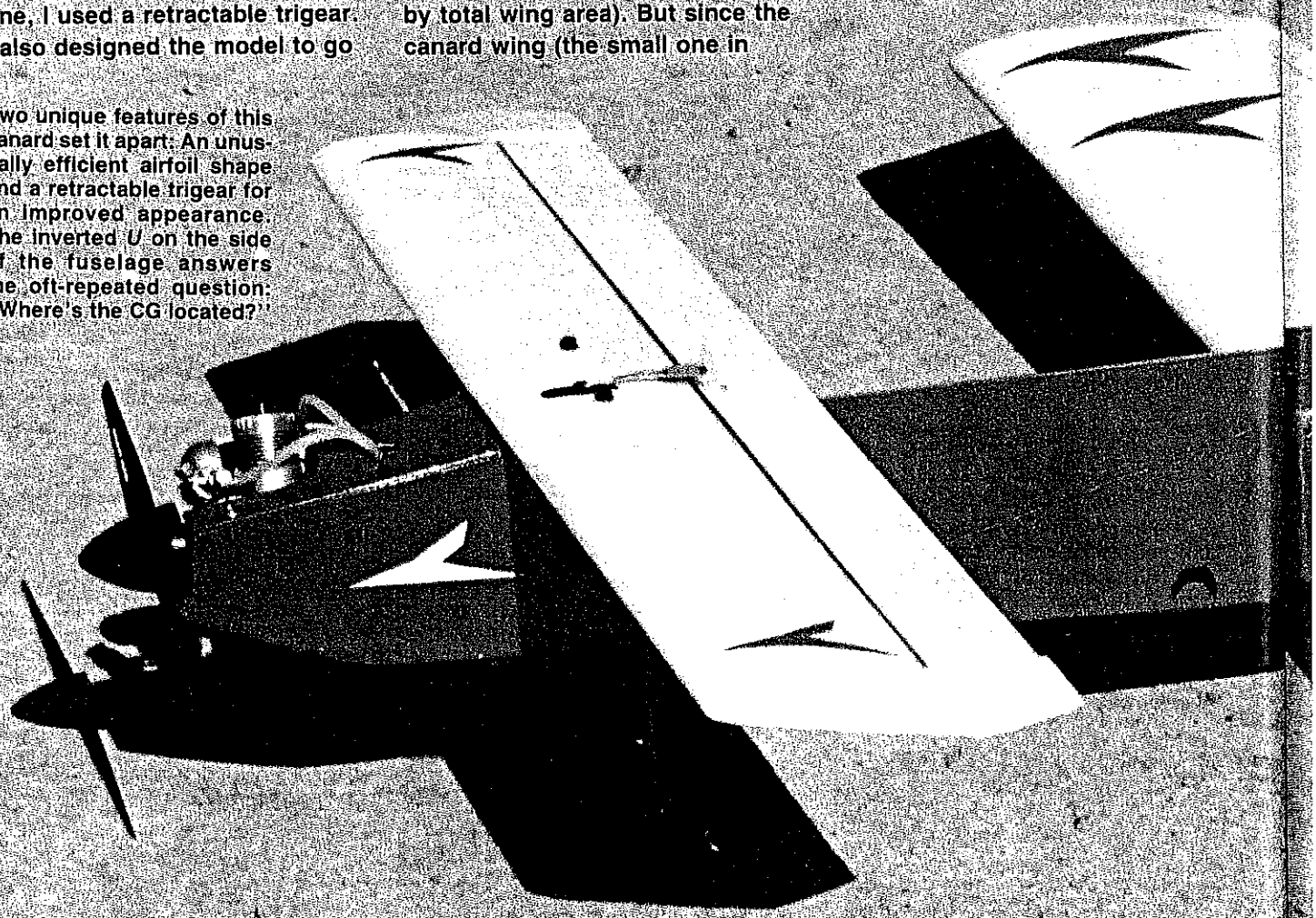
If you've ever considered building a tail-first design, then had second thoughts because canards just look too oddball, here's one that could change your mind. Using a retractable trigear for extra eye appeal, this potent RC canard-wing model flies like a champ on either twin .40 engines or a single .60. ■Al Masters

BACK IN THE 1960s when I was flying my LAKE LA-4, a full-scale pusher amphibian, it wasn't uncommon for a control tower operator to ask, "What kind of airplane is that?" As a canard design, the Airmaster prompts the same sort of curiosity, even from fellow modelers.

Canards are generally regarded as "weird Willys." To improve the appearance of this one, I used a retractable trigear. I also designed the model to go from twin .40 engines to a single .60 installation.

Basically, canard designs differ from conventional rear-tailed aircraft in having two lifting wings, and hence a lower wing loading. At a calculated flying weight of 10 pounds (160 ounces), the Airmaster has an *average* wing loading of about 23 ounces per square foot of wing area (total flying weight divided by total wing area). But since the canard wing (the small one in front) is only about one-fourth of the total wing area, when the model is balanced using the center-of-gravity indicated on the plans the actual canard wing loading works out to a respectable 34 ounces per square foot, with the main wing loading at only 19 ounces per square foot.

When we slow the model down



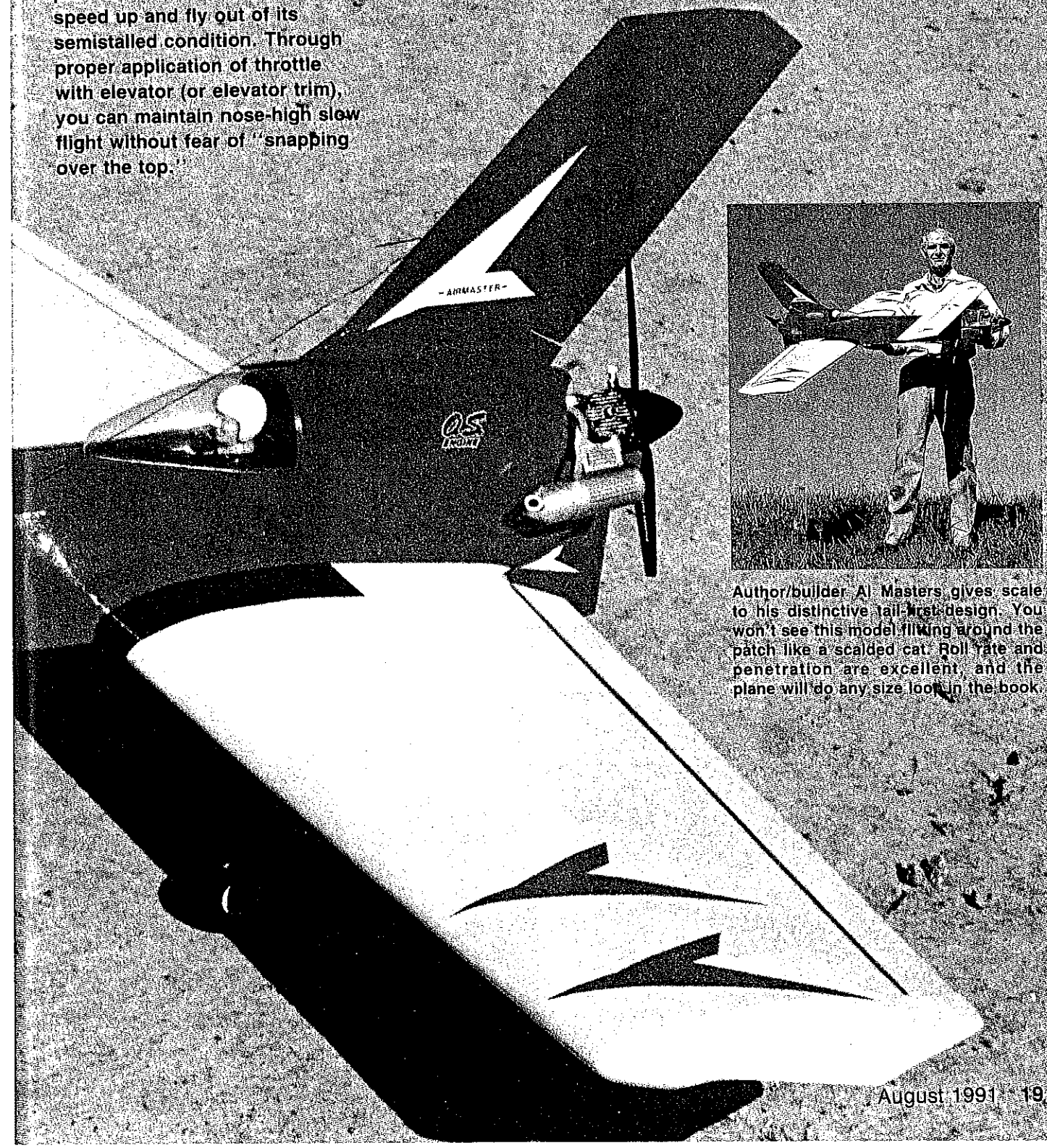
Two unique features of this canard set it apart: An unusually efficient airfoil shape and a retractable trigear for an improved appearance. The inverted *U* on the side of the fuselage answers the oft-repeated question: "Where's the CG located?"

by reducing power, the canard wing loses some lift and the nose begins to drop. Feeding in correcting elevator will hold up the nose and increase the canard wing lift, until finally the plane enters a slightly nose-high descent. Since the main wing is still above its stall speed, aileron control remains solid. Applying power or dropping the nose—with elevator alone if altitude permits—allows the model to speed up and fly out of its semistalled condition. Through proper application of throttle with elevator (or elevator trim), you can maintain nose-high slow flight without fear of "snapping over the top."

