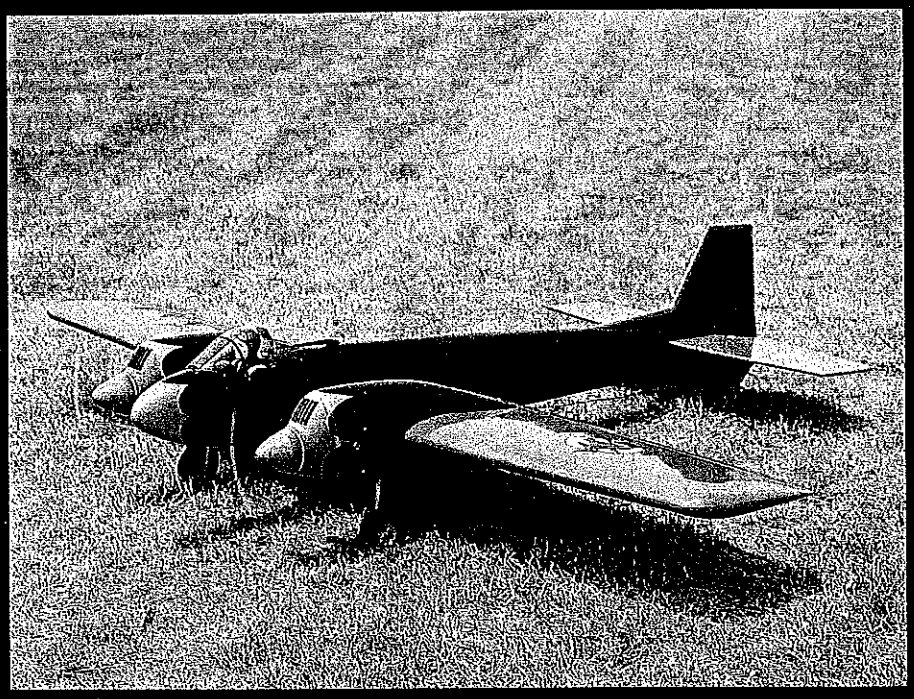
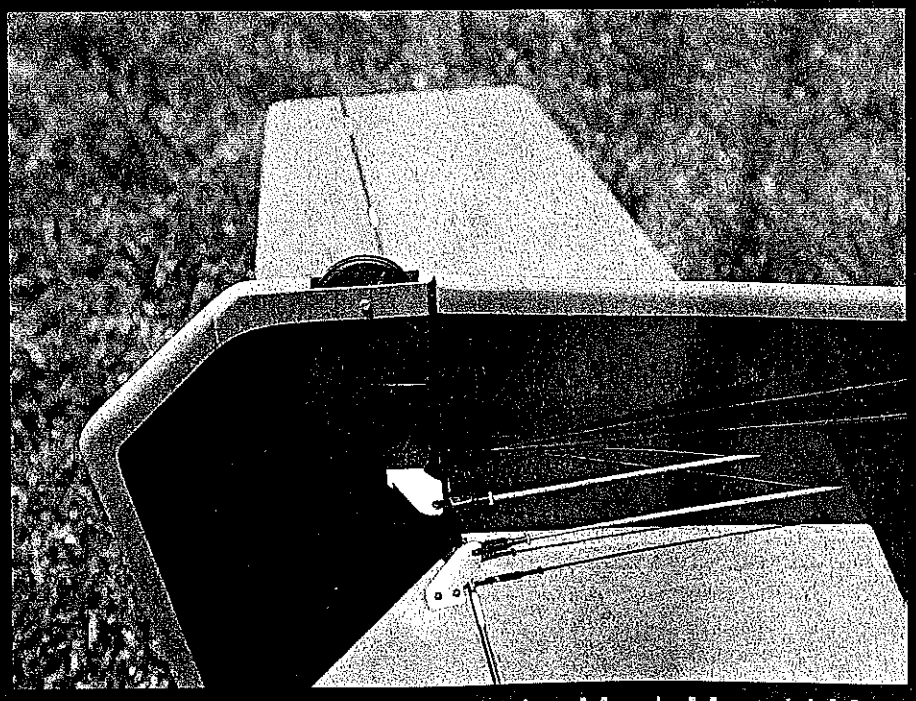
WITCH



Left: Witch Craft taxies back to pits after first flight. Aileron flutter damaged servos, but was cured—see text.

