4-40 BIPE

By Doc Mathews

Designed by Doc Mathews, the 4-40 Bipe is a continuation of his 4-Series. Those who have flown it are calling it a "Pilot Friendly Bipe."

That biplanes are immensely attractive to modelers is self evident. What ofttimes is not so evident are some distinct difficulties encountered in building and flying models with two wings. This design is directed at reducing the difficulties while accentuating the attractions.

Anyone who has built a biplane is fully aware of those difficulties. One must build twice as many wings, then struggle valiantly to somehow get them on to the fuselage relatively square in all three planes while battling wire bending and soldering. The 4-40 bipe still requires a pair of wings (although rather easily constructed ones), **but** bending the wire and mounting the wings has been so simplified only a concentrated effort could get them out of line.

The easy building, self aligning construction features of the other designs in this series are carried over into the 4-40 bipe. That they work very well is evidenced by the incredible acceptance and popularity of the 4-20, 4-40, and 4-120. Those who have built any of the monoplanes will be pleased to hear that the same "easy building, easy fly, great fun" virtues are also present in the 4-40 bipe.

Speaking of easy flying --- many biplanes are a handful on take-off and landing. Often, a very agile rudder thumb is needed to avoid "all over the runway" type take-offs. The 4-40 bipe has a deliberately overwide landing gear tread and the unit is also well-placed relative to the Center of Gravity. That is the reason for the moderate stagger. As a consequence, ground handling is just as docile as the monoplanes in this family.

A relatively low wing loading (for a bipe) and a special airfoil section enable the 4-40 bipe to be flown at much slower speeds than ordinary bipe designs. Consequently, it is much less inclined to "snap and burn" if

the approach is stretched too far or the flare is instituted too soon.

In-between take-off and landing, the 4-40 bipe is agile and aerobatic, yet slow and gentle. The large group of pilots who have flown the various prototypes are universal in calling the 4-40 bipe a **"Pilot Friendly Bipe."**

CONSTRUCTION

Surely, if you've read this far you must be interested in building a 4-40 bipe, so let's take a look at doing just that.

Admittedly, the design may look a bit flimsy at first glance, but one must realize the incredible strength differences between balsa and spruce, something on the order of ten to one as a matter of fact. Lite ply (poplar) weighs about the same as 3/16" balsa sheet, yet has the strength of 3/8", and can be cut smoothly with a knife or saw. Both spruce and lite ply are available at most well-stocked hobby shops and by mail from several of the advertisers in RCM. **Under no circumstance substitute balsa for the hardwoods in this design.**

Hardware items used in this design are all standard and may well be stocked by your hobby dealer (or he can order them). All are available by mail from Ace R/C, 116 W. 19th St., Higginsville, Missouri 64037.

Read the text and study the plans until all aspects of construction are clear. Then cut out a kit of parts by transferring the outlines onto the appropriate wood using carbon paper between the plans and the wood. All holes and so forth are best made at this time.

A simple jigsaw such as a Dremel is helpful in building this model, though a good sharp modeling knife will work. Cut-outs can easily be made by drilling a 1/4" hole into the ply then inserting the saw blade into the hole. Tabs and slots are best cut with a knife. The model can be built without the alignment tabs, but I don't recommend it.

With the tabs and slots, an absolutely "true" fuselage is almost assured. Use a smooth, **flat** building surface and follow sound tenants of construction to assure exceptional flying performances. All prototypes have been constructed almost entirely with cyanoacrylate adhesives, the only exceptions being the firewall and wing center joints. Covering this design with anything other than silk or MonoKote is **not** recommended.

Fuselage:

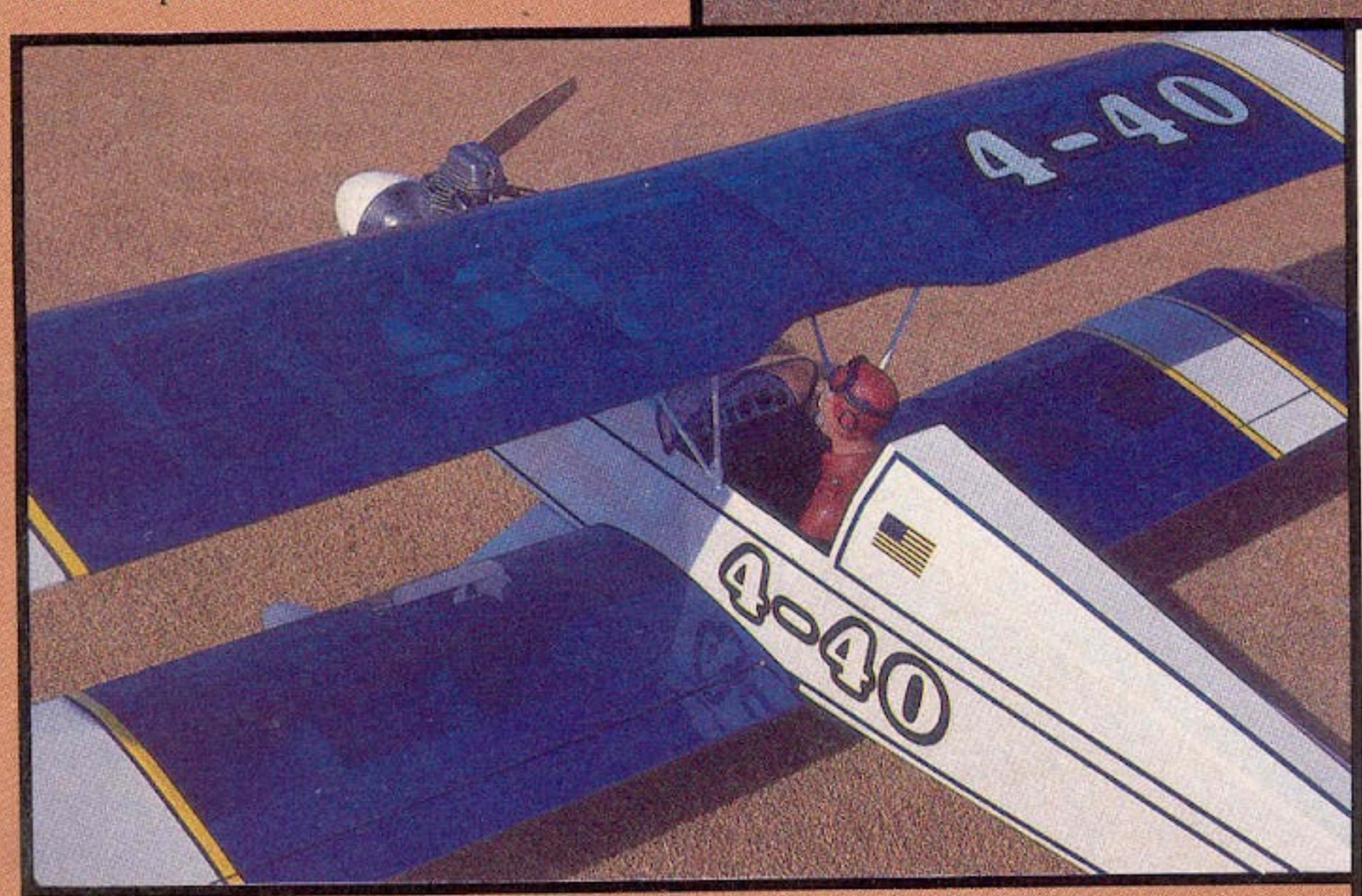
Make a right side by tracing over the plans on to lite ply. Mark the bulkhead and slot locations at this time. Cut out the side, then use it as a pattern for the left unit. Note that the lite ply is actually not 1/8" thick but rather a slightly smaller 3mm. The slots should be a tight fit for the bulkheads so that a minimum of thick CA adhesive can be used.

Develop all the other fuselage parts, then trial fit the entire unit before adhesive is used. Observe the following sequence to avoid "painting yourself into a corner." Without gluing, fit the sides, F-2 (notch up) and F-3/T-4 together. Slip the trunion blocks in place also with slot up, then put the hatch floor in place. The hatch floor holds the structure square. When satisfied with the fit, glue the parts together. A thin bead of CA should be run along all the joints.

With some scrap ply, fill in

the gap above the trunion blocks (keep the adhesive out of the slots!). Then fit the rear portion of the bottom. Clamp the rear fuselage post together, keeping the edges aligned. Make sure the fuselage is square, then spot glue the bottom rear to the sides.

Add the turtledeck formers and stringers and epoxy the predrilled firewall to the triangular stock. Leave at least a 1/8" space between the triangular stock and the top.



Add the landing gear blocks and the front bottom. This is a good time to preplan your radio and servo installation and to drill the appropriate holes, etc. A cross-over of the NyRods helps reduce sharp angles and is recommended; otherwise, use what works best for you.

The following steps require that the wings be built before proceeding, so go to that, then come back.

Cut and bend the wire cabane parts. A good shining with sandpaper will ease soldering later. Insert all four vertical struts into the trunion blocks, and push them in and out a few times to size the holes.

Cut out two wing saddle jigs from lite ply or other scrap. Lay the fuselage flat on the surface and spot glue the template to the fuselage sides. Make sure the template is flush with the front of F-2. Now replace the wire into the slots with the solder lugs prebent to about a 75° outboard angle. Small sections of brass tubing should be cut and carefully squeezed for a slip-on fit over the 1/8" wire pieces (7/32" x 1/2" works well).

Rubber band the top wing onto the templates making sure it is well-seated. Turn the assembly upside down and let it rest on the top wing. Using a length of string, adjust the wing tips for and aft from a point exactly in the center of the tail post. We usually hold the string at the tail post with a pin and adjust the wing by loosening the rubber bands and sliding it around. Be sure the wing is centered over the fuselage centerline.

Once a perfect set-up is arrived at, mark the holes on the block, remove the wing to

4-40 BIPE
Designed By:
D.B. Mathews
TYPE AIRCRAFT
Sport Biplane
WINGSPAN
48" Top; 43" Bottom
WING CHORD
7 Inches (both)
TOTAL WING AREA
625 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Constant Chord
DIHEDRAL EACH TIP
3/8" Top; 1" Bottom
O.A. FUSELAGE LENGTH
42½ Inches
RADIO COMPARTMENT SIZE
(L) 7¾" x (W) 3" x (H) 2½"
STABILIZER SPAN
17¾ Inches
STABILIZER CHORD (incl. elev.)
7⅝ Inches
STABILIZER AREA
115 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
5¾ Inches
VERTICAL FIN WIDTH (incl. rud.)
7⅝ Inches
REC. ENGINE SIZE
.40-.46 4-stroke
FUEL TANK SIZE
4 Oz.
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Lite Ply
Wing	Spruce & Balsa
Empennage	Balsa
Wt. Ready To Fly	**75 Oz.**
Wing Loading	**17.3 Oz./Sq. Ft.**

drill and tap the blocks. Refit the wing to the saddle and tighten up the four 10-32 nylon bolts to hold the lugs against the blocks. Now solder the lugs to the wire. A large, high wattage iron and a good flux are helpful. We use Stabrite Silver Solder and a 200 watt iron. A torch is not recommended here because of the likelihood of igniting the model.

With everything still in place, slip the brass tubing around the cross braces and solder them to the cabanes. Remove the wing and clean the flux with laquer thinner. File away excess solder.

Reposition the upper wing without the template; again lay the assembly flat and repeat the alignment step for the lower wing. Once it is perfect, drill the bolt holes into the blocks and tap. Upper and lower wings should now be square fore and aft as well as in the vertical and horizontal planes.

Completion of the fuselage structure is pretty conventional and should not present any difficulty for the builder. We don't CA the struts into the slots until the model has been covered. Throttle linkage on a 4-stroke can be a bit of a problem. We like to make a right angle bend in .047 music wire, then run it through yellow NyRod with a threaded coupler and clevis on the servo end for adjustment.