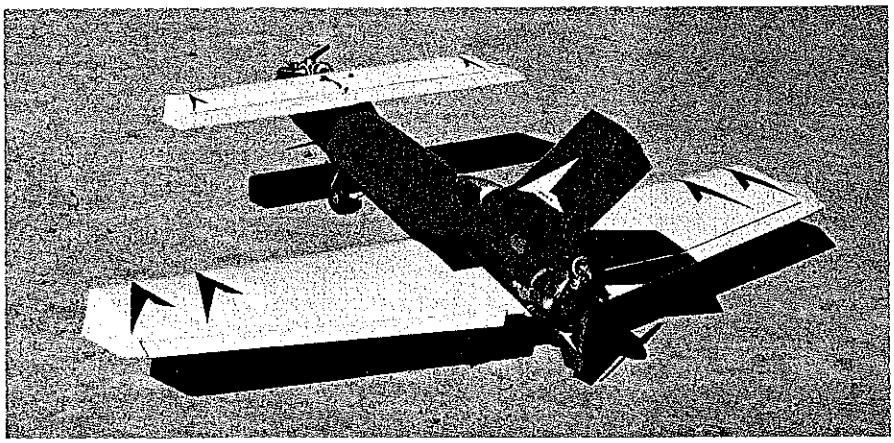
In most tail-first models, the location of the canard wing necessitates burying the control linkage for the elevator within the fuselage. For the Airmaster, I substituted a more efficient airfoil shape for the customary flat-plate (sheet balsa) design and mounted the canard wing on top of the fuselage. This arrangement not only allows the elevator servo and linkage to be housed within the canard center section but also provides some aerodynamic perks.

To simplify construction, the canard wing is built and covered separately from the main wing. The canard is attached with nylon bolts, making it easy to remove for fuselage access or transport.

With the canard set at 0° incidence, inverted flight is excellent. The full-span elevator provides ample control for



Author/builder Al Masters gives scale to his distinctive tail-first design. You won't see this model flitting around the patch like a scalded cat. Roll rate and penetration are excellent, and the plane will do any size loop in the book.

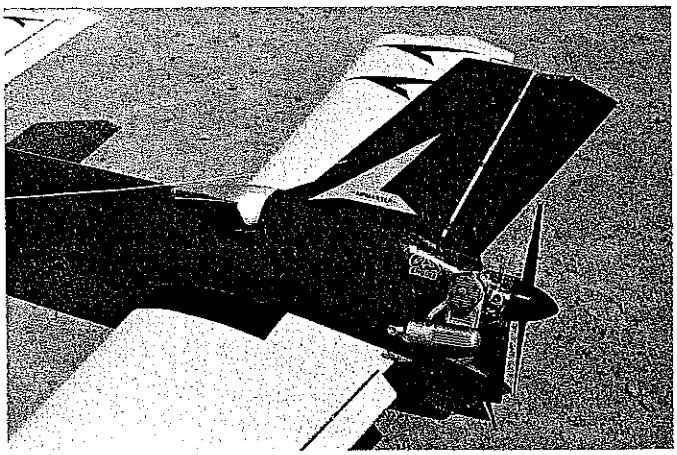


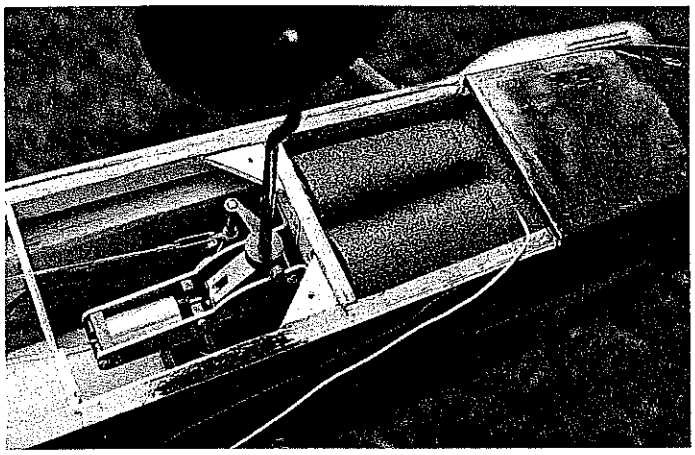
Biplane lovers might want to try a canard. You get two lifting wings, but no rigging problems.

outside loops. The ground attitude shown on the plan allows the canard to kick in early in the takeoff run and reduces the amount of elevator necessary for rotation.

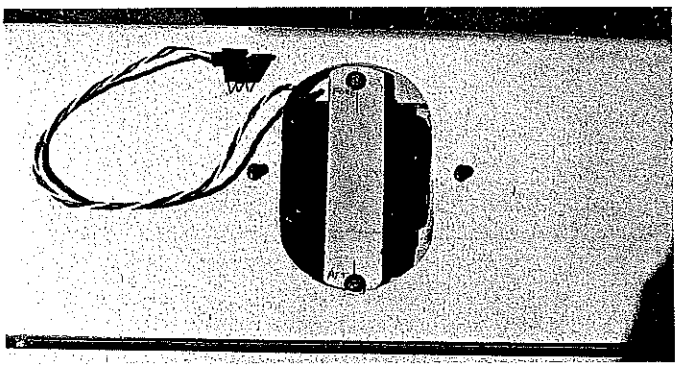
Since I was using twin .40 engines, I put the prototype through extensive ground tests on our hard dirt runway even before the first flight tests. That way I could identify changes to be made on the second prototype early in the game. Designing something original has its frustrations.

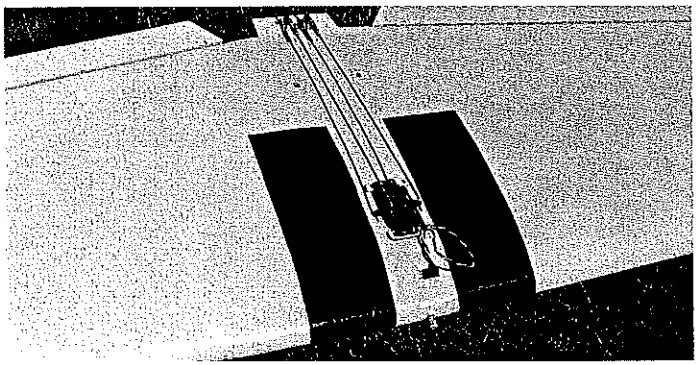
During high-speed ground runs and taxi tests, glow-plug-size pebbles scattered along our dirt runway were kicked up by



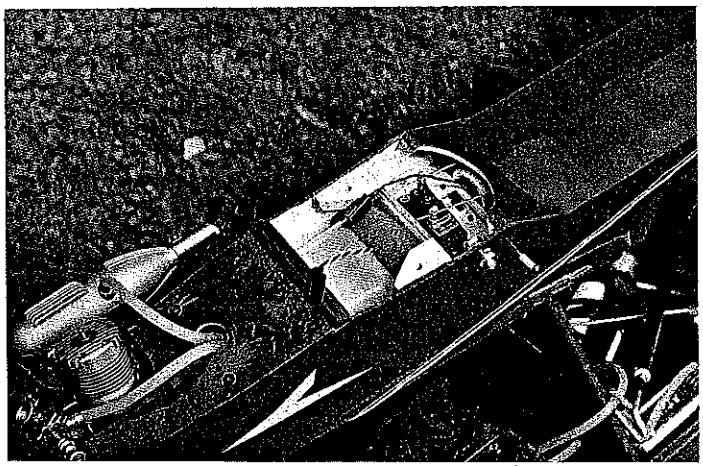


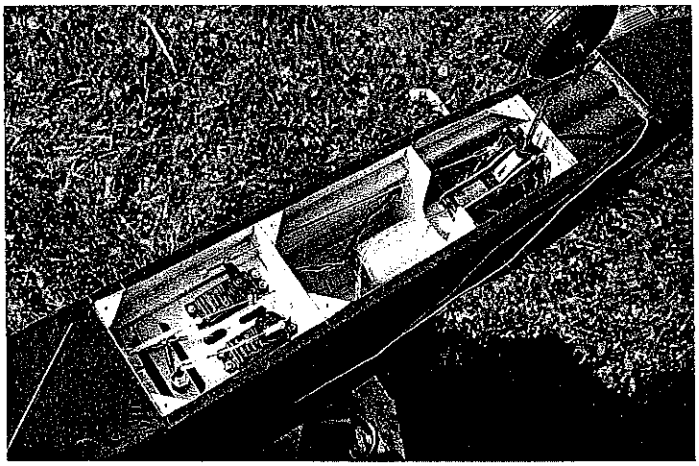
Left: Rather than functioning as a tail skid, the lower vertical fin supplies necessary fin area behind the CG. Right: Close-up of the battery/receiver bay. The receiver and Ni-Cds are packed neatly in foam (pipe insulation in this case) forward of the Spring-Air nose wheel unit.