Below: Tail wheel and control horn installation. A 2-56 bolt serves as the tail wheel axle.

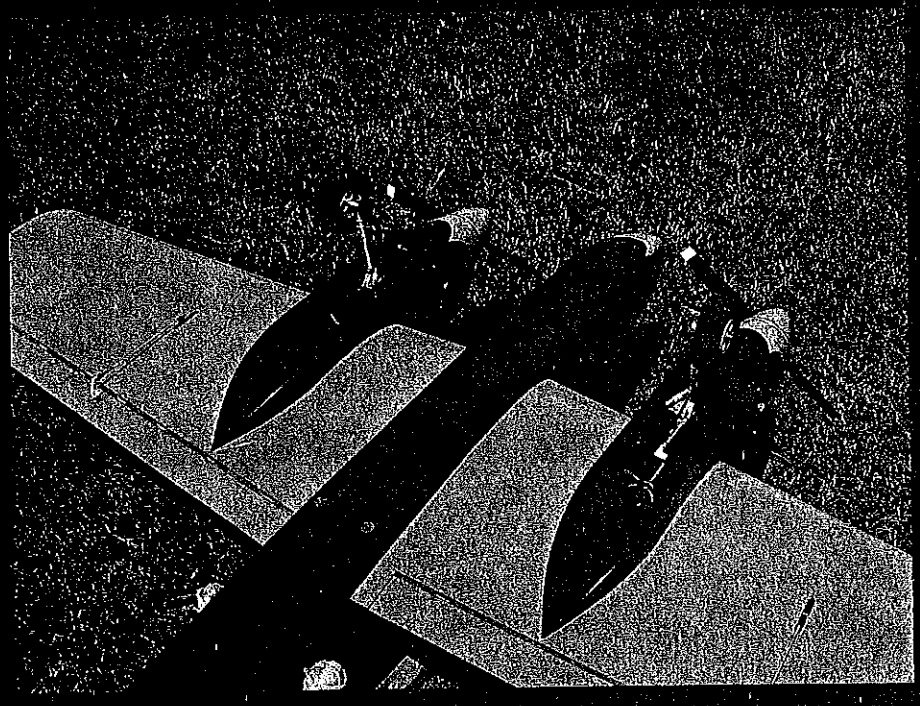


I have not broken any new ground; this is a conventional design. I wanted an easy flying, capable aircraft. The wing area is 1239 square inches, and at 17 pounds total weight, it is quite light. The wing is tapered, and the symmetrical airfoil is a little more than 16% thick for reasonable speed and enough lift for comfortable landings.

The fin, subfin, and rudder are made quite large to help flying if one engine decides to retire early. The engine nacelles are spaced far enough from the fuselage to use up to 17-inch propellers.