The tail wheel tiller can be held to the rudder bottom with a small scrap of NyRod that has been reinforced with cloth and CA.

The prototypes have all tended toward nose heaviness (and that sure isn't bad); therefore, keep the R/C servos well back in the compartment. The tank hatch can be held in the conventional manner with two ply plates and two screws if desired. Du-Bro or Banner axles can be substituted for the bolts if a rough field is to be used. If a Goldberg or Du-Bro spinner is used, the nose blocks will need to be shorter to allow for the projection behind the prop.

Empennage:

Select medium density "A" grain stock for these surfaces. Weight is not a problem. We prefer pinned hinges held in place with small segments of toothpick. Obviously, the surfaces need to be rounded on the exterior and a bevel used on the elevator and rudder hinge line. Don't hinge them permanently until the covering has been applied.

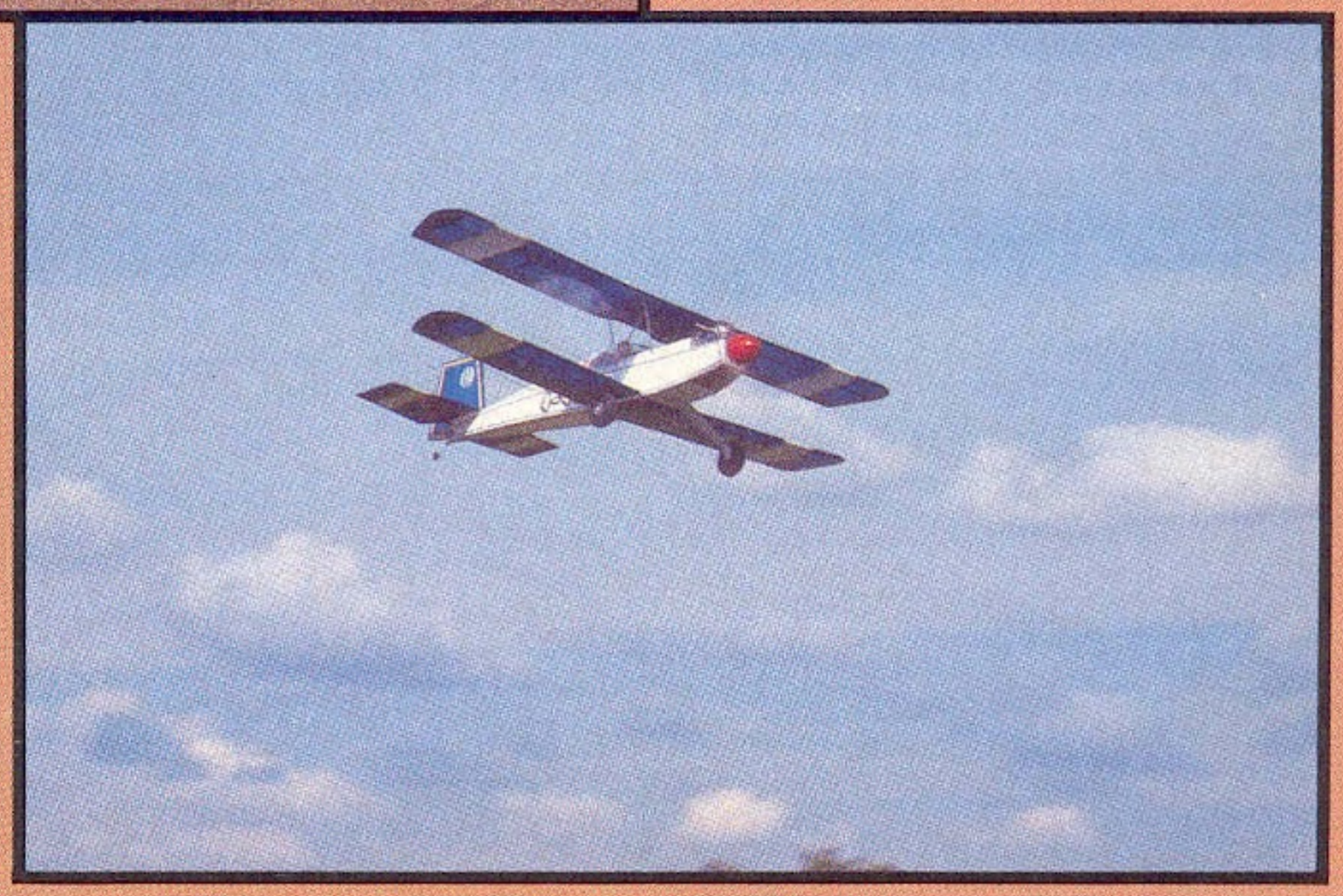
Wings:

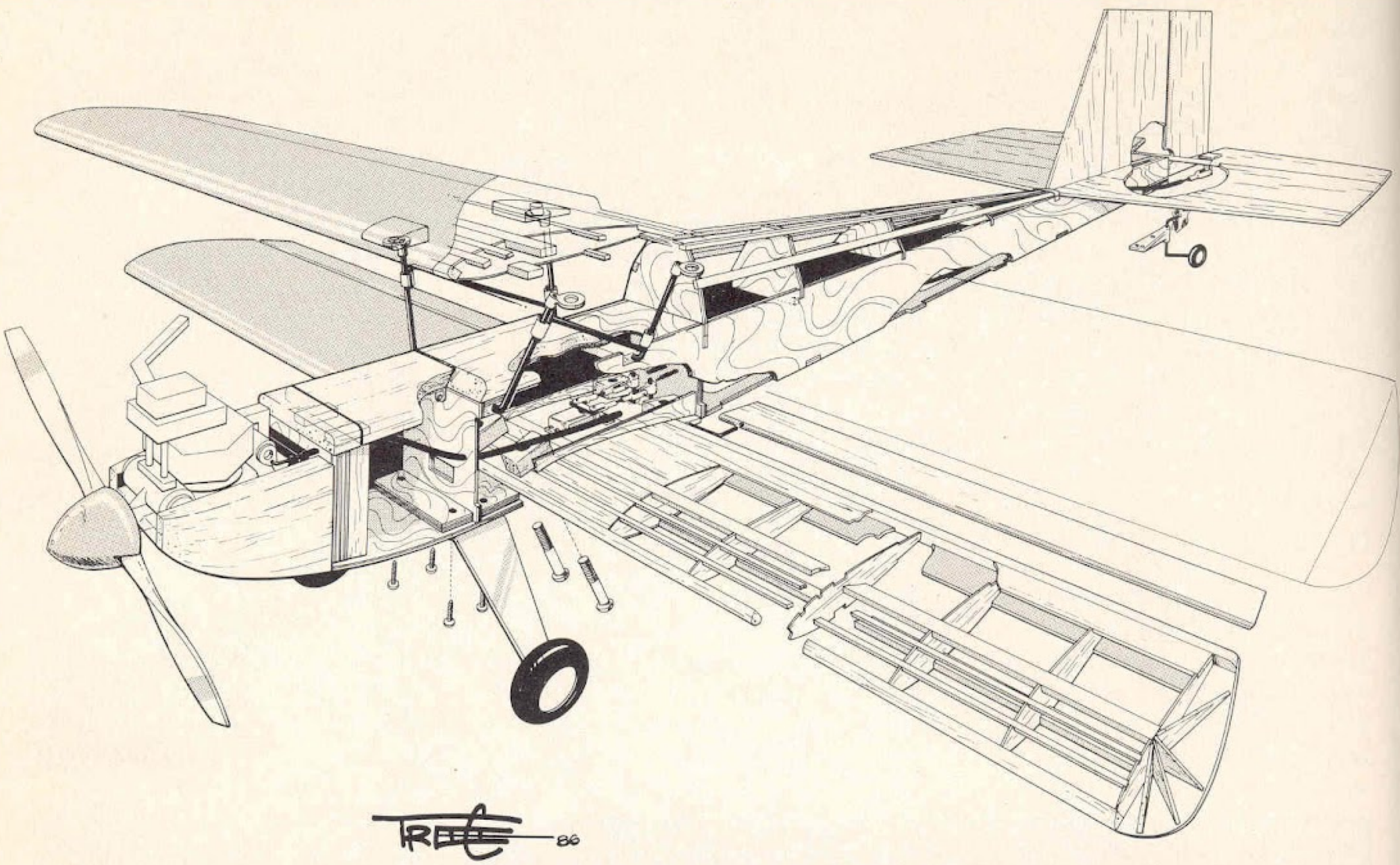
Stack cut the ribs using a master ply pattern developed from the drawings. Carefully cut the spar notches for a tight fit for best adhesion with thick CA. The spruce should also be lightly sanded to remove the oils before assembly. All panels are built flat from the front spar rearward; therefore, a good flat building surface is all that one needs to develop perfectly true, warp free wing panels.

Construction is from the bottom up. Pin the sheet trailing edge and center section sheet over the plans. Position the bottom spars and then the ribs. Use a small 90° triangle or a House of Balsa "Upright" to keep the ribs square. Add the top trailing edge sheeting and spars followed by the leading edge and turbulator spars. Center ribs should be angled using the jig as shown on the plans.

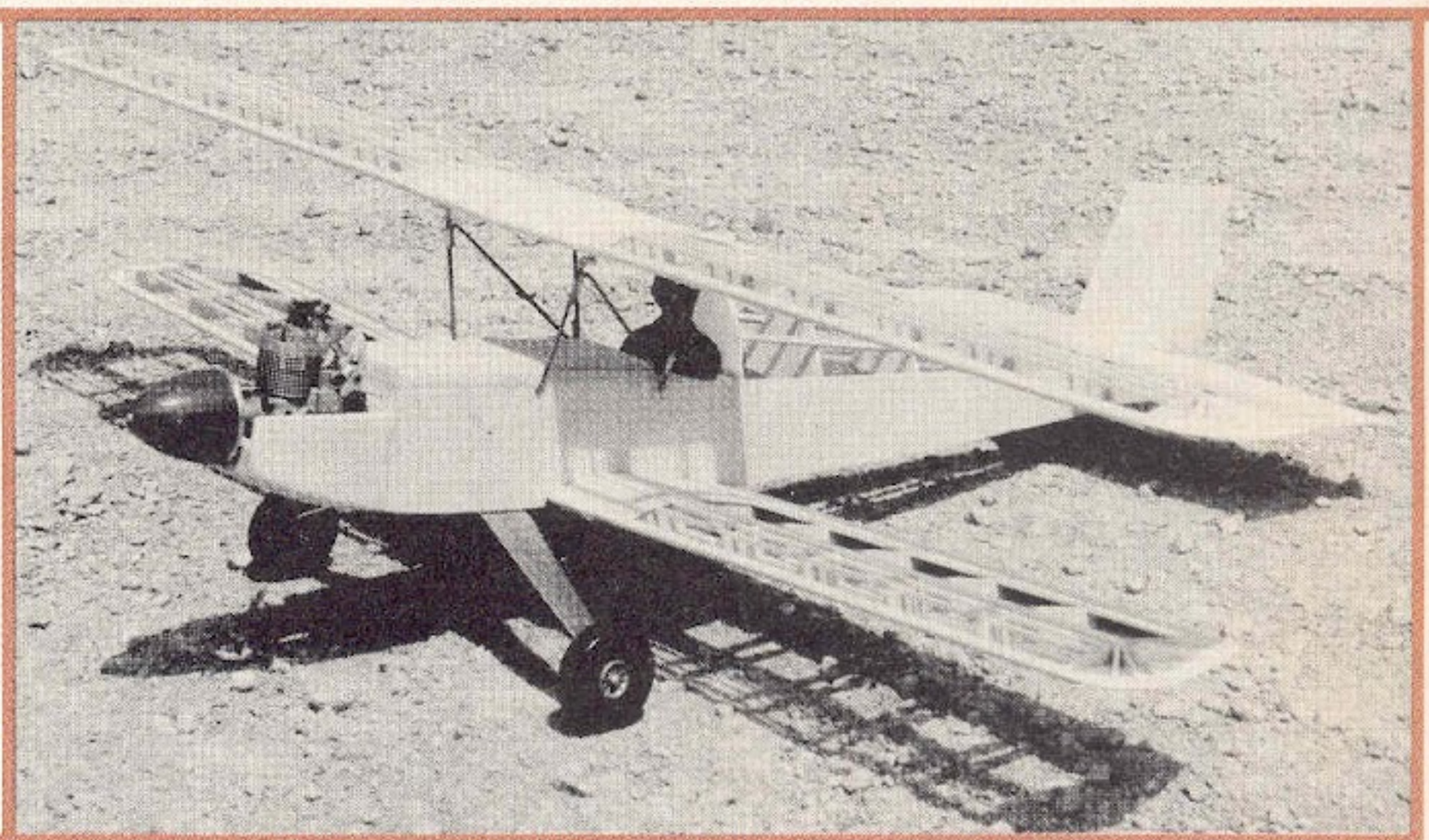
Hardwood pieces should be installed with epoxy after removing the panel from the work surface. Check the side view for proper positions. These should be marked and drilled in the fuselage "marriage" step.