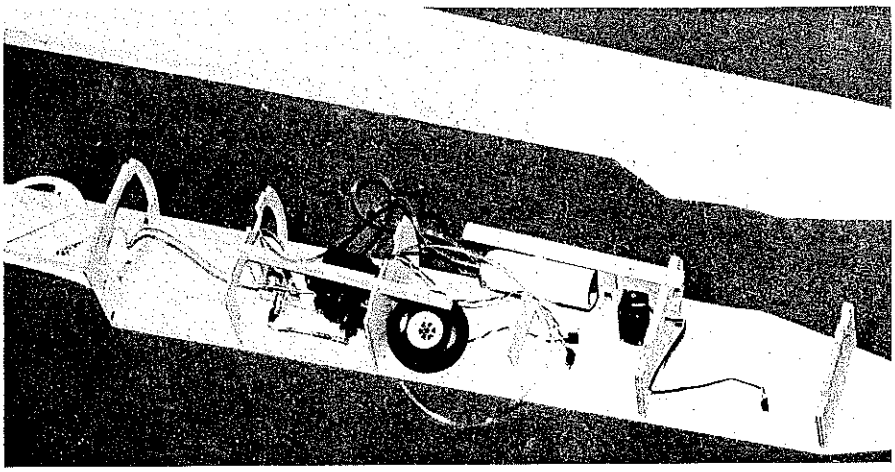


Left: A look at the underside of the canard wing shows the elevator servo installation. The $^{1}/_{16}$ plywood keeper holds the elevator servo in place. A flush servo installation can prevent damage to the fuselage in the event of a mishap. Right: Although the aileron servo is carried well forward in the wing, a servo lead extension must still be used to reach the receiver in the front of the fuselage.

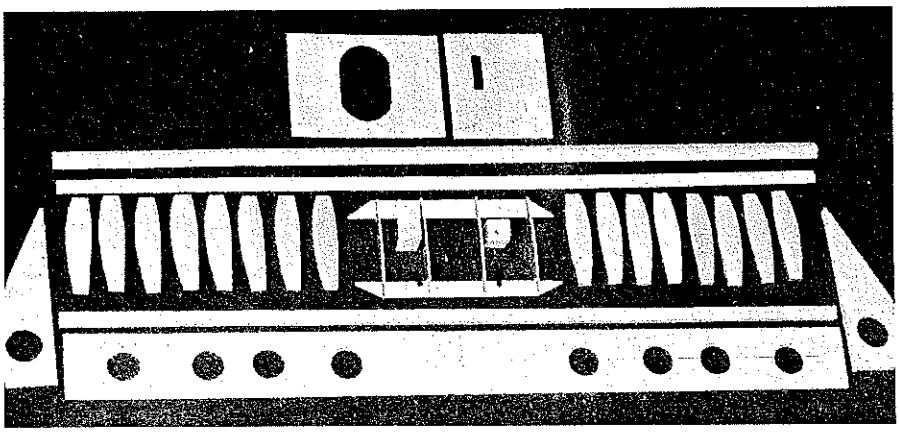




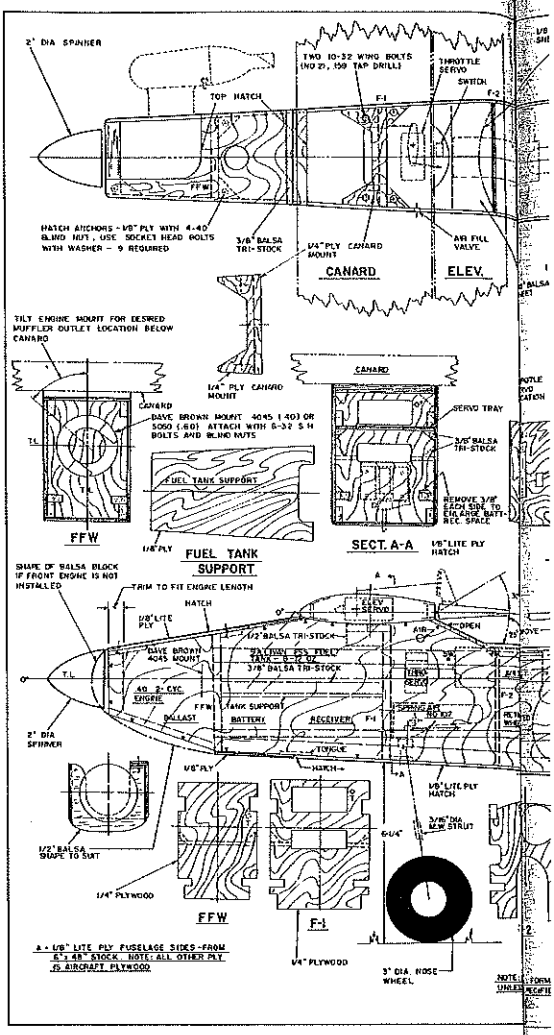
Left: The canard wing is attached with nylon bolts, making it easily removable for access to the throttle servo and for transport. The fore and aft fuel tank compartments can accommodate tanks of up to 12-ounce capacity. Right: The Lite Ply lower hatch has been removed to expose the four fuselage bays. Note the Spring-Air retract valve behind the rudder and retract gear servo.



During the early stages of design and construction, the author checks the location and fit of related parts by installing them in temporary subassemblies.



The major canard wing parts and the one-piece elevator ready for assembly. The rugged canard wing uses an efficient airfoil section instead of the conventional flat-plate design.

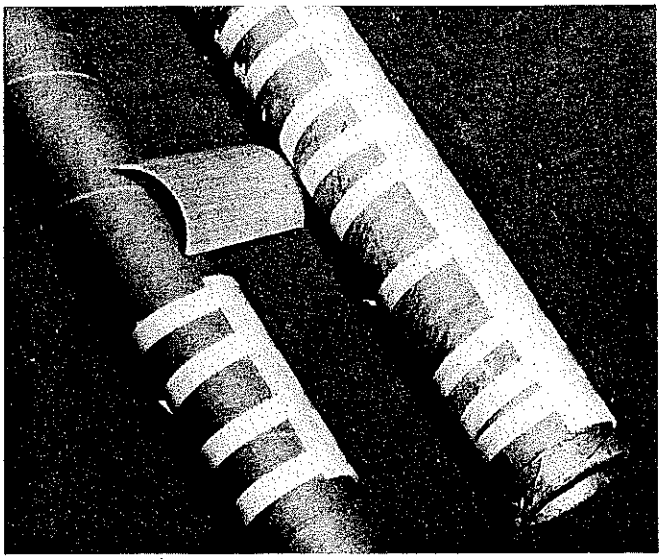


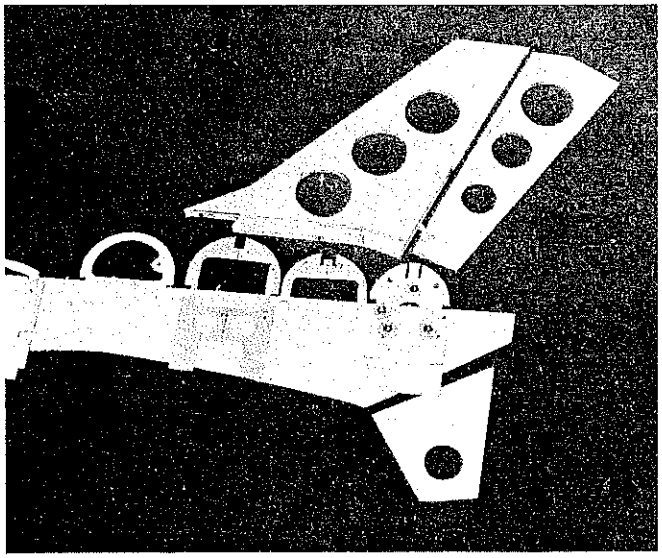
the nose wheel and passed through the pusher propeller, damaging the tip. Raising the aft engine an inch minimized that problem in the second model. This meant redesigning the upper vertical fin and rudder to ensure clearance for the pusher prop. The "stone problem" never developed on a grass runway.

Incidentally, full-scale airplanes such as the Dornier 335 use a fender on the nose wheel to prevent prop tip damage. (See my article "RC Push-Pull 240," April 1989 *Model Aviation*.)

As with full-scale tail-first designs, test flying to determine the desirable center-of-gravity (CG) for a particular model can be unpredictable. (Dr. Heinrich Focke lost his life during experiments with the CG location for the Focke-Wulf 19A canard in the late 1920s.) In fact, on its first flight Airmaster number one never left the 10-foot box.