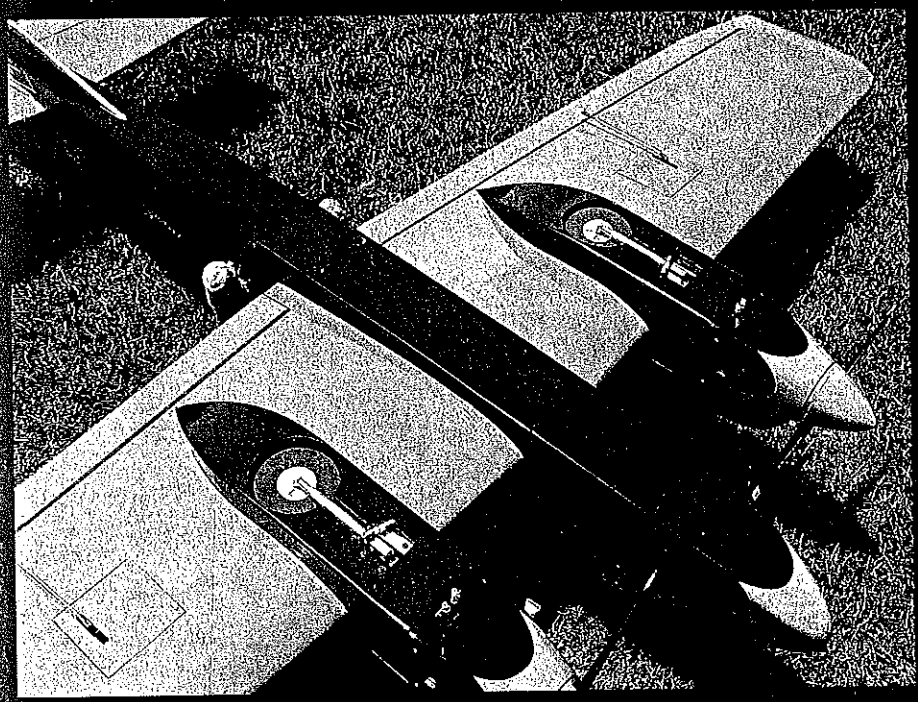
The fiberglass cowls are from my Schneider Trophy-Mock Macchi M-39 (*Flying Models*, October 1990). These cowls are available from Fiberglass Specialties (38624 Mt. Kisco Dr., Sterling Heights MI 48310). They can hide any number of engines: 90 to 150 four-stroke and .60 to 1.20 two-stroke. Witch

CRAFT



Right: The original Witch Craft used rotating Romair retracts; plans show fixed landing gear.

Below: Nacelles are spaced to accomodate props up to 17 inches in diameter. Cowls are available from Fiberglass Specialties.



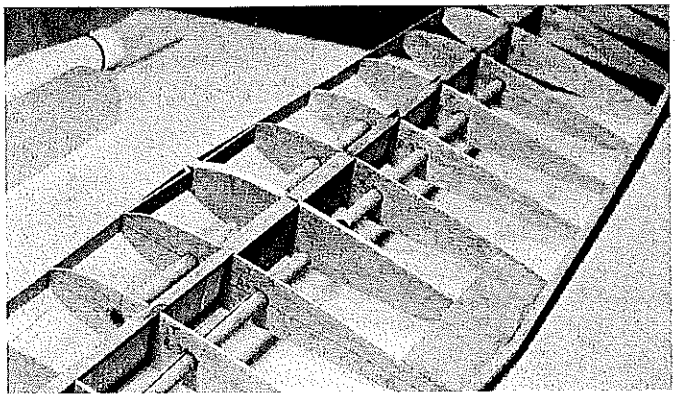
Craft should fly quite well on any two of these engines.

I originally installed 90° rotating Romair retracts in my model, but I later replaced them with 1/5-scale Century Jet retracts, as the model is a bit too heavy for the Romairs. Fixed gear is shown on the plan.

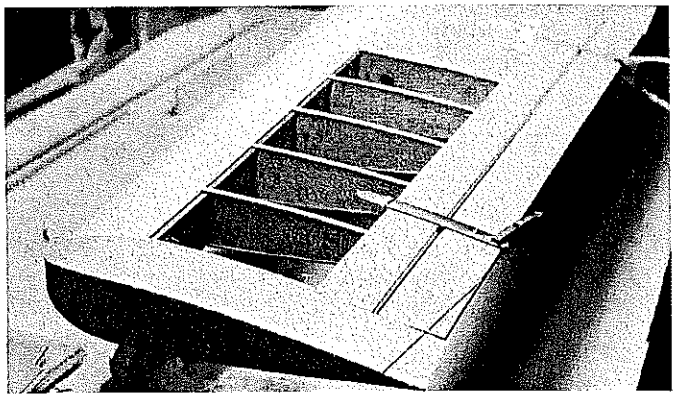
This has been a rewarding project for me. Not only do I have a beautiful twin to fly, but it took first place at the 1993 WRAM Show in the sport category.