No dihedral braces are used in

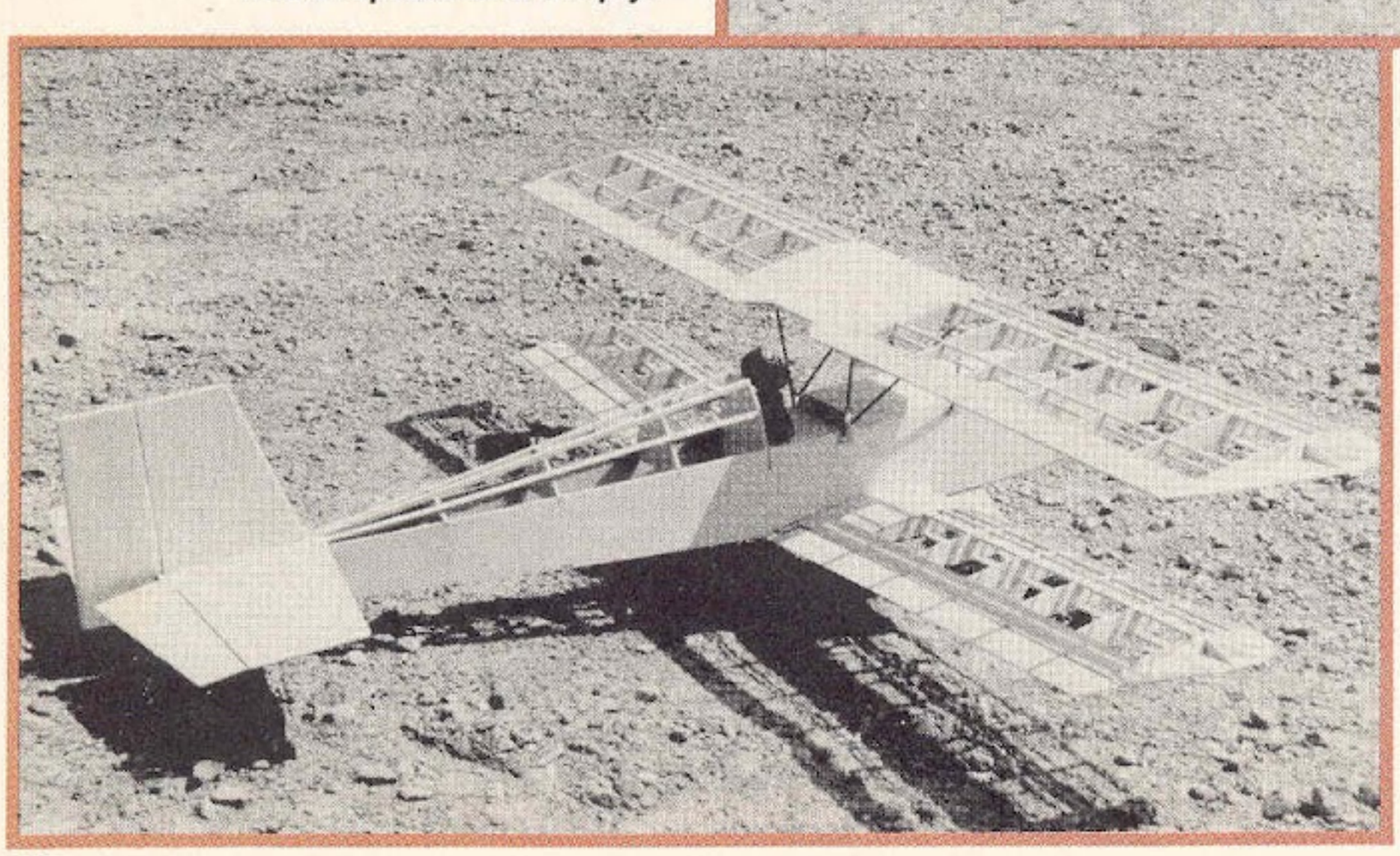




this design! We have used this approach many times on numerous designs and have yet to have a wing center section failure. Frankly, it is our opinion that ply center section braces are a vestigial remnant in modeling left over from the days before we had epoxy. All that is required to develop a solid and accurate dihedral joint in this design is to block up the

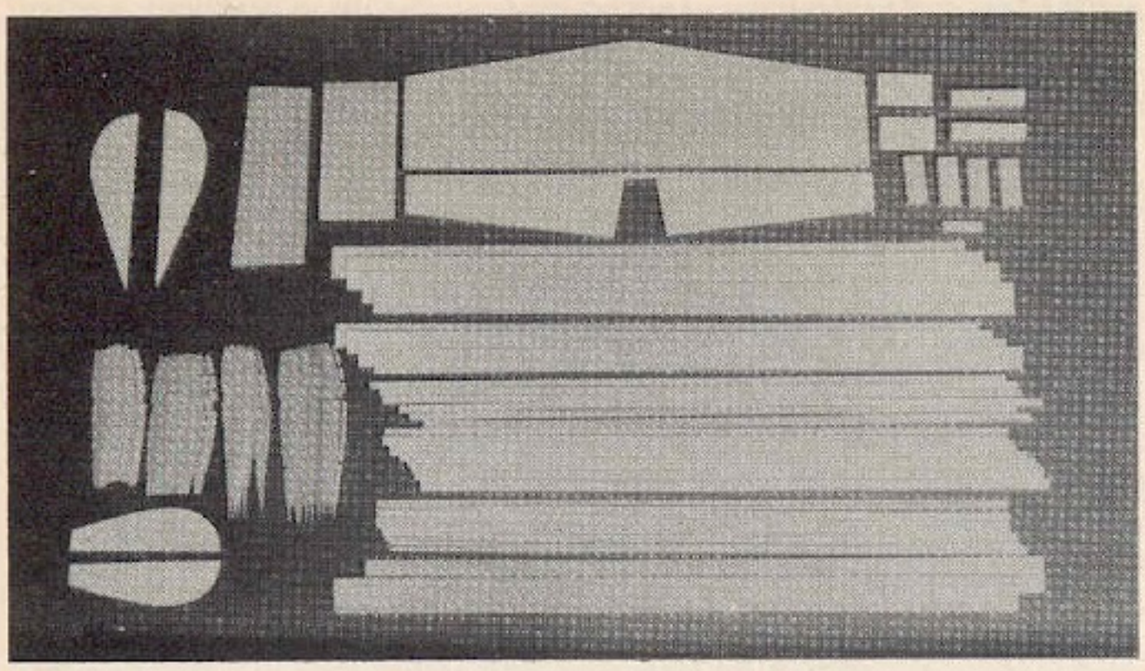


Simple framework looks light and airy but is very strong thanks to the use of lots of spruce and lite ply.

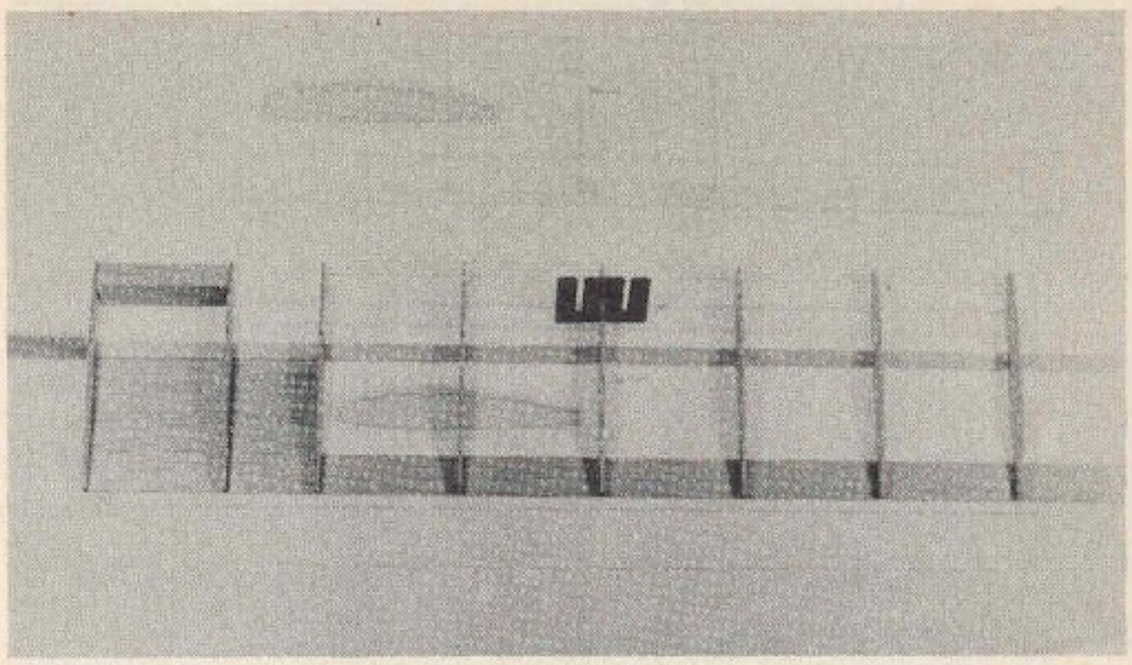


panel's tip, sand the angle, and join the two panels with 5-minute epoxy. The center section is then wrapped with glass cloth and epoxy, or glass cloth and thin CA for a very sturdy joint. In this instance it is advisable to extend the glass cloth over the hold-on blocks and to wrap it around the lower wing trailing edge.