Camera ready, I stood beside the runway at the estimated takeoff point. With the two .40s at full throttle, the model executed a perfect 10-foot-diameter loop immediately after lift-off. Test pilot Al Camp was so startled that he instantly chopped power, whereupon the model completed the loop and firmly planted its

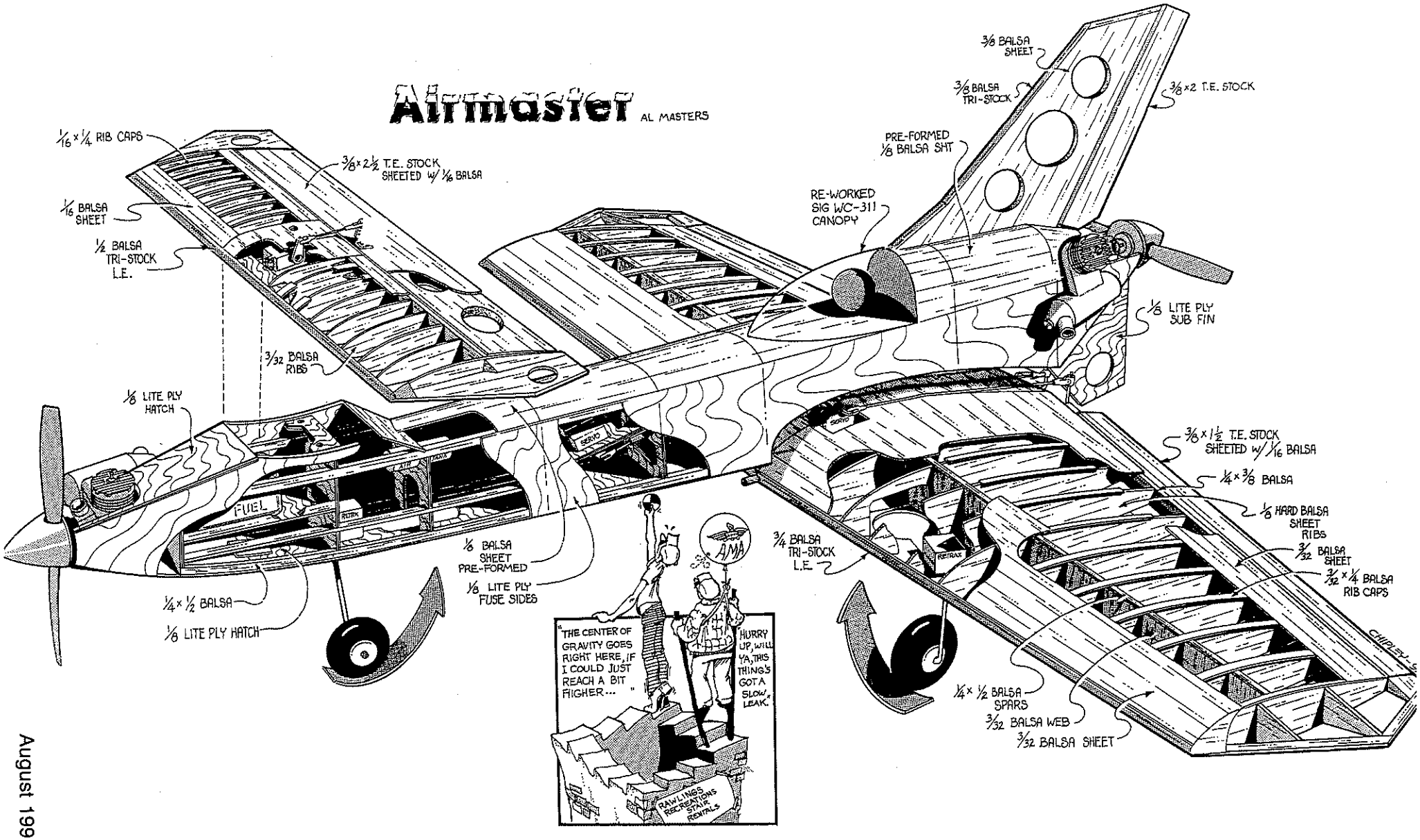




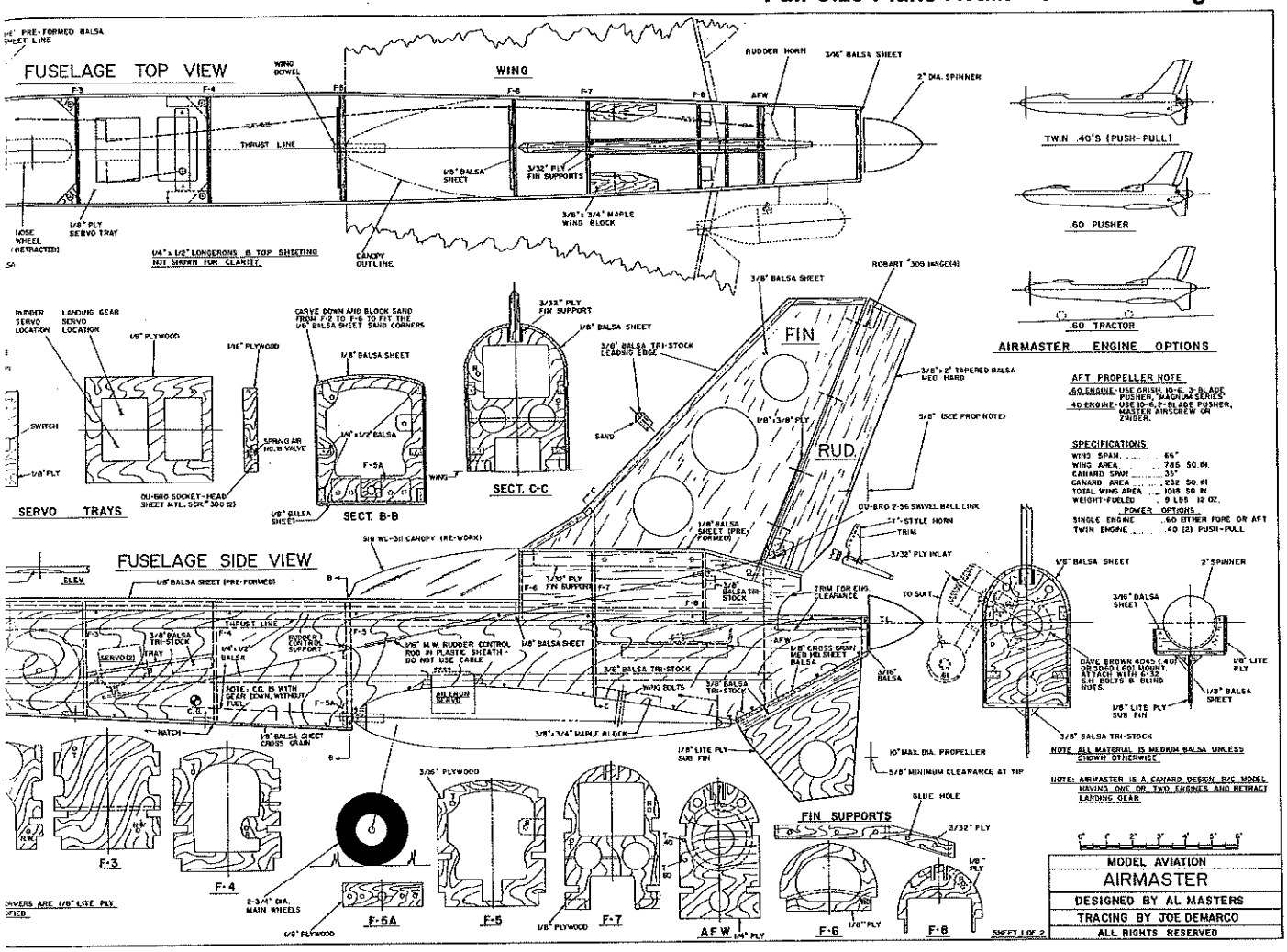
Left: The balsa skins are preformed by soaking them in ammonia water and wrapping them around a suitable cylindrical form. Allow the skins to dry before use. This method not only minimizes locked-in construction stresses but eliminates a big pile of wood shavings. Right: The aft fuselage bulkheads and vertical fin and rudder parts laid out in their relative positions. As noted, the lower fin does not function as a tail skid.

Airmaster

AL MASTERS



Full-Size Plans Available . . . See Page 204



three wheels on the spot they'd vacated about a second earlier. The photo I managed to snap caught the moment of lift-off and clearly shows the result of full *up* control (*down* elevator) with a very effective elevator. There was no damage.

To achieve the necessary design changes, I made a new fuselage for Airmaster number two. Adding four inches to the nose section moved the nose gear forward and permitted shifting the retract gear servo, air tank, and valve system from the main wing to the forward fuselage. And with the front engine four inches farther forward, less ballast would be needed to balance the model. Even so, ballast is required to achieve the correct center-of-gravity on all four versions.

The second prototype was first tested with a K&B .61 engine in the pusher (aft) position. Walt Paris, our club secretary, drew first honors. It was a rewarding flight. Two vertical fins had been added at the wing tips to offset the added fuselage area forward of the CG, although they were later removed without any adverse effect on directional stability.

I designed both firewalls to accept either .40 or .60 engines, with blind nuts for both sizes of mount in place. Once flight tests had been completed with the .60 pusher version, it was a simple matter to add a K&B .40 up front and replace the K&B .61 with an O.S. 40FP in the pusher spot. *Voila*, a twin!

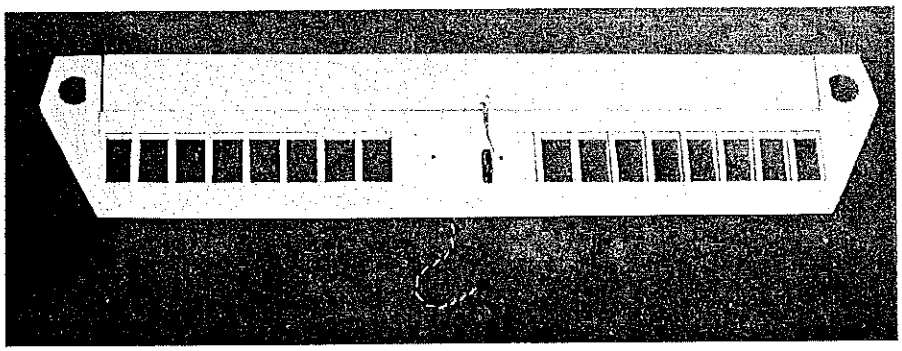
The only structural problem has occurred in the upper vertical fin and rudder section. Knowing from experience that pushers are rough on tail sections, I had purposely beefed up the fin attach area. Using the rudder and fin for a try at knife-edge flight can subject them to flight loads of such magnitude that both can pass through the pusher prop and break off.