CONSTRUCTION

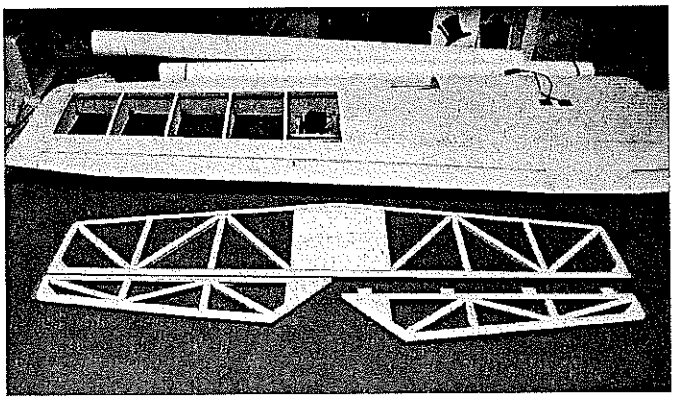
Wing: Cut two of each rib from 3/32 balsa sheet. Pin the 1/4 x 1/2 spruce main spar to the protected plan. A 3/8 square shim keeps the ribs level. Glue R-2 and R-10 in place. Pin the 1/8 x 1 false leading edge and 3/8 x 3/4 trailing edge on the ribs.Install the rest of the ribs. Fit the ribs to prevent bowing of the leading and trailing edges. Glue the top spar in place. Remove the wing panel from the plan and build one more just the



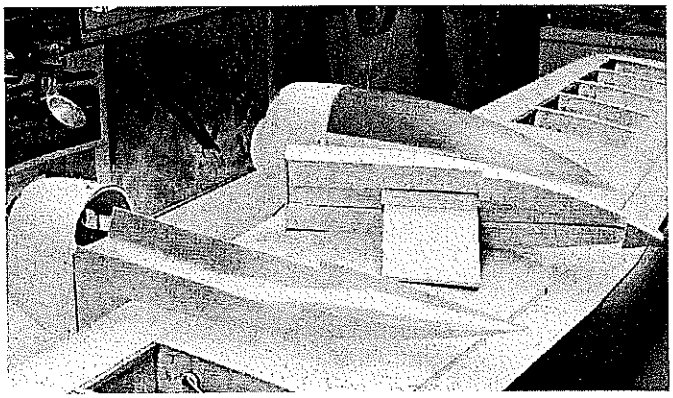
Servo extension tubes are 1/32 balsa tubes formed around 1/2-inch dowel. Install before joining wing panels.



The wing has been sheeted, with ailerons installed temporarily while tip blocks are cut and shaped.



Wing is ready to cover—note nacelle cutouts in LE. Stab framework has been completed, with hinging in progress.



Balsa plug was made to lay up a fiberglass engine nacelle top—also available from Fiberglass Specialties.

same. Remove the second wing panel from the plan and install vertical-grain shear webs. Fit 3/32 balsa sheet between the ribs up against the spars. Mark for an inside cut to form an I-beam or mark at top and bottom of spar. Then face glue to the spars to from a channel. Either one will do the job.

Make servo extension tubes by soaking 1/32 x 2 balsa sheet and taping in place around a 1/2-inch dowel. Remove when dry and glue in wing panels before joining wings together.

Weight one wing panel, using a 3/8 sq. shim to keep level. Butt the second panel to the first with a 1 1/2-inch block under the tip rib to get proper dihedral. Glue in 1/8 plywood spar joiners using epoxy; clamp till set.

Glue a balsa block at the trailing edge; this is a hard point for wing bolts. Turn the wing over, bottom up, and sheet the leading and trailing edges with 3/32 balsa sheet. Sheet the center section out to rib 5 and add capstrips. Turn the wing right side up, and weight one wing panel at a time using a 3/8 square shim to keep level. Using a Robart incidence meter at the root rib, set the wing at 0°.

Use the meter to check the tip rib for 0 degrees. When you are sure the panel is not twisted, you can sheet the leading and trailing edges. When the glue is dry, repeat the procedure on the other wing panel. This should guarantee a straight wing.

Add capstrips and center section sheeting. Attach the 3/8 x 1 leading edge and plane to shape. Drill two 3/8 holes in the leading edge and glue in 3/8 dowels.

Ailerons are made from two 3/8 x 2 1/4 aileron stock glued together. Dry-fit the aileron to the wing with Sig Easy Hinges. They will be glued after the aircraft is covered.