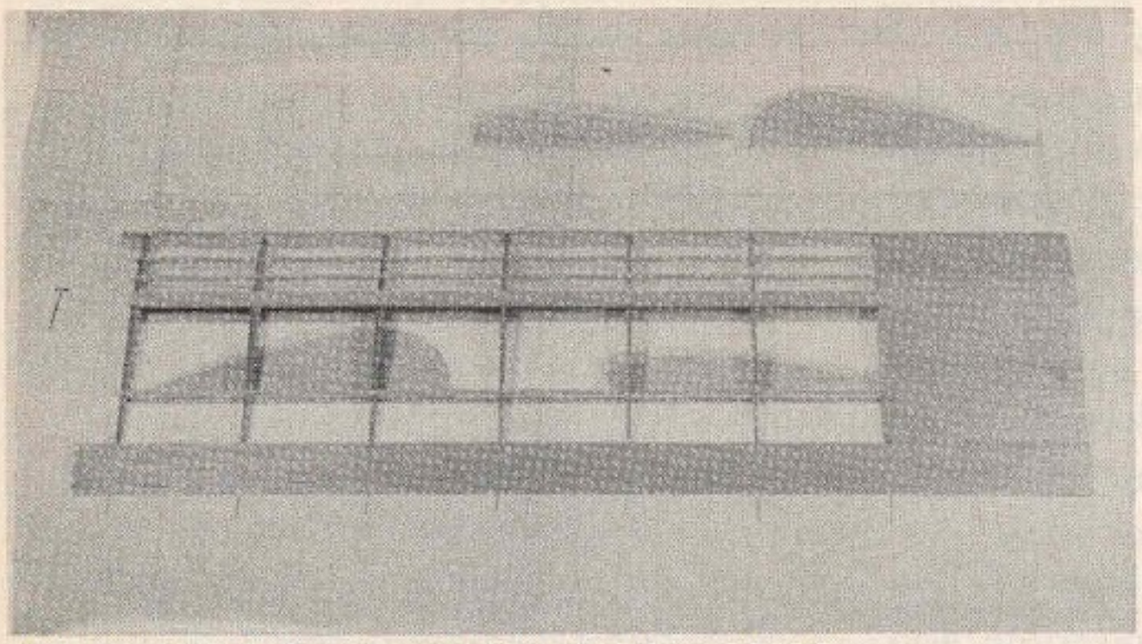
The aileron torque box is nothing more than a notched section of the aileron balsa stock. Some extra sanding will be required to match the trailing



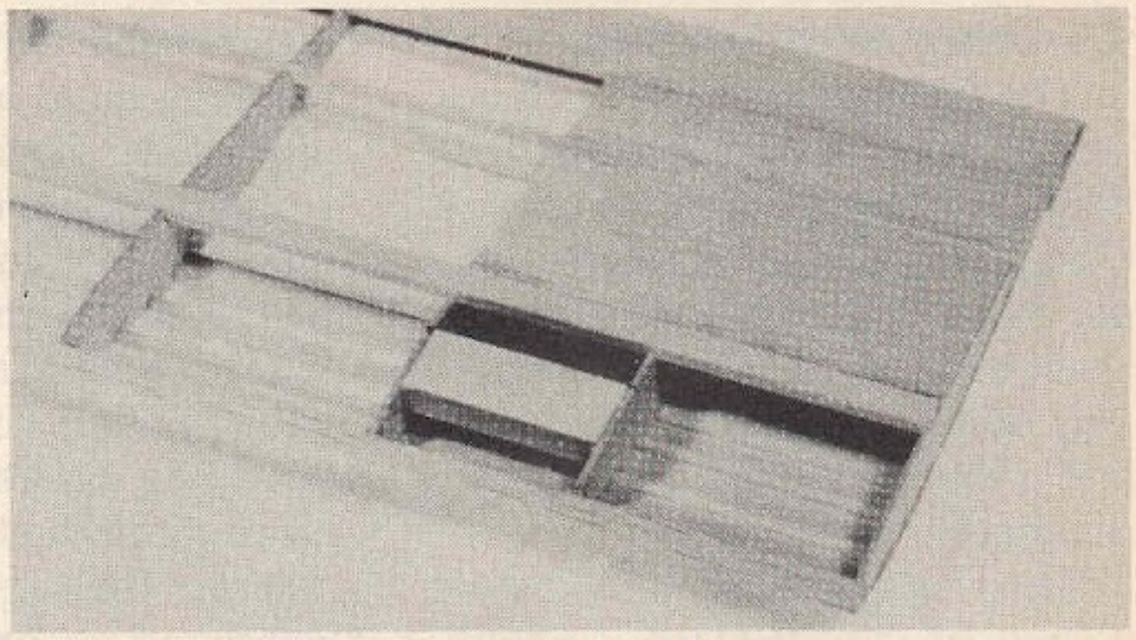
Parts kit for wing and empennage.



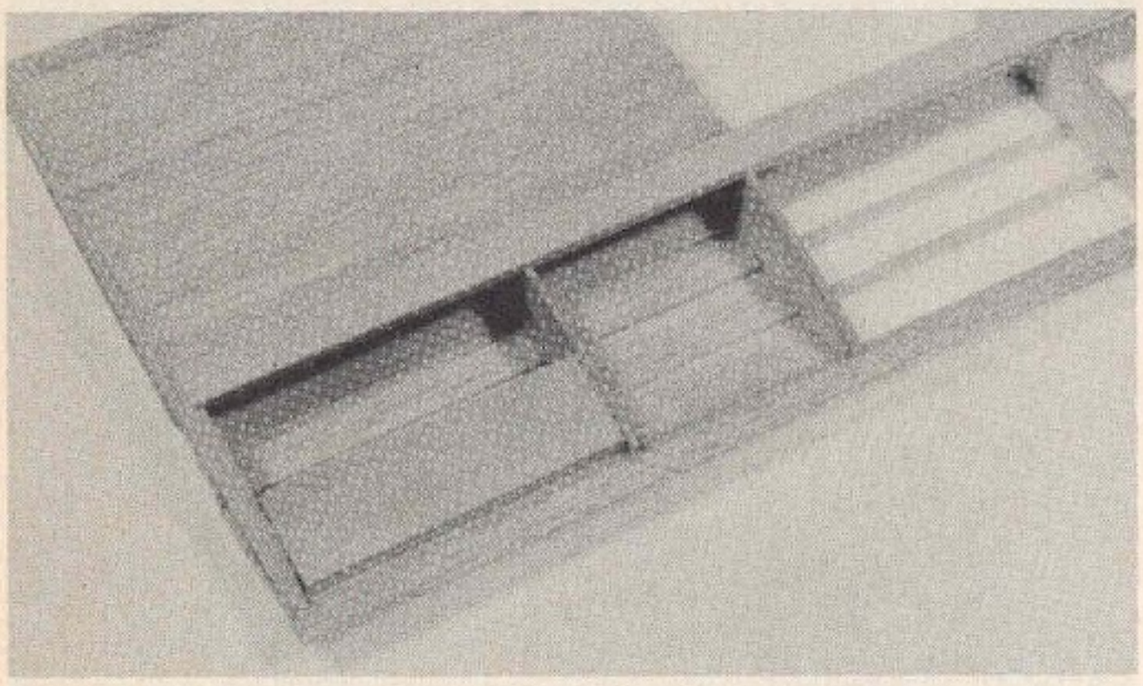
Building from bottom up with ribs flat from spar rearward.



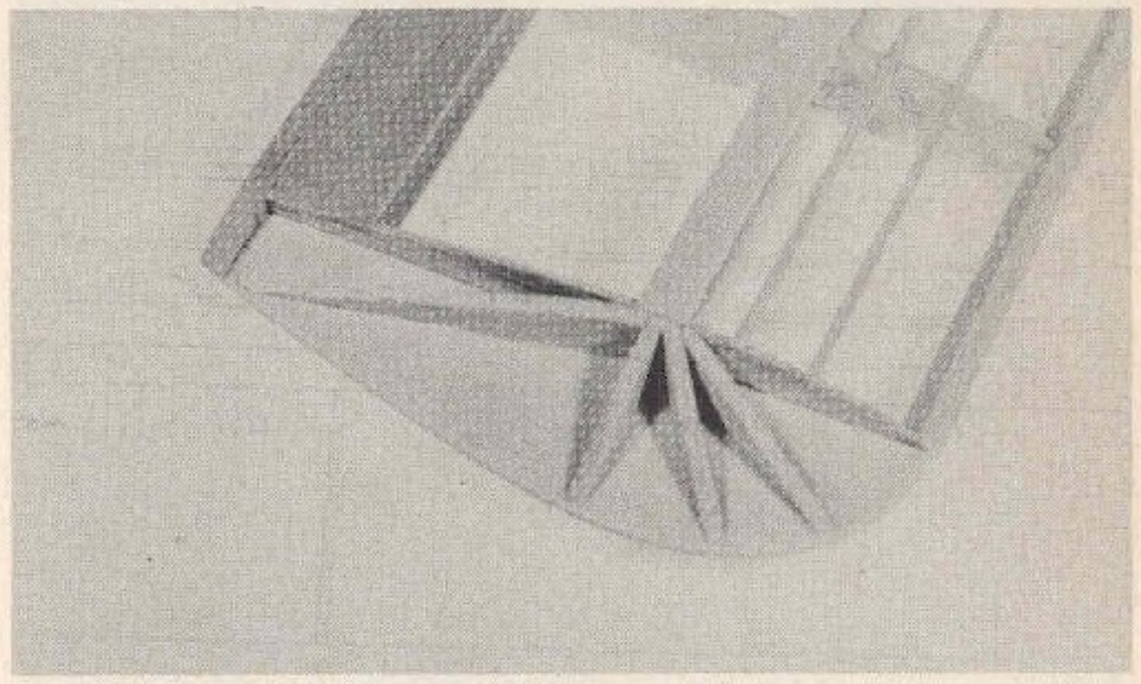
Top spar, turbulators, and top sheeting added.



Lower panel with hardwood block in place.



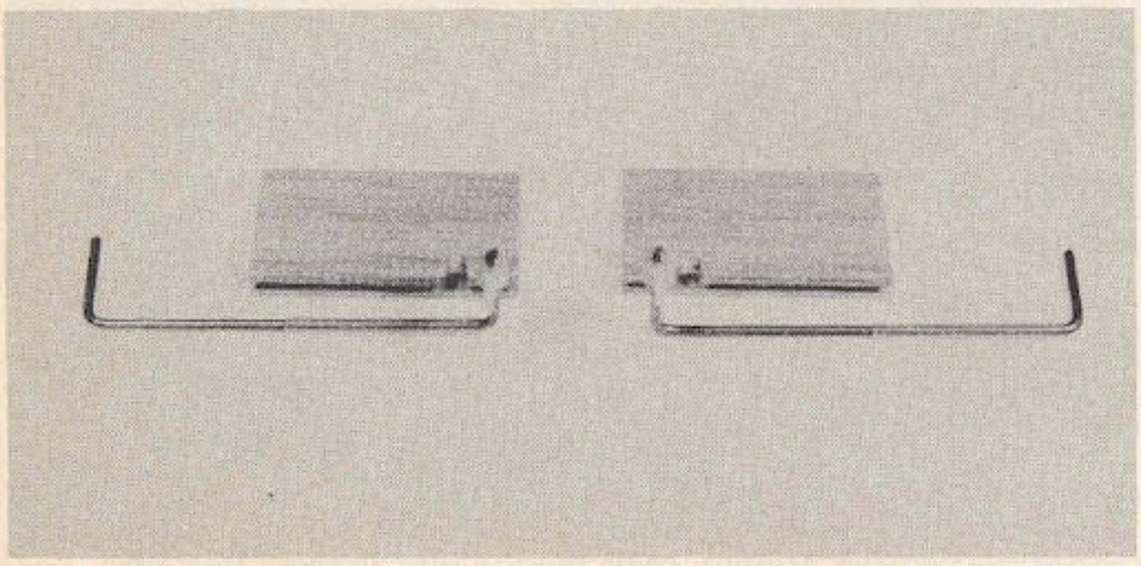
Upper panel with hardwood block in place.