Hence the vertical fin and rudder post are sandwiched between two plywood supports. Be sure to use epoxy when attaching this assembly to the fuselage. Relying only on CyA in this area, as I did with the second prototype, can result in the loss of a pusher prop or even the destruction of the model. The vortices from the pusher prop tip may create bending stresses in the rudder great enough to cause a break. Guard against that by using medium-hard balsa for the rudder.

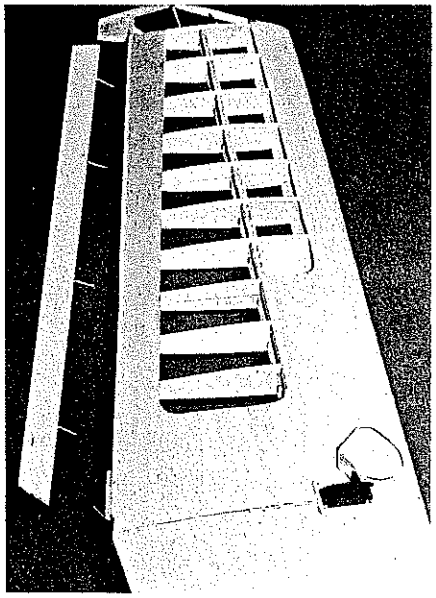
To make sure the Airmaster could handle less than ideal field conditions, Ray Doan and I did final flight tests from a not too recently mowed grass strip at our other club field.

You can be confident, then, that this design has been thoroughly tested. The canard airframe is easy to build, and you're given a choice of engine configurations. The retractable landing gear enhances the model's appearance.

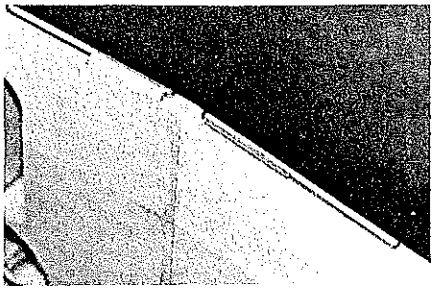
Finally, biplane lovers get two wings—without the rigging problems!



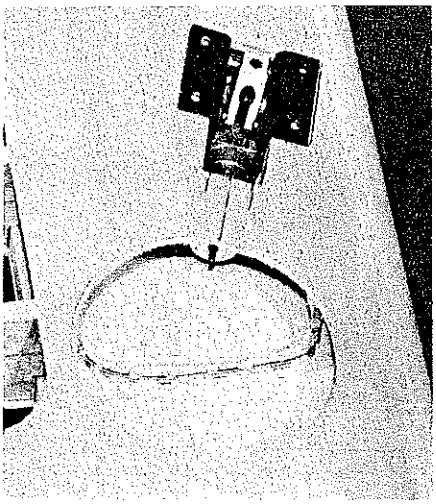
Looking down on the completed canard structure and elevator. The elevator and servo will be removed for covering, and the hinge points will be installed last. Nylon bolts attach the wing.



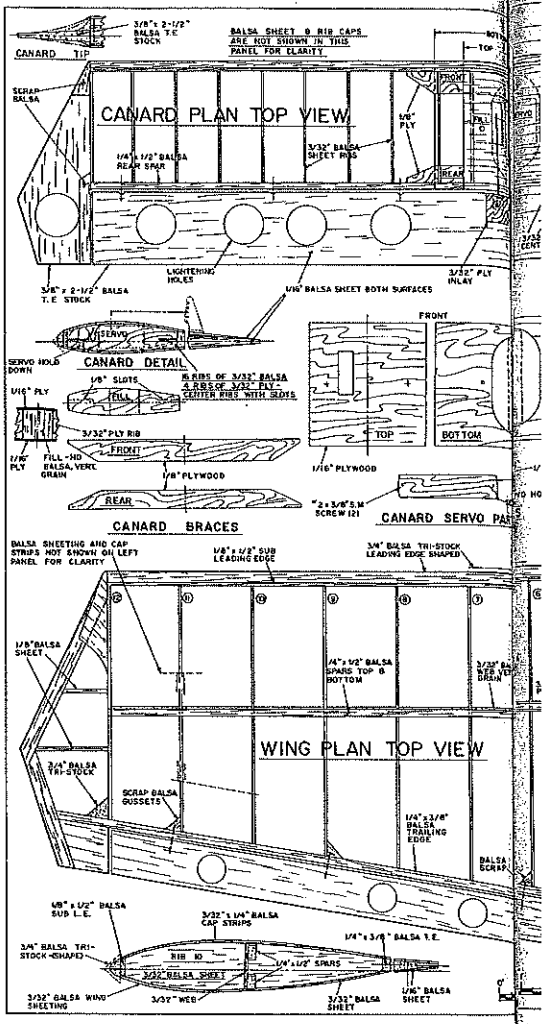
Except for installation of the aileron, the upper left wing panel is structurally complete. The aileron servo must be used with an extension to reach the receiver in the front of the fuselage. Wing construction methods are standard and straightforward.



The two 3/32 music wire aileron links pass through K&S 1/8-in.-sq. brass tubes. Epoxied in place, the tubes can be neatly covered over with grooved balsa triangle stock.



A wheel well has been partially opened and a Rhom retract unit is being fitted. Both the Spring-Air and Rhom systems work well, but the author prefers the Spring-Air unit because it runs only one air line, has positive downlock in the event of air loss, and has an easy-to-mount control valve.



Construction. Regardless of which section you prefer to build first—wing, fuselage, or tail components—begin by making the formed 1/8-in. sheet balsa for the top of the fuselage. When you're ready to add it to the fuselage, it will be thoroughly dry.

Select two sheets of 4-in.-wide, 1/8-in.-thick medium balsa from 36-in.-long stock. Cut 12 inches from each sheet, and soak the four pieces in ammonia water for at least five minutes. Drain the wood, then wrap each piece around a cylindrical form. Use whatever you have on hand—cardboard tubes, soup cans held together with tape, coffee cans, etc.—the diameter isn't critical. Hold the shape with masking tape.

While these assemblies are drying, begin making your kit of parts.

Fuselage. Use two sheets of 1/8-in. Lite Ply for the sides, each 6 in. wide and 48 in. long. Placing one sheet under the plan side view, locate the endpoints of straight lines with a pin pressed through to the ply. Locate the thrust line the same way; this will serve as the datum line.

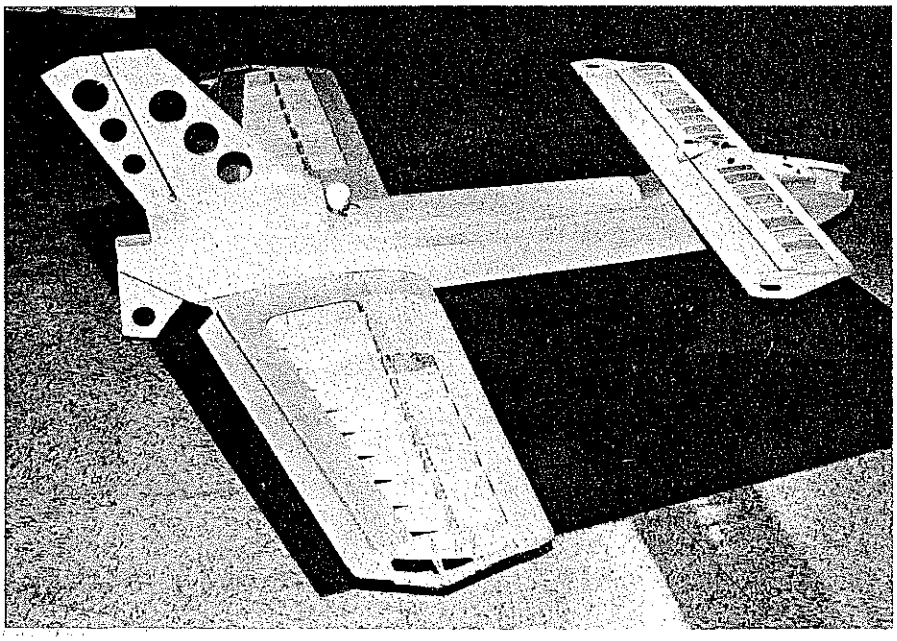
Connect the pin marks with a straightedge and a ball-point pen. The only curved sections are the two wing saddles. These can be traced after slipping carbon paper between the plan and plywood.

Cut out the first side. Mark it with the thrust line, the bulkheads, and the three 1/4 x 1/2-in. longeron positions. Make the side full length, extending it past the firewall at each end; you'll be trimming it to suit your engine dimensions later.