Add the balsa block to center rear of the wing. Cut wingtip blocks to shape and hollow to lighten. Glue tips on and finish shaping and sanding the wing. Set the wing aside for now.

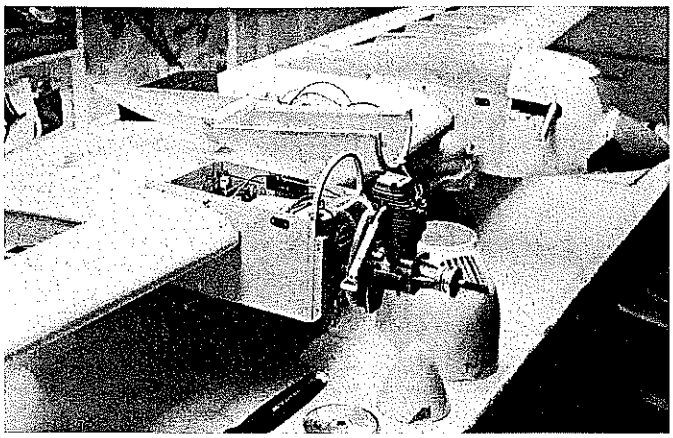
Cut four engine nacelle sides from 1/8 balsa sheet, and four doublers from 1/32 plywood. Cut two NA-2 and NA-3 formers from 1/8 Lite Ply. Place firewalls on waxed paper on a flat work surface. Stand up nacelle sides next to firewall. Using a straightedge, glue in place. Reinforce with triangular stock. Glue in NA-2 at proper location, using tri-stock here also. You now have a rigid box.

Before adding the nacelles to the wing, it is best to do as much work to them as possible. Mount the engines, fit the cowls, mount and fit 3/16 music wire landing gear. Now you can cut out the bays between rib R-3 and rib R-4 back to the spars. Weight wing down on work surface and set at 0° using Robart incidence meter. Slide in engine nacelles and check for 0°.

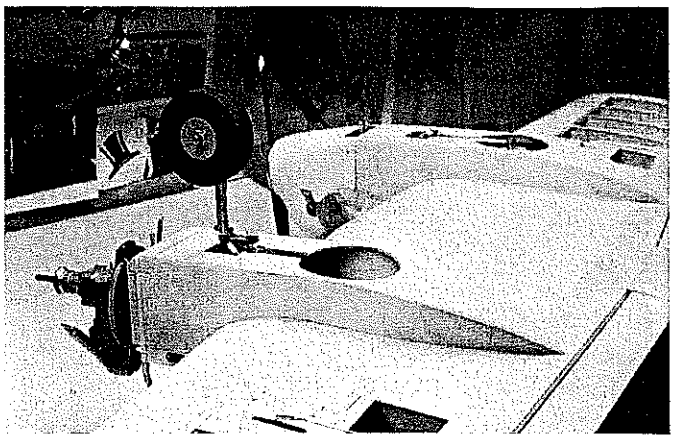
Turn the wing over. Glue in NA-3 while pulling the rear of the nacelle together (moisten if necessary). Sheet the bottom of the nacelle with 1/8 balsa (cross grain). You can install fuel tanks and servos at this time.

I made the nacelle tops using fiberglass on a balsa plug. The cowls and nacelle tops are available from Fiberglass Specialties, 38624 Mt. Kisco Drive, Sterling Heights MI 48310. Glue on hardwood blocks and secure cowls and nacelle tops with pan head screws.

Fuselage: Make two fuselage sides using 3/16 balsa sheet. Glue up pieces to get length and width. Cut two 1/32 doublers and glue to inside of fuselage sides. Tape both sides together to true them up.