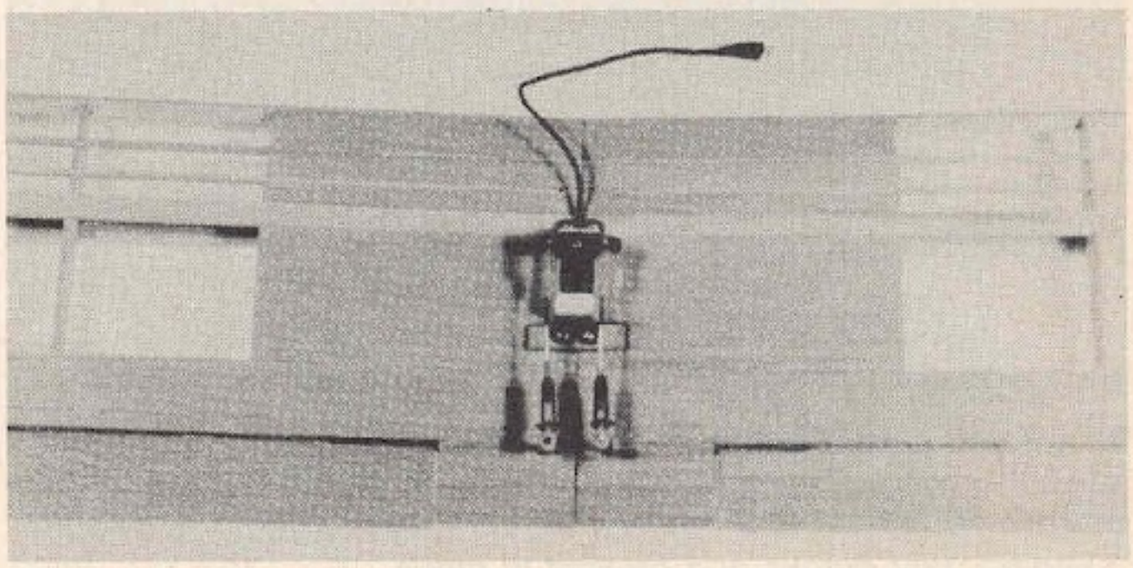
Lite ply tip and balsa filler pieces.

edge cap and the ailerons. Trial fit the bottom wing before glassing it; some adjustment will be needed for a perfect fit to the fuselage.

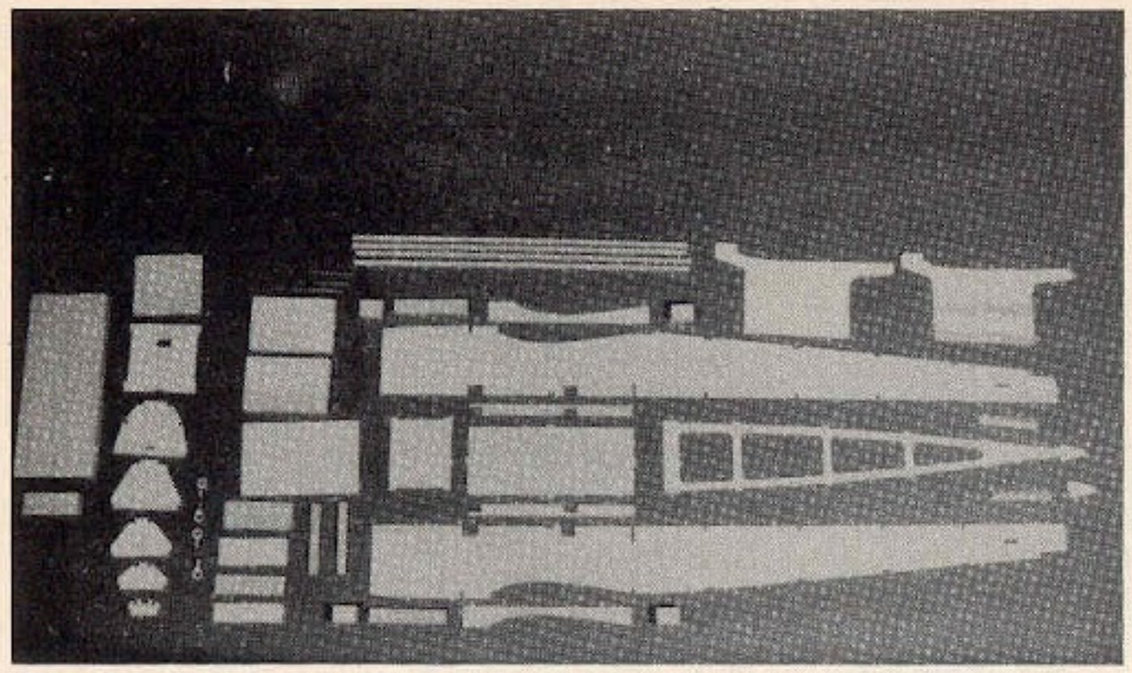
Aileron response with the 4-40 bipe can best be described as gentle. That is, it will produce a roll but not a violent one. If the builder is a hot-shot and wants the plane to be capable of multiple rolls and wild snaps, he should consider one of the mods we have tried. Build two bottom wings using a second servo connected to the first with a "Y" connector. This produces a model that rolls like a four aileron Pitts! We recommend this sort of set-up **only** to experienced aerobatic pilots, however.



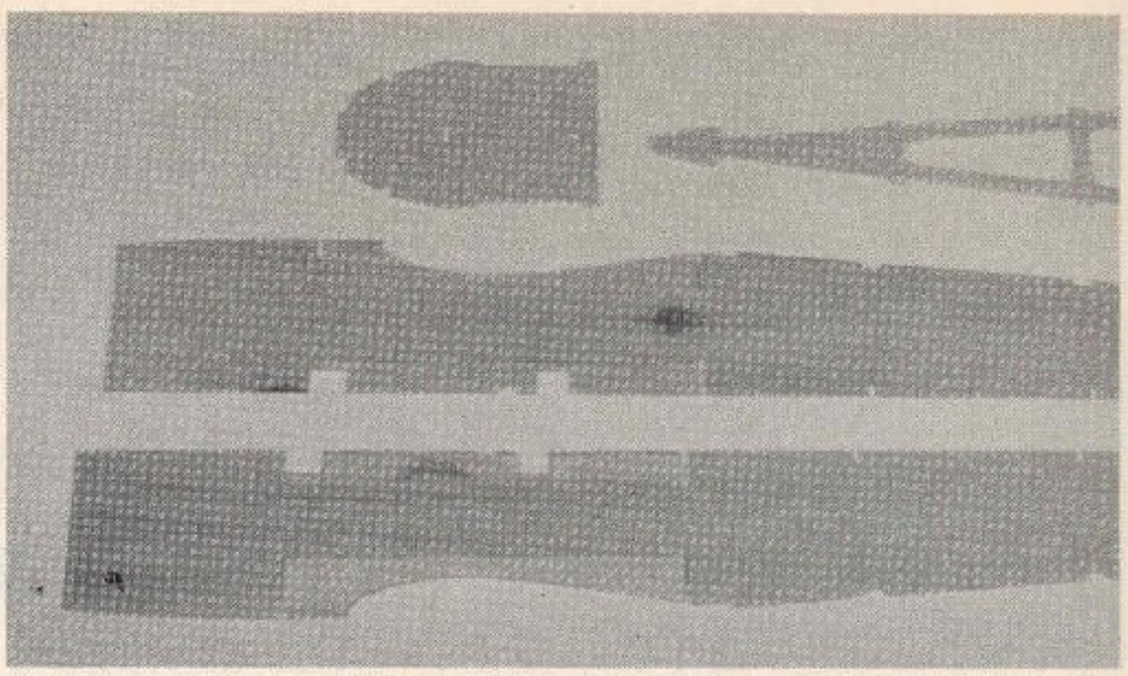
Slotted trailing edge section and aileron torque rods.



Ailerons and servo hook-up.



Fuselage parts kit with minimal parts count.



Assemble sides and doublers using CA glue. F-3/T-3 are joined.

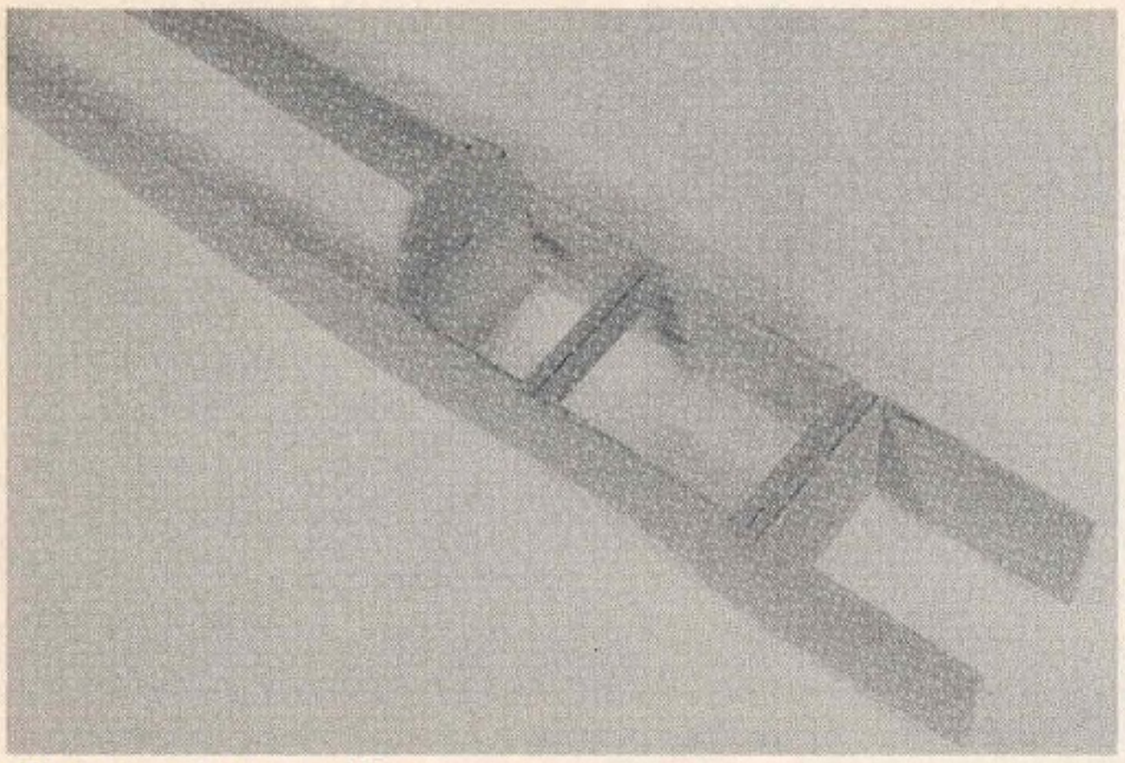
Covering And Detailing:

The fuselage and tail surfaces can be covered and finished in any material the builder prefers. The wings are simply designed for a solid non-flexible material such as MonoKote or silk, and any other material will likely not provide sufficient torsional strength.