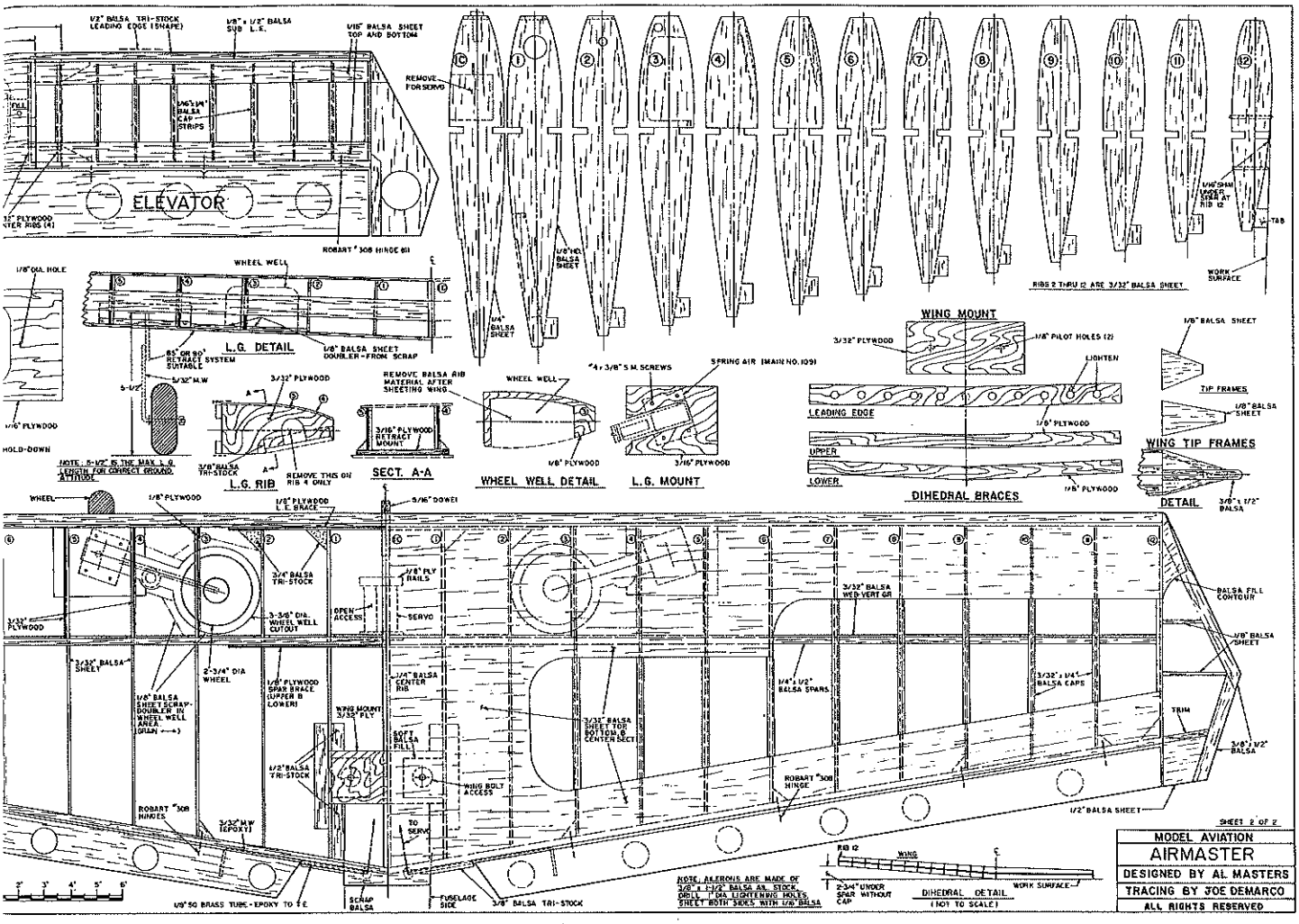
Sand the first side to outline, then use it as a pattern for tracing the second side. When that has been cut and sanded, hold the sides together with masking tape while sanding them to matching size.

Take a moment to differentiate the right side from the left. All bulkhead lines and the thrust line should be on the inside surface of each side. Draw these lines on the second side, and mark the longeron positions there as well. Attach the longerons with CyA. Let the upper one extend above the side; it will be trimmed to accept the top sheeting later (see F-2 on the plan).

To simplify tracing, all the bulkheads and formers have been arranged near the edge of the plan. Always include the vertical centerline when making these parts, and take utmost care to cut them so



The completed Airmaster structure sits on its trigear ready for covering.



that the sides remain parallel and the bottoms are square with the sides.

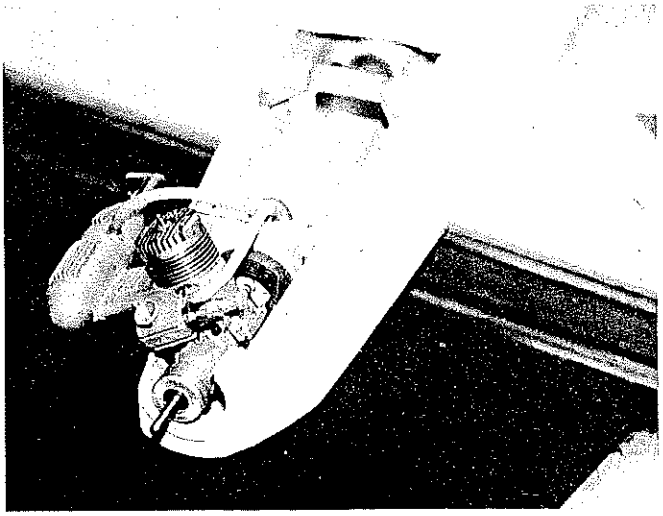
The slots for the fin supports in F-7, F-8, and the aft firewall (AFW) must be accurately cut. Make sure the fin supports fit snugly in these slots. Also, test fit the ⅜-in. balsa sheet that will be used for the vertical fin. The fit should not be loose.

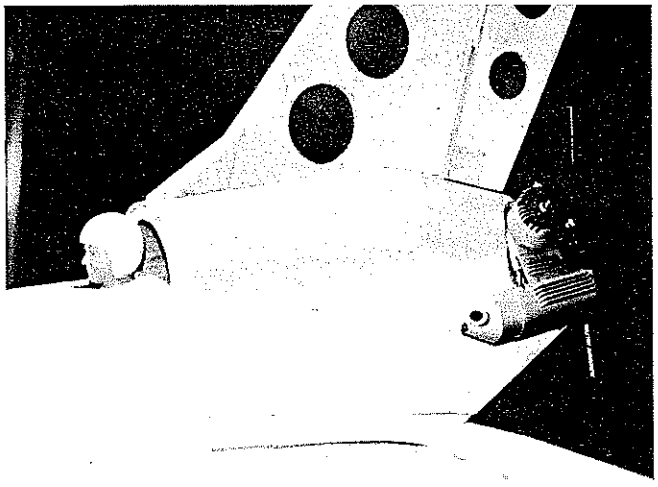
Choose your engine installation at this point. If you decide on a twin configuration and have engines of different makes, use the heaviest one for the tractor. Mount the engine, align it with the thrust line on the firewall, and cant it as desired. Note the position of the engine with respect to the fuel tank and carburetor. Mark the firewalls, and install the blind nuts.

Position the nose wheel retract on F-1, and secure it with blind nuts. A Fults RF-500 fixed nose wheel unit can be used if retracts will not be installed.

This is a good time to trial fit one of the fuselage sides with the bulkheads pressed into place. The parts will hold together nicely. You can work out the arrangement

Continued on page 92





Left: The tractor engine should be canted so that the exhaust outlet clears the canard leading edge. The fuselage length is trimmed to fit the engine chosen, in this case a K&B .40. Right: Make sure the rudder horn and pushrod are installed on the correct side for proper coordination with the nose wheel steering. The author had to correct the one shown here. The O.S. .40 with a standard muffler has been fitted in the pusher spot. Trim the section aft of the firewall to suit your engine. The pilot is optional; fuelproofing and sealing the engine compartments are not.

Airmaster/Masters

Continued from page 25

for the Ni-Cds, receiver, and servos and check the fit of the air tank. It's also helpful to drill the holes for the control rods at this point.

Begin fuselage assembly by supporting the uprights for the sides and epoxying the front firewall in place, using F-5 as a spacer only. (Here as elsewhere, there's no need for humongous gobs of epoxy—a thin layer will suffice.) When the epoxy has cured, bring the aft section together and epoxy the aft firewall in place. Hold it with clamps or tape until the epoxy has cured. Sight along the assembly to make sure both firewalls match up with the vertical centerlines.

Force the remaining bulkheads in place. Verify that everything is in alignment by sighting along the assembly and checking vertical centerlines. When you're satisfied, lock the parts together with a shot of CyA. Recheck for trueness, correcting as necessary, before double gluing F-1 and F-5 with epoxy.

Push the two fin supports in position, flush with the tops of the bulkheads. Use epoxy at all bulkhead contact points in this area. Set the fuselage aside.

Canard. Build the basic frame directly over the plan, protected by a layer of waxed paper or the equivalent. Pin the ¼ x ½-in. rear spar and the ⅛ x ½-in. sub-leading edge over the plan. Since the ribs are not flat bottomed, be prepared to shim the leading edge with scrap balsa as necessary.