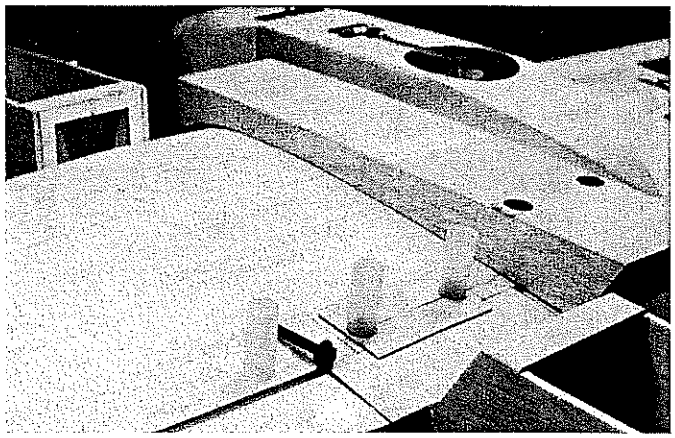


Engine nacelle with top and cowl removed. Nacelle sides are 1/8 balsa, doubled with 1/32 plywood.



Nacelle installation in progress. Bottom sheeting is cross-grained 1/8 balsa. Wheels are four inches in diameter.

Fuselage planking in progress. Alternating strips (one up, one down) makes the job easier.



Bottle tops are used for wing bolt recesses. With belly pan in place, bottle tops can be trimmed level.

Make the wing cutout using a sabre saw with a fine-tooth blade. Drill a hole first to start the cut. *Do not cut belly pan at this time.* Cut formers from Lite Ply (cross grain).

Lay the fuselage sides on the plan and mark inside at former locations. Tape or clamp the rear of the fuselage together. Using two #64 rubber bands at each location, install all formers. Check the fuselage for alignment, using the top view on the plan. When you are sure it is straight, Zap (cyanoacrylate glue) all joints. Glue in F-2A and F-4b using spacers to guide the saw cut later on.

Sheet the bottom of the fuselage with 1/8 balsa (cross grain) leaving the front open to help in locating wing dowel plates. Using scarf joints, make up enough 1/8 x 3/8 planks 54 inches long to plank the fuselage top. Glue one plank dead center at top, then alternate one plank bottom, one top on both sides till filled. Using this method, you will only have to cut a scarf joint at either end and shave down the last plank to fit on either side.

After planking, sand smooth and fill cracks with Red Devil one-time spackle. Glue on the balsa nose block, carve and sand to shape. Lay fuselage upside down in cradle.

Use a Zona saw to cut the belly pan. Remove the center section of F-3. Lay the wing in the saddle and check for a good fit. Mark and drill the leading edge for two 3/8 dowels. Remove the wing and glue in wing bolt plates to fuselage side. Use triangular stock.

Return the wing to the saddle and glue in wing dowel plates through the hole left in the front of the fuselage. Align the wing with the fuselage. Drill and tap plates for 1/4-20 bolts. Finish sheeting the front of the fuselage and then fit belly pan. I use Zap bottle caps for bolt conduits. Just drill 1/4-inch hole in top of bottle cap, insert bolt, tighten down on wing, then fill in around cap for a flush job.

Using scrap 3/8 balsa to act as a spacer for the fin and stab, glue balsa block on both sides of the fin, and carve and sand to shape. Remove scrap. Now you have slots to accept the fin and stab.

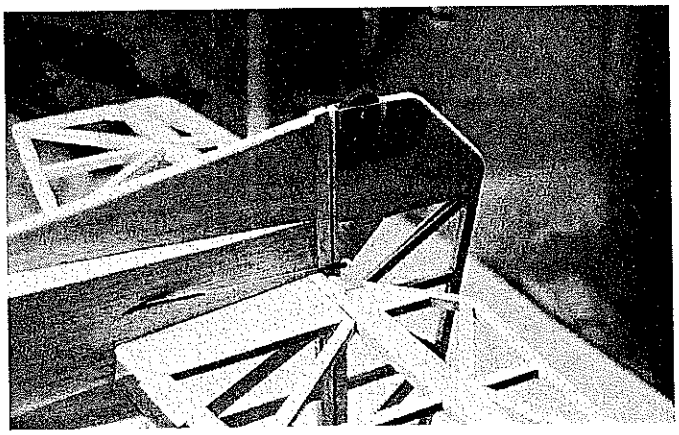
Build the rudder and stabilizer from 3/8 balsa. Dry-fit with Sig Easy Hinges. Cut a hole in the rudder bottom. Glue on Formica, 1/32 plywood, or .032 aluminum on each side to form a pocket for the tail wheel. Use a 2-56 bolt for the axle. I have used this type wheel on at least six different aircraft, and have never pulled the rudder off.