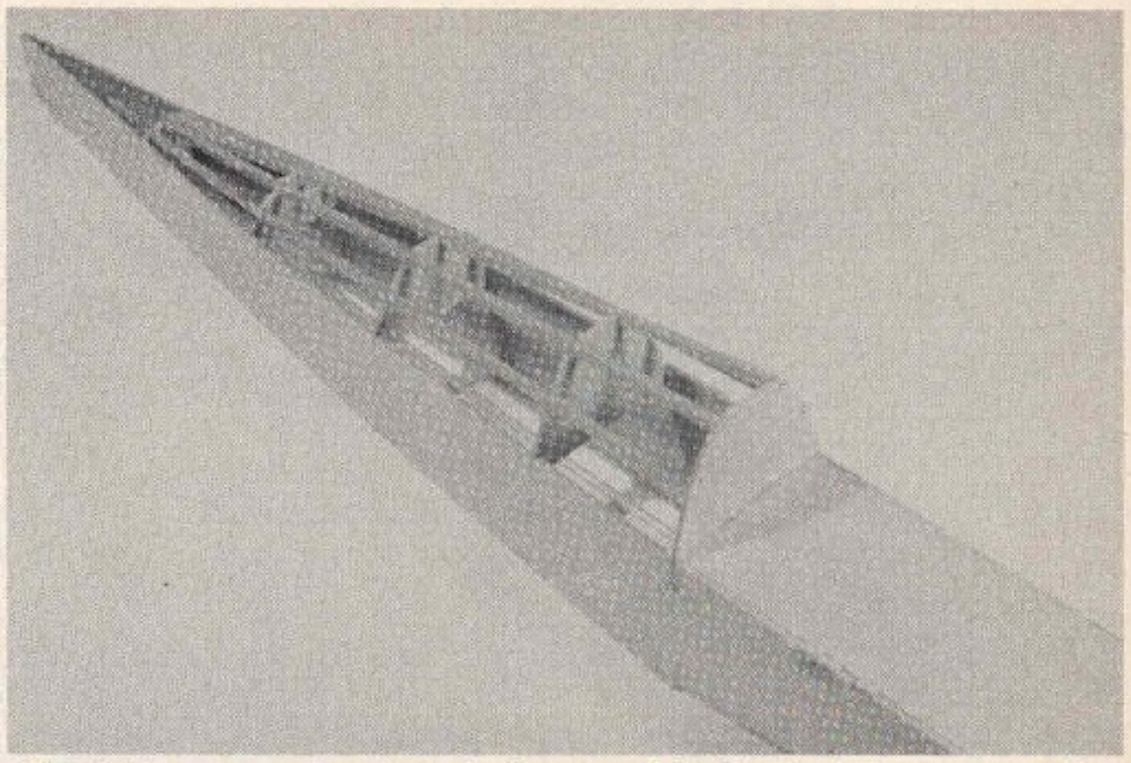
The triangular tail brace stock is best covered before attachment. Obviously, the covering must be removed at any gluing surface such as the stab-fuselage joint. The tank and engine compartments need to be fuelproofed with epoxy or such. Cabane wires can be painted with epoxy if Krylon clean metal primer is used after careful cleaning with steel wool.

Many canopy-pilot combinations are possible and are purely a matter of builder's choice. Whatever windscreen is chosen, it is best held with Wilhold R.C. 56 glue. The pilot figure should be held with a pair of self tapping screws run in from the fuselage bottom.

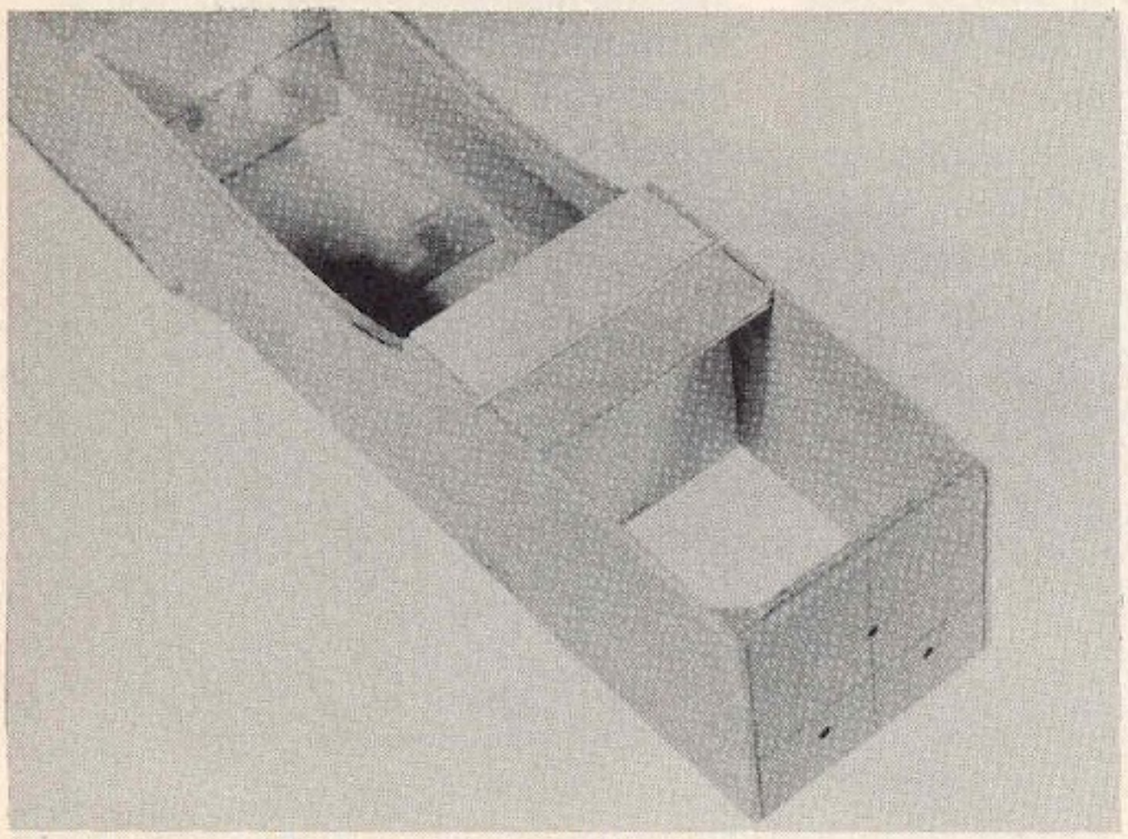
The landing gear can be installed with screws, although we prefer bolts and blind nuts. If the two servo wing is used, the upper servo should face down



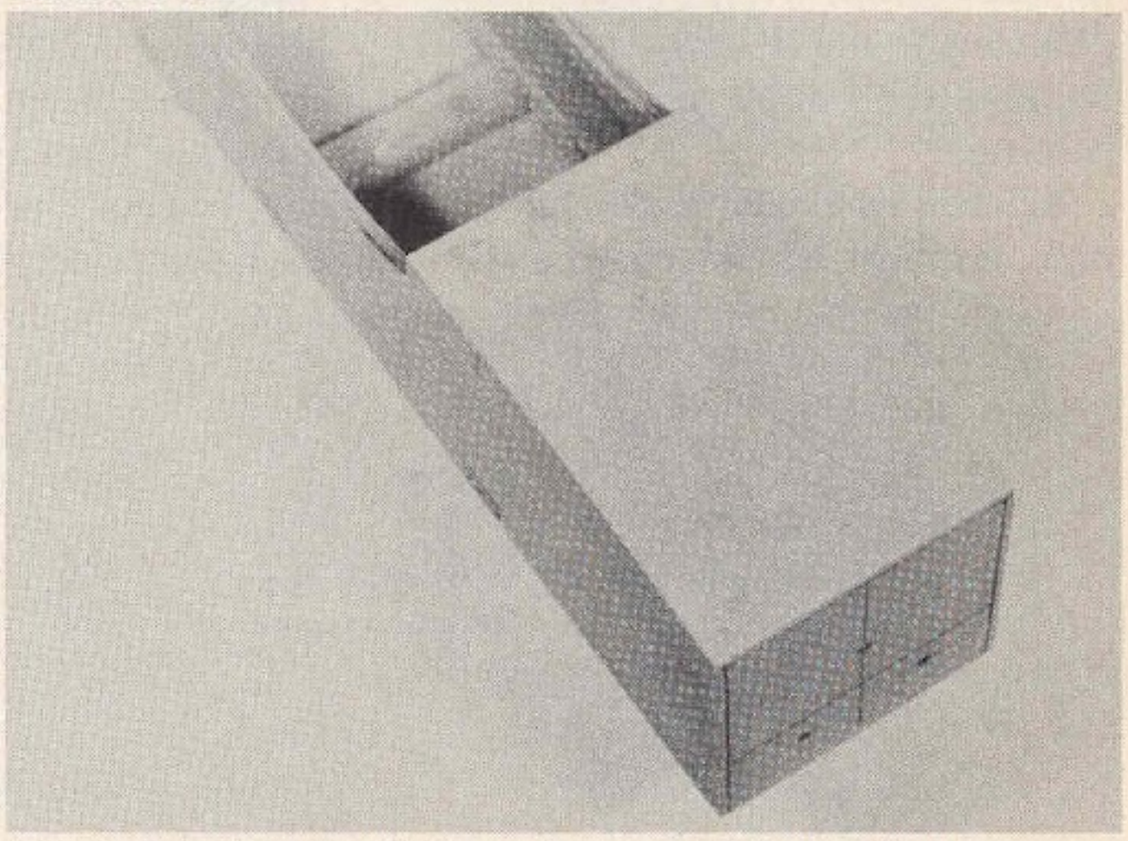
First step in assembly.



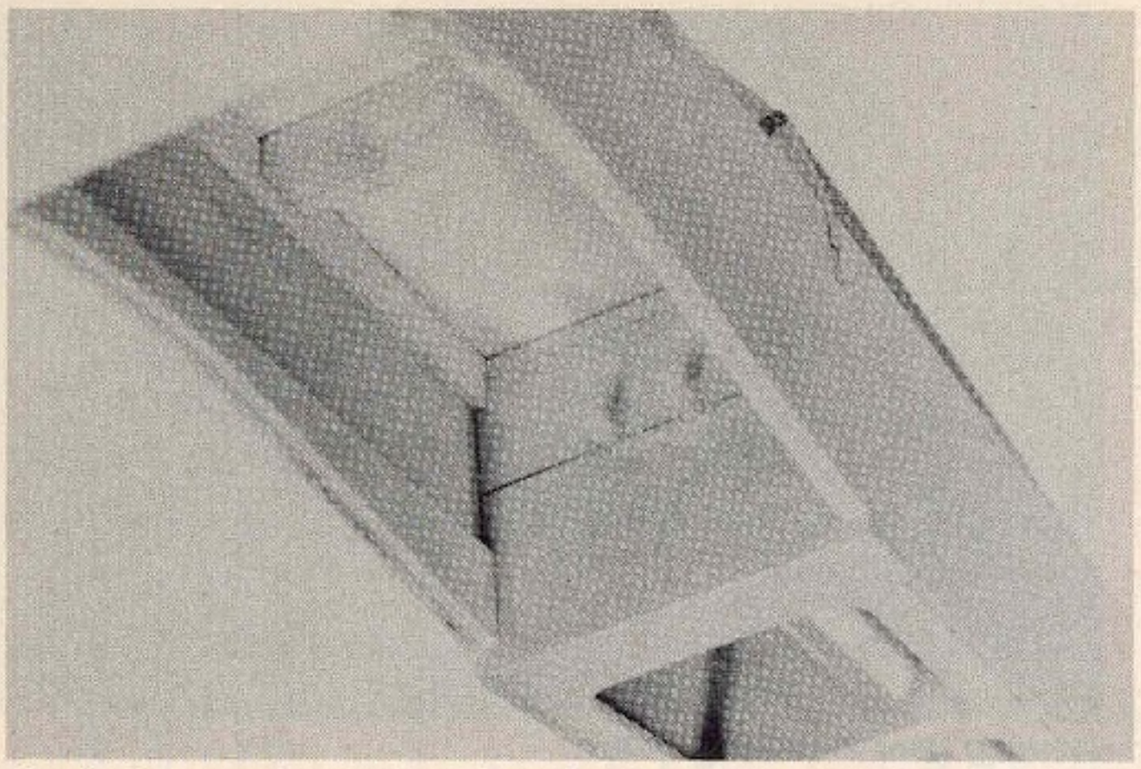
Hatch floor, rear fuselage bottom and turtle deck formers are in place. With stringers installed, a simple box is converted into an attractive unit.