Glue in the 3/32 balsa sheet ribs. Fit, but don't glue, the front and rear ⅛-in. plywood braces into the four slotted plywood center ribs. Accurately position this subassembly, and lock it in place with CyA. Double glue the plywood joints with epoxy.

Cut the top and bottom 1/16 plywood center sections, making sure the grain is running as shown on the plan so that the wood can be formed over the ribs. Locate the canard wing bolt centers on the fuselage plan, and drill two ⅛-in. pilot holes in the bottom center section piece. Accuracy of the center-to-center dimension is important for servo clearance, but the front-to-rear location can vary slightly.

Remove the partially completed canard panel from the building board, and attach the bottom center section piece with epoxy and clamps. Glue in the two vertical-grain hard balsa fill blocks, sanding them flush with the top of the plywood ribs. Attach the 1/16 plywood top piece with epoxy, clamping it in place.

Starting from the ⅛-in. pilot hole side, drill two holes with a No. 21 (.159) drill. Drill through the blocks and the top piece.

Complete the canard by adding the 1/16 x 1-in. balsa sheet, the rib caps, and the ½-in. triangle-stock leading edge. Tapered elevator stock is used for the canard tips.

Elevator. This is cut from ⅜ x ½-in. elevator stock. Cut the lightening holes. Drill the ⅛-in. holes for the Robart hinge points, then mark and drill the rear spar of the canard with matching holes.

Remove material from the top surface of the elevator core so that it will accept the 3/32 plywood insert for the top-mounted control horn.

Complete the elevator by adding 1/16

Continued on page 96

Airmaster/Masters

Continued from page 92

sheet balsa to both sides; hinge points will be installed after covering. Set the unit aside.

Wing. Trace and cut one set of ribs following the plan in the conventional way, then use them as templates in making the other set. Finish-sand the ribs in pairs.

Cut the dihedral braces and rib doublers from the specified plywood, being sure to make a right and a left set of rib doublers. Use ⅛-in. ply for the doubler at the wheel well. Glue the rib doublers to their respective ribs. Drill the doublers for the holes that will accept the retract air lines.

If you choose not to install retracts, standard fixed-wire gear with grooved blocks mounted into suitable plywood rib doublers may be substituted. Another suggestion is a standard formed aluminum gear mounted on plywood forward of the main wing. The design as shown has been tested with the wide main gear tread, which gives excellent ground control. The gear should be held to the length shown on the plan.

Cover the plan with protective film. Cut four straight ¼ x ½-in. balsa spars to length. Glue the lower dihedral brace to one of the spar halves, and position the spar over the plan. Secure it with pins or weights.

Position ribs 1 to 12 on the spar, making sure the construction tabs are on the work surface. Make the spar notches larger on ribs 1 and 2 so that they fit over the dihedral brace.

Pin the ¼ x ⅜-in. trailing edge (TE) and the ⅛ x ½-in. sub-leading edge in place on the ribs as an aid in alignment. When the ribs are perpendicular to the work surface, CyA them to the spar, sub-leading edge, and trailing edge. Glue the upper spar in place. Block sand the upper surface of the trailing edge slightly to follow the rib contours.

Add the 3/32 balsa TE sheet (2-in. stock), allowing enough length to extend past the location of the yet-to-be-added rib 1C. Add the four hinge supports and vertical-grain webs between ribs 1 and 12.

Slip rib 1C in place, and, with the spar 1⅜ in. off the work surface at rib 12, position it perpendicular to the work surface. Trim the 3/32 trailing edge sheet to the centerline of 1C. Glue the latter to the trailing edge and the TE sheet, then lightly tack glue it to the spars and the sub-leading edge.

Set the panel aside, and build the second one the same way. Enlarge the spar notches in ribs 1C, 1, and 2 to accept the spars with the ⅛-in. plywood dihedral braces. Elevate the first panel 2¾ in. as shown in the plan, and butt join the lower spars. Fit and clamp the upper dihedral brace. Make sure it fits flush with or slightly below the spars, since it's difficult to sand down later.

Razor-saw the leading edge dihedral brace, and clamp it in position. Check over the subassembly, making sure the spars run straight from tip to tip, then glue all joints with CyA. Take care to keep glue off the clamps.

Remove the clamps, carefully turn the wing over, and clamp and CyA the lower dihedral brace. Add the four ¾-in. triangle braces at ribs 1 and 2. Complete the spar webbing in the center section. Cut off the construction tabs.

Add the plywood wing mount. The mount should be flush with the tops of ribs 1 and 1C so that the center section top sheeting can be fitted over it. Bolster this area with ½-in. triangle stock.

Use soft balsa for the blocks that you'll be drilling for the wing bolt access holes. Make the blocks 1½ in. on all sides, and drill a ¾-in. hole through each. From the inside, center the hole over one of the two pilot holes in the wing mount, and CyA he block in place. Repeat with the other block. Sand the blocks flush with the ribs.

Make up and fit the main gear retract mounts. I have used both the Rhom-Air and Spring-Air units over the years. Either is satisfactory. The Spring-Air system runs only one air line, has positive downlock in the event of air loss, and features an easily mounted control lock.

It's important that the wheels extend as close to the center-of-gravity as possible when the main gear is down. By reducing the canard loading, this minimizes the elevator input required for rotation prior to takeoff. Main gear struts should be 5/32 wire. The wheel wells are deep enough that either the 85° or 90° units can be made to fit.

Position and glue the 3/16 plywood gear mounts. Add the adjacent triangle stock supports. Feed the air line(s), storing them in the aileron servo bay. Close up the center sections, and complete the wing

Continued on page 100

Airmaster/Masters

Continued from page 96

sheeting. Open up the wing bolt access holes, and true up the openings with sandpaper wrapped around a piece of ⅝-in. dowel.

Make a template for the wheel well and strut cutout areas, and use it to trace the outline on the bottom sheeting. Cut out the balsa sheet and rib sections where required to provide the necessary clearance for the gear. Reinforce the area with ⅛-in. sheet scrap balsa as indicated on the plan.

Complete the wing by adding the tips, leading edge (LE), and rib caps.

Ailerons. Cut the two aileron cores from ⅜ x 1½-in. aileron stock. Cut out the lightening holes, then cover the core with 1/16 lightweight balsa sheet.

Drill the four holes for the hinge pins using a ⅛-in. bit. Drill the 3/32 hole for the torque rod. Transfer the hinge locations to the wing, and drill the wing to match.

Trial fit the ailerons with the hinge pins and the torque rod assemblies. When everything is in alignment, epoxy the brass tubes on the wing trailing edge. Remove the ailerons for final sanding and covering.

Sand the top of the wing center section and shape the leading edge to final form so that the wing can be trial fitted to the wing saddle. Make absolutely certain that both sides of the fuselage meet the top of the wing at the same angle. Sand the saddle for a good fit with the wing.

Remove the wing. Epoxy the wing hold-down blocks, and clamp them in place until the glue has cured.

At the wing and leading edge centerlines, drill a 3/16 pilot hole through the leading edge, the ⅛-in. plywood LE brace, and about 1½ in. into rib 1C. Keeping the drill perpendicular to the plywood LE brace, redrill the hole to 5/16 diameter to fit a dowel of the same size.

Insert the dowel in the wing, then hold the wing in the saddle as you assemble F-5A over the dowel. This ⅛-in. ply piece permits adjustment of the wing. Tape the wing in place as you check and recheck the alignment in all directions. When you're satisfied, clamp F-5A to F-5 from the inside.

Using the wing mount pilot holes as a guide, drill through the hardwood blocks with a 3/32 drill. Remove the wing, and tap the blocks for the ¼-20 wing bolts. Redrill the holes to ¼ in.

The fuselage can now be completed. Carve away the middle longeron in the battery/receiver bay as shown in section A-A of the plan. Add the fuel tank supports. Fit the servo trays in place.

Epoxy the ¼-in. plywood canard mount in place. Using the canard as a guide, drill through the canard mount with a No. 21 drill (.159). Tap the two holes for the 10-32 nylon wing bolts, and ream the wing bolt holes in the canard with a 3/16 bit.

Bolt the wing in place. Apply vaseline to the 5/16 dowel hole in F-5A, and push a piece of 5/16 dowel through F-5A and into the wing. Epoxy F-5A in place. Remove the wing when the epoxy has cured, then remove the dowel from the wing. The latter will be epoxied in place after the wing has been covered.

Close up the fuselage top with the now thoroughly dried preformed balsa sheet. Carve the top longerons down at an angle, and fit the 24-in. pieces between F-2 and F-6 (refer to section B-B on the plan). Trim the pieces as required, and glue them in place from the inside as you hold the sheet against the bulkheads. A longitudinal seam can be made anywhere on top with no problem.

The section under the elevator can be a little tricky at the junction of the curved sheet and the angled ⅛-in. cross-grained balsa sheet piece. Make a paper template for this piece, then keep cutting and trying till you get it right.

For the aft section sheeting, first install the formed sheet from F-6 to F-8, leaving a ⅜-in.-wide slot for the vertical fin. Add some small ⅜-in. triangle stock pieces to F-8 to support the sheet at the bulkhead seam. Although the plan shows only two of these pieces for the sake of clarity, you'll actually be gluing in three or four of them.