Glue the fin and subfin to the fuselage. The stab can be slid in temporarily to install servos and pushrods. After the fuselage has been painted and finished, the covered stab can be permanently installed.

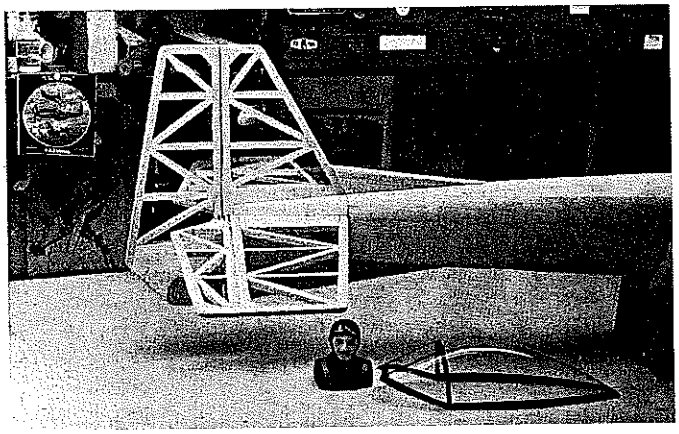
Controls: Use one servo for each engine, one servo for each elevator half, one servo for each aileron, and one 1/4-scale servo for the rudder. Use 4-40 pushrods on ailerons and tail surfaces.

Aileron throw is 3/4 inch each way; elevator is one inch each way; rudder is all you can get. I like a lot of control movement, and use the exponential and dual rates that I was born with (in my

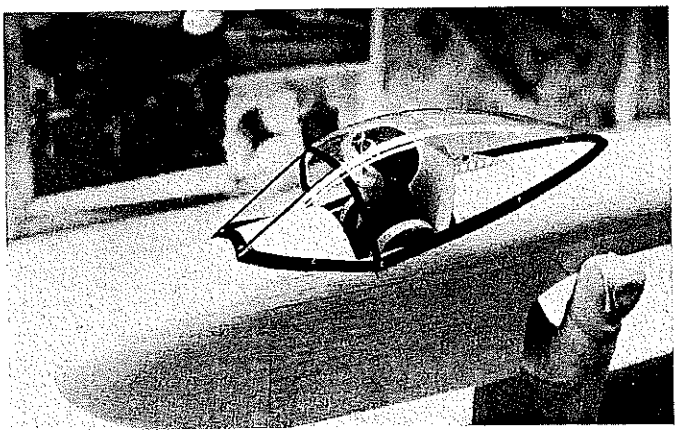
Wing and stab are checked with Robart meter for 0° incidence. Stab is not glued in place at this point.



Separate pushrods used for each elevator half. Elevator can still be removed at this point for covering. Note tail wheel.



Tail group with pilot and 15-inch Sig canopy. Surfaces are built from 3/8 balsa and mated with Sig Easy Hinges.



Canopy is attched with button-head screws. Fuselage is finished with light fiberglass cloth and Z-poxy resin.

fingers).

Finish: I covered the wing and stabilizer with UltraCote. I used light glass cloth and Z-poxy finishing resin on the fuselage. On the rudder and fin, I used Sig Koverall and nitrate dope.

I coated the fuselage, cowls, and nacelle tops with auto primer, then painted with Hobbypoxy. The trim is also Hobbypoxy. A pilot was installed under the 15-inch Sig bubble canopy.

The plans show a plywood block glued into the fuselage at the balance point; a large screw eye fits into it. Hang the assembled aircraft from a hook and balance using a Robart incidence meter. We are looking for 0°. Mine came out nose heavy, so I moved the radio battery rearward to achieve balance.

It is now time for flight testing.

Flying: The main thing with any twin is to get the two engines running reliably. I ran both engines thru a full tank of fuel, and checked idle and high speed with the plane held level and with the nose pointing straight up. Everything checked out just fine.

I filled both fuel tanks and pumped up the retract air tank. I range-checked the radio and all controls; everything was "go." I taxiied out to midfield and applied full power. What a beautiful sound two engines make!