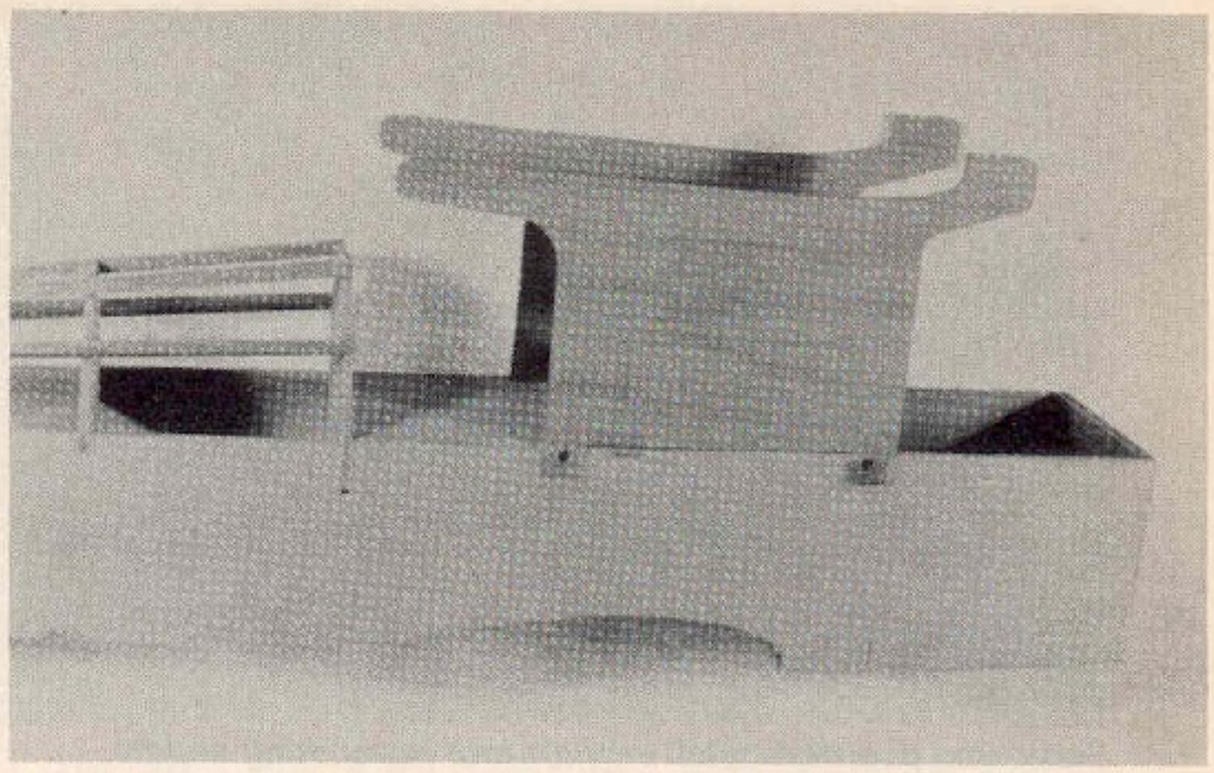
Landing gear blocks and firewall in place.



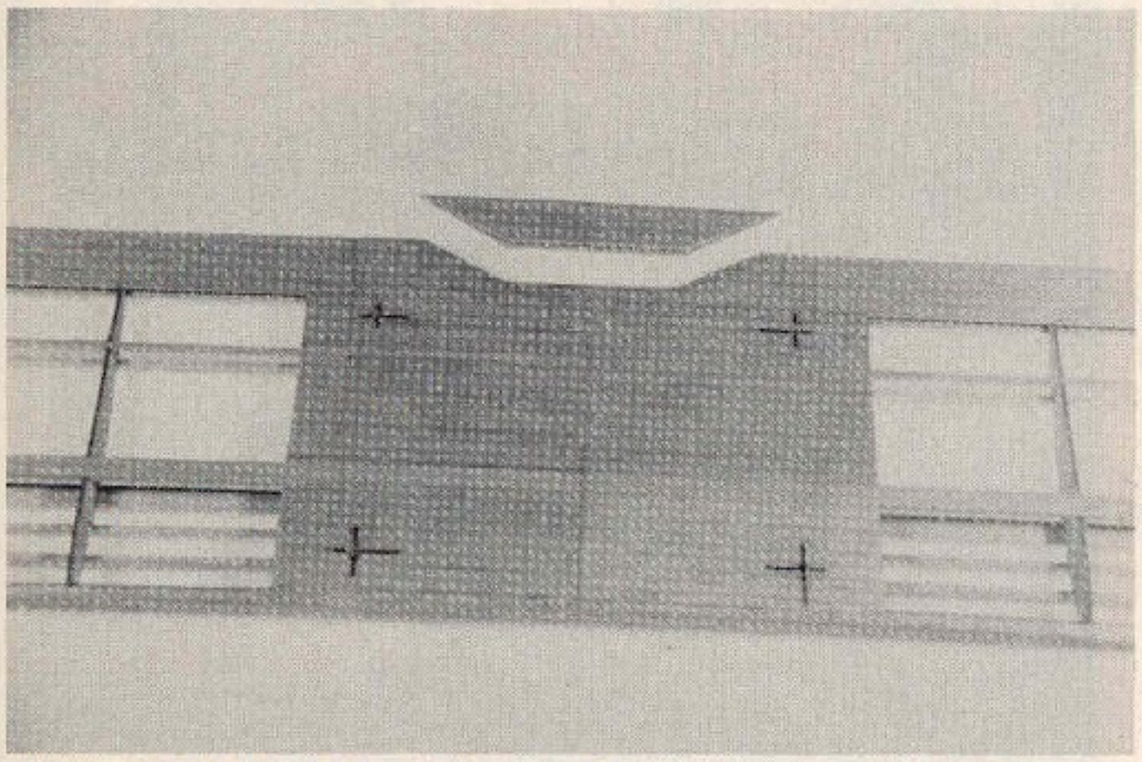
Front ply bottom applied over blocks and firewall bottom.



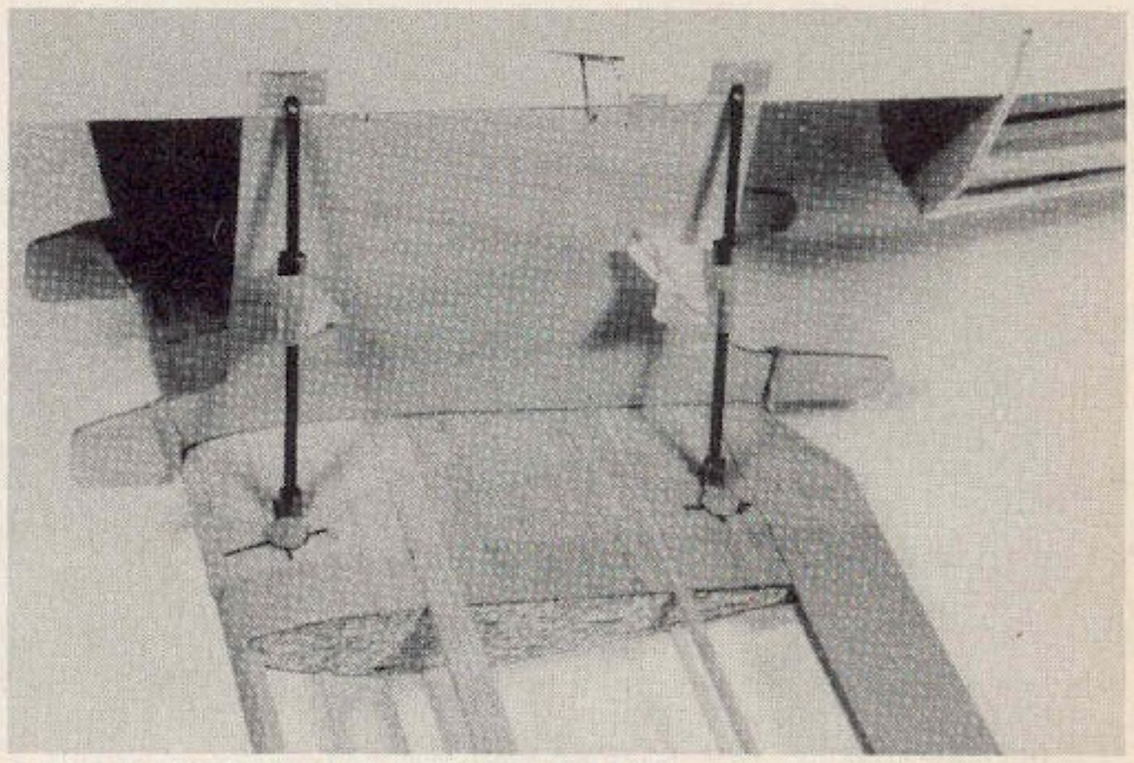
Typical set-up for pushrods varies by servos used.



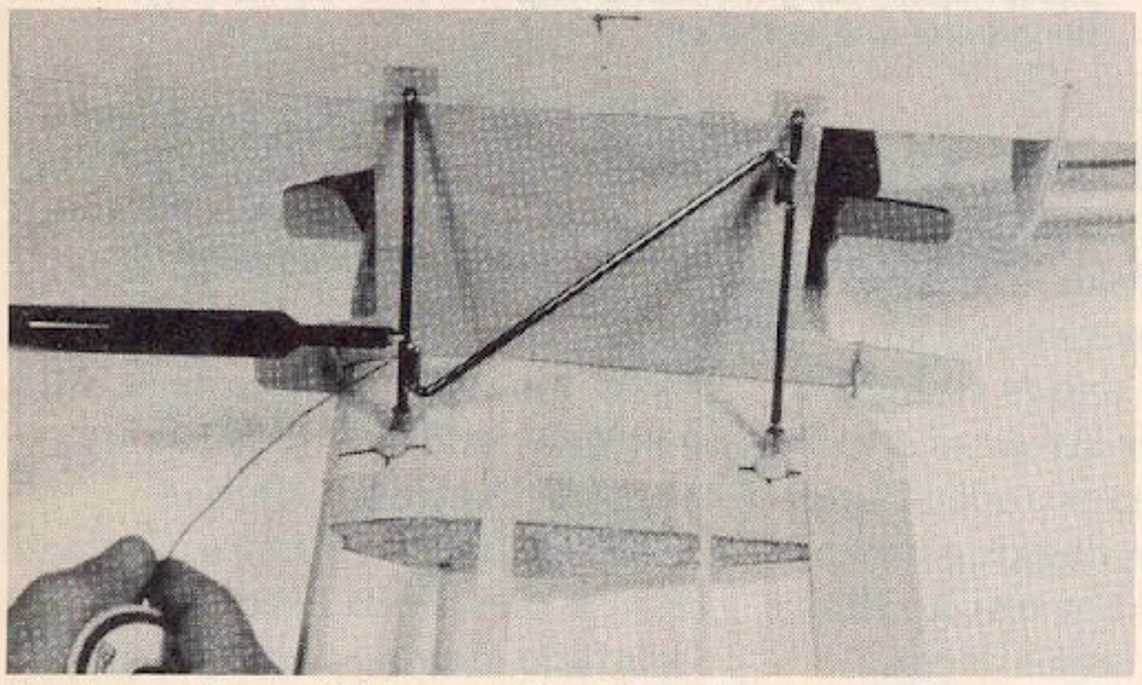
Wing positioning template spot glued to fuselage sides.