Carve the triangle stock pieces to the correct angle for the sheet transition before fitting the sheet. Since this section is a

compound curve, you'll have to cut and piece the sheeting. Extend the sheet well aft of AFW; how you trim it behind the firewall will depend on your aft engine installation. Apply pressure to the sheet, and use CyA from the inside. If there will be no aft engine, balsa block can be added and shaped to the builder's choice.

Hatches. Epoxy the hatch anchors in place. Install the 4-40 blind nuts. Cut a piece of 6-in.-wide Lite Ply stock to the length of the lower hatch, and glue the hatch tongue to one end. Screw the six 4-40 socket-head hatch screws into the blind nuts from the inside, allowing only 1/32 in. to protrude above each nut.

With the hatch blank in place, press to indent the material at each screw location. Drill the holes for the screws, and attach the hatch blank. Trace the outline, and cut out the hatch.

The opening for the retract nose wheel strut is carried forward to permit the hatch to be moved aft to clear the tongue when the screws are removed. The hatch can then be lifted clear of the nose wheel for complete access to the underside of the fuselage. If you're using a fixed nose wheel, make the hatch U-shaped at the strut to allow removal.

Trial mount the front engine, and trim the fuselage to the desired length. Add and shape the balsa block at the chin. If no engine will be installed at the front, block in this area and round it off to suit. Fit the front hatch.

Fins and rudder. Use 3/8-in.-thick balsa sheet for the vertical fin. The rudder post is 1/8-in. plywood. Carry the fin material and plywood post to the bottom of the 3/32 plywood fin supports in the fuselage. Cut the lightening holes, and treat the inside edges of the holes with CyA. Cap the leading edge with 3/8-in. balsa triangle stock.

While the lower fin doesn't function as a tail skid, it contributes needed fin area behind the center-of-gravity. Make it from 1/8-in. Lite Ply and 3/8-in. balsa triangle stock.

Cut the rudder from elevator stock. Fit it with an inlay of 3/32 plywood for the control horn. Make the holes for the rudder hinge points.

Covering and assembly. Play with the inside goodies to convince yourself they'll all go in. Remove them, and cover the structural components with your favorite material.

Cover the vertical fin down to its point of entry in the fin support slot. Since the glue joint is critical in this area, it should be left exposed.

Cover the fuselage and fin, then epoxy the latter in place. Cover the lower fin. When epoxying it in place, take great pains to ensure that it's absolutely congruent with the fuselage centerline and the upper fin and post unit.

Before epoxying the hinge points in place, treat the hinge centers with petroleum jelly to guard against loss of hinge action after the epoxy cures.

Epoxy the wing dowel in place. Add the canopy, with provisions for a pilot if desired.

Always fuelproof and seal the engine compartments.

Install the nose gear and the rudder servo. The rudder control rod is 1/16 music wire running through a Nyrod sheath. It's attached to the rudder horn with a Du-Bro 2-56 swivel ball linkage to prevent flutter-inducing rudder play.

Use servo extensions to facilitate removal of both the canard wing and the main wing. Leads can be extended without changing the plug or socket by cutting the three wires and soldering in the required lengths of stranded extension wire purchased from Radio Shack. Du-Bro heat-shrink tubing is used over each solder joint and a larger shrink tubing over the three-wire joint bundle. Choked extensions were not necessary with the FM or PCM systems used in the four prototypes.

Mufflers. It's preferable, but not mandatory, to change the position of the aft engine muffler so that the exhaust is directed rearward. Standard mufflers were used for all test models. Some muffler

Continued on page 102

outlets can be sawn off at a 45-degree angle if desired. The O.S. .40 muffler outlet can be rotated to achieve the most suitable exhaust direction. Muffler styles are available for the O.S. .40 and the HB .40 in pusher installations; others may be available as well.

Propellers. An important caveat: Because of the location of the rudder and lower fin, the pusher prop must not exceed 10 inches in diameter. Also, avoid the highly flexible style of pusher prop, especially with a .60-size engine in the aft spot. I have specified the three-bladed unit in the Grish Magnum series because this type of prop can absorb the high power of larger engines without deflecting into—and chewing up—the tail section.

Aft fuel tank. After much testing, I put the fuel tank clunk in the forward position. The clunk line should be as short as possible, but still flexible enough to reach the tank bottom. This permits the use of shorter fuel and pressure lines. Avoid placing the aft fuel tank too low. (See my article "Push-Pull 240," April 1989 *Model Aviation*.)

Ballast. With everything in place and the gear down, add ballast to achieve the indicated center-of-gravity. Do this before filling the fuel tank.

A twin .40 installation requires about nine ounces of ballast. With a single .60 engine in the pusher spot, you'll need a pound or two of lead up front to rebalance the model. That sounds like a lot, but the wing loading will still be well within bounds. On the other hand, if you're using a single .60 up front, relocating the Ni-Cds, receiver, and gear servo to the rear will reduce the amount of aft ballast required.

Flying. For your own peace of mind, allow plenty of speed buildup on that first takeoff run. You can be confident that the Airmaster won't take off prematurely in a stall attitude as often happens with conventional-tail designs. I have yet to meet the pilot who is comfortable with a snap roll microseconds after lift-off.

As with canards generally, the Airmaster is predictable and stable in the air. Retract the gear, and watch it move out. Looks great! Whether you use the single-.60 or twin-.40 engine installation, this is no small, overpowered airplane flitting around the patch like a scalded cat. It's an assertive flier with character to spare.

Both roll rate and penetration are excellent. The plane will do loops of all sizes, from the type that stakes out a large chunk of sky to the more spectacular, tight "dog chasing its tail" variety. The twin-engine rendition will stay in comfortable flight with either engine stopped. At reduced power and with the elevator adjusted to full *up*, the model appears to hover at almost zero forward speed. A sharp-breaking stall has yet to be experienced.

Don't be afraid to make nose-high approaches—positive aileron control continues all the way to touchdown. Always remember to feed in a little throttle on final approach to slow the rate of descent before you run out of elevator.

Doubtless it's only a matter of time before some hot-pilot builder hangs two .60s on this design. They'll go in nicely with no modifications other than adjusting the center-of-gravity to offset the added weight. Take it easy when removing ballast to experiment with moving the CG

rearward. The flight character can change from groovy, to twitchy, to no control at all! □

Toledo '91/Myers

Continued from page 30

modules are expected later this year for both 72 MHz and 75 MHz. Futaba will continue to sell crystal pairs for both 72 and 75 MHz.

Hobby Shack showed the Excell line, a new addition to its "Cirrus" line (which began in 1972). It was described to me as a digitized FM/PCM system with a 512-bit code. The dual conversion, narrow-band receiver accepts either 512 or 1024-bit code. PCM and PPM versions are available. Made by Futaba, prices range from $110 for a three-servo four-channel FM set to $230 for a four-servo, seven-channel PCM system.

Cox Hobbies showed prototypes of a dual conversion narrow-band AM receiver for their "Cobra" line, which now features bean-shaped narrow-band two-and three-channel transmitters. A $35 upgrade has been announced for older wideband versions of this radio system. Cox radios usually appear in high-production "toys," like RTF airplanes. I predict that this system will find favor among sailplane pilots.

Users of 75 MHz systems have been at a loss how to sanction all 30 channels, because so many of their 75 MHz AM systems won't be modified to narrow-band performance. The IMPBA (International Model Power Boat Association) held its Directors' meeting at Toledo during the show. I was invited to address them on the matter of frequencies. Afterwards they voted to sanction use of all 30 of the 75 MHz channels, with the proviso that odd-channel radios must be FM.

I think that this is an excellent decision for them, because it will allow them to continue with their wideband radios, while they phase in narrow-band equipment as it becomes available. Narrow-band FM transmitters on the odd channels are not likely to interfere with decent wideband receivers on the even channels, and the narrow-band FM receivers on the odd channels should ignore decent wideband transmitters on the even channels. A decent wideband system would qualify for the old RCMA/AMA silver sticker. There was some discussion of beginning an RCMA/IMPBA sticker system for 75 MHz radios, but nothing was settled.

Now, let's look at some pictures of the show. □

RC Helicopters/Jolly

Continued from page 31

glass tail rotor blades providing enhanced performance to the model's well-known smooth flying qualities.

• *Magic 60 L.* Those Helicopter pilots who are accustomed to counterclockwise rotor-system rotation will surely appreciate the new Magic 60 L Robbe/Schluter Helicopter kit. They will now be able to enjoy Schluter engineering to its fullest. This machine retains all the extensively engineered qualities of the standard Magic 60 kit, while the mechanics have been redesigned to accept a new spur gear that reverses the rotor system's rotation. With the 60 and 60 L, Robbe offers an attractive Schluter alternative for all pilots whether they are used to clockwise- or counterclockwise-rotation systems.

• *Junior 50 II.* Robbe/Schluter's smallest and hottest performing .50-size Helicopter is now even better. The tedious job of building wooden servo trays has become a thing of the past for Schluter Helicopters sharing System 88 mechanics. Like the Scout 60 and Magic 60, the Junior 50 II is now equipped with a plastic servo structure and redesigned canopy. The canopy has a sleeker aerodynamic shape and extends beyond the rear of the side frames to give the Junior II a whole new look. The newly designed canopy, matching bulkhead and plastic servo structure are available as accessories for all existing Junior 50 Helicopters.

• *Champion* fairing. Originally designed as an option for the Magic 60, these side fairings have proven popular and effective. They are now available for the Champion.

Continued on page 108