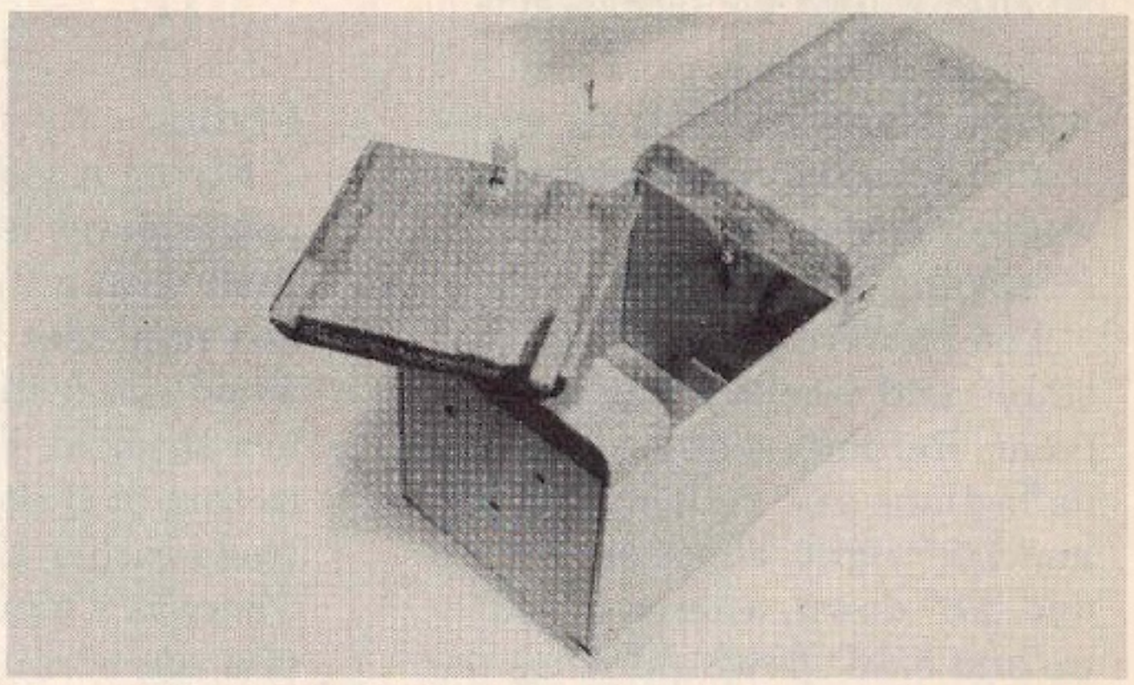
Upper wing marked for bolt holes after careful alignment on template fixture.



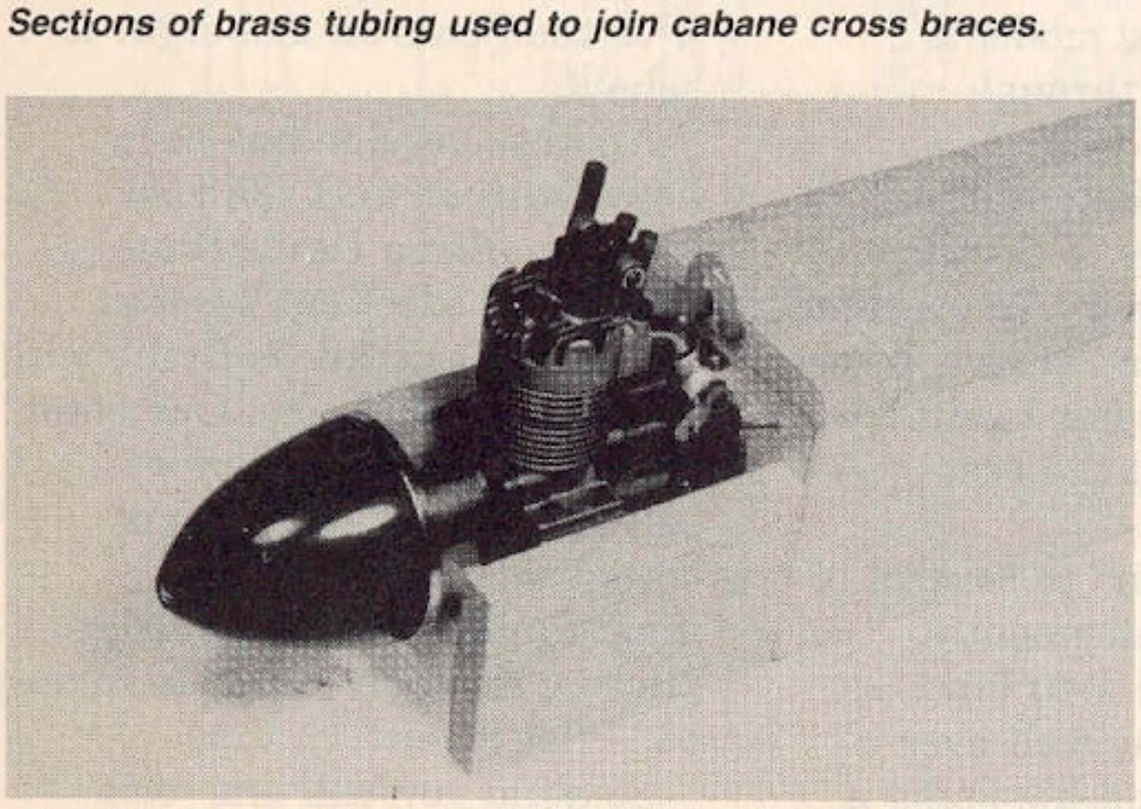
Lugs in position and ready to solder.



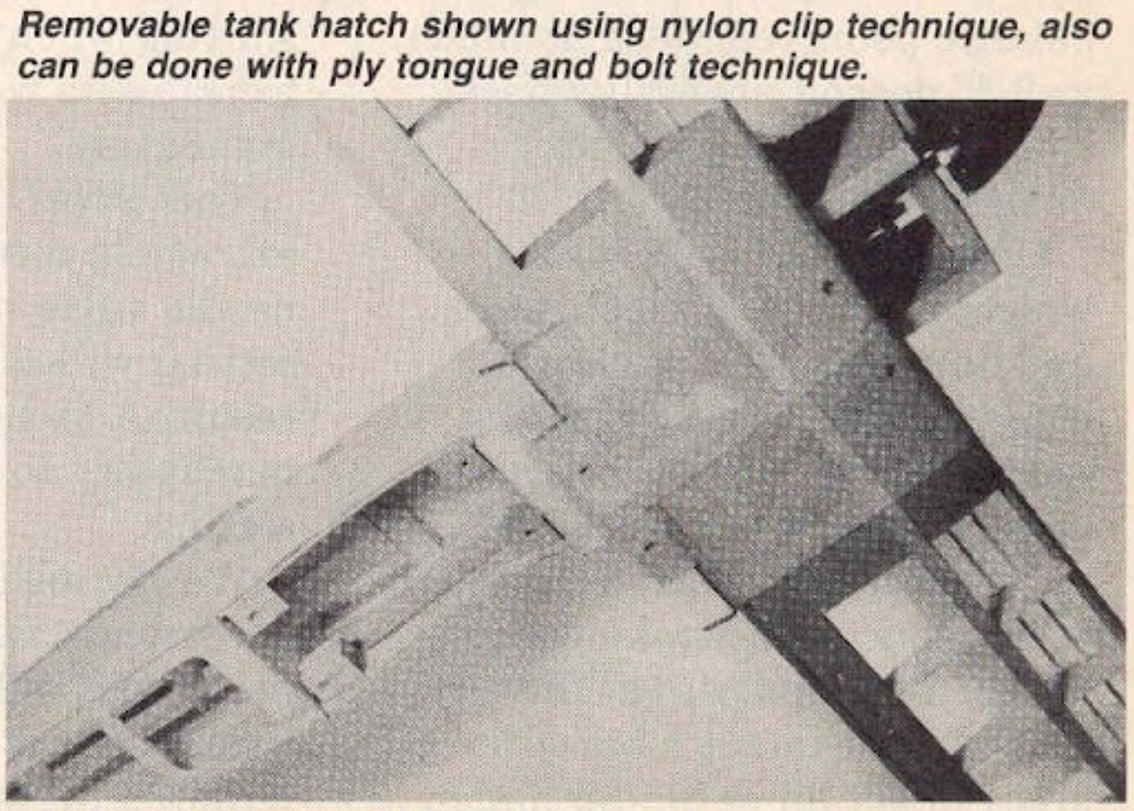
Sections of brass tubing used to join cabane cross braces.



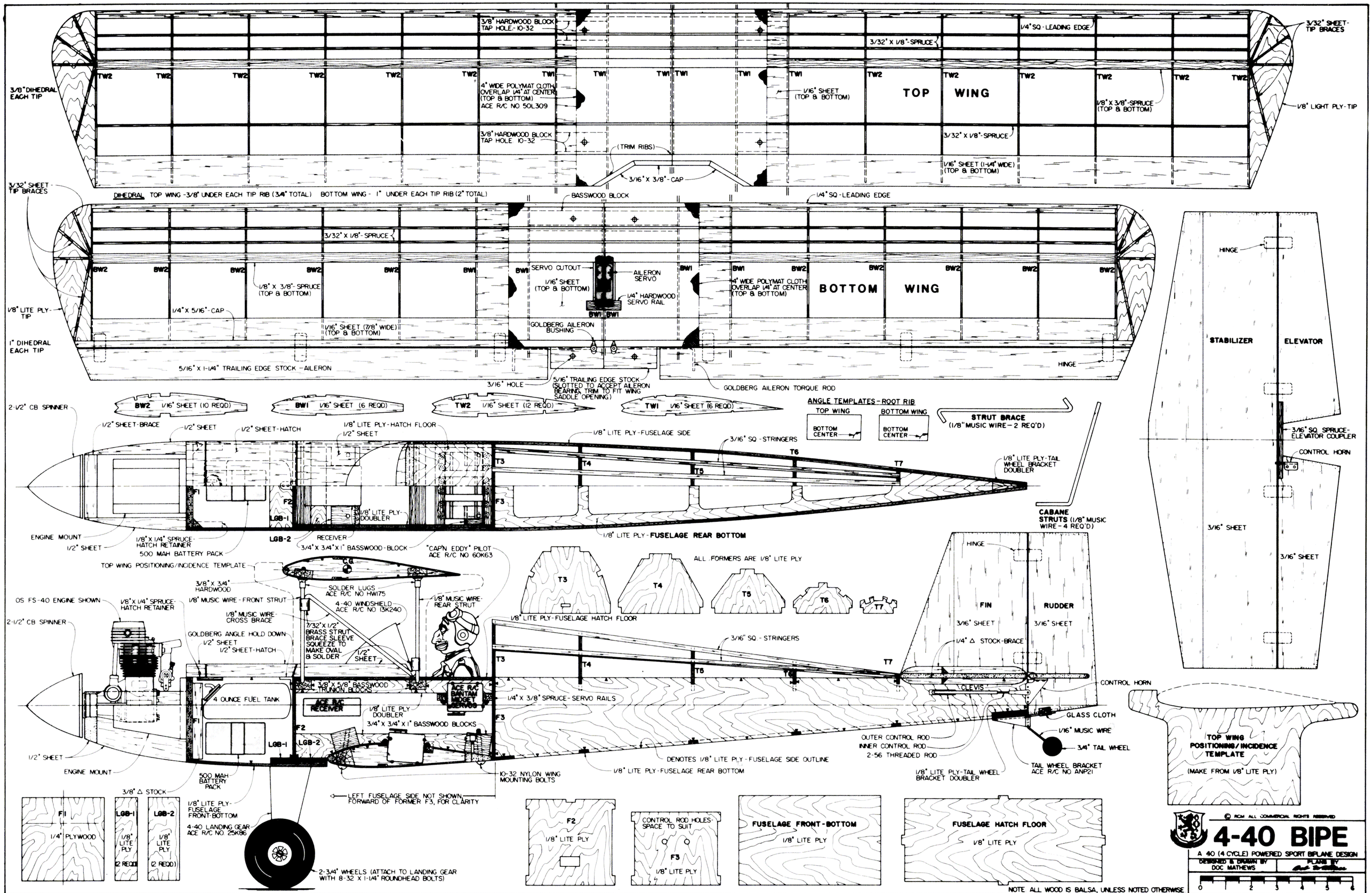
Removable tank hatch shown using nylon clip technique, also can be done with ply tongue and bolt technique.



Nose blocks and bottom cross brace ready to sand into contour of spinner.



Bottom wing bolt and block detail.



4-40 BIPE

A 40 (4 CYCLE) POWERED SPORT BIPLANE DESIGN

DESIGNED & DRAWN BY DOC MATHEWS

PLANS BY

NOTE ALL WOOD IS BALSA, UNLESS NOTED OTHERWISE

PLAN NO. 977