Witch Craft

Type: RC sport

Wingspan: 84 inches

Engine size/type: Two O.S. Max 90s

Number of servos: 7

Flying weight: 17 pounds

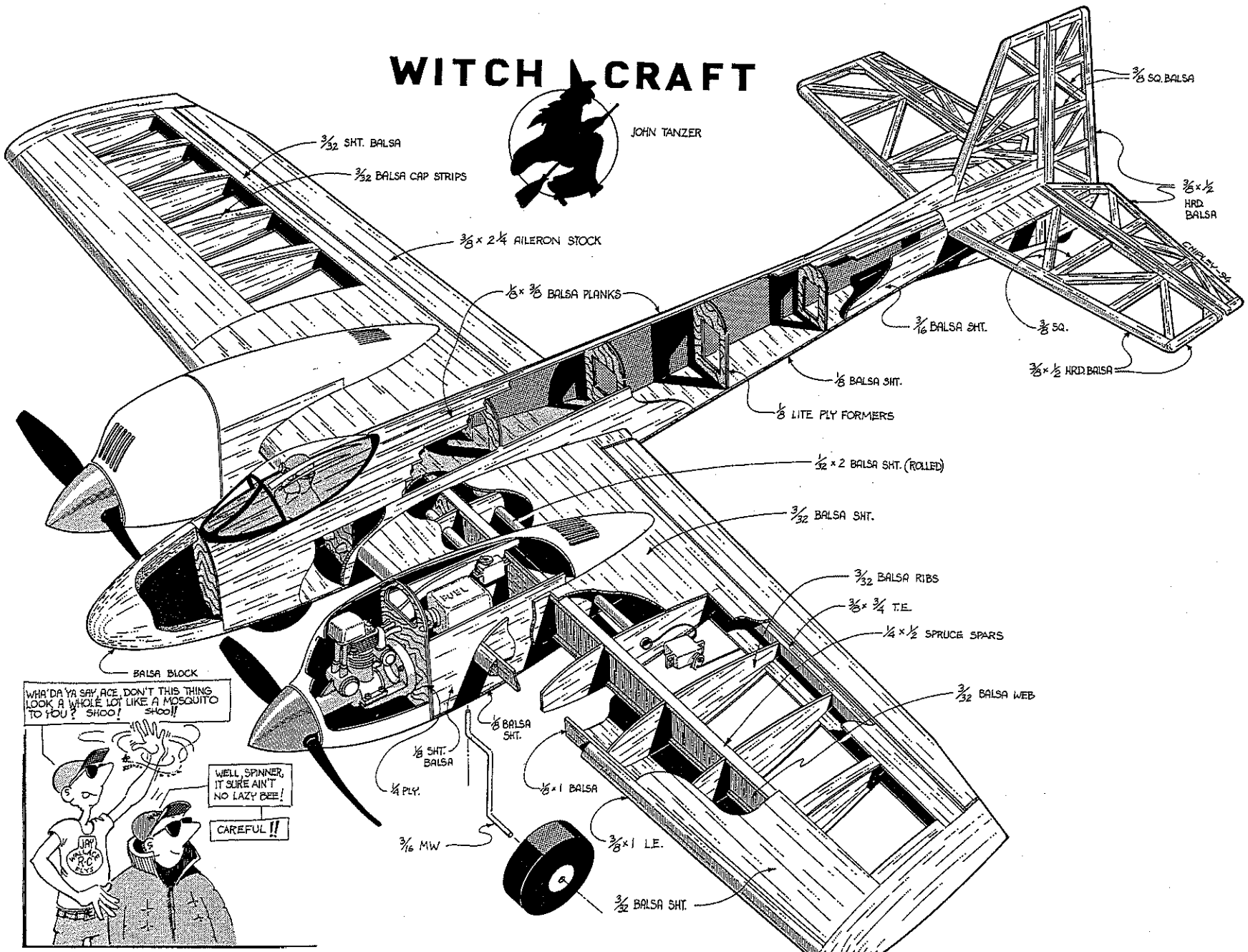
Construction: Built-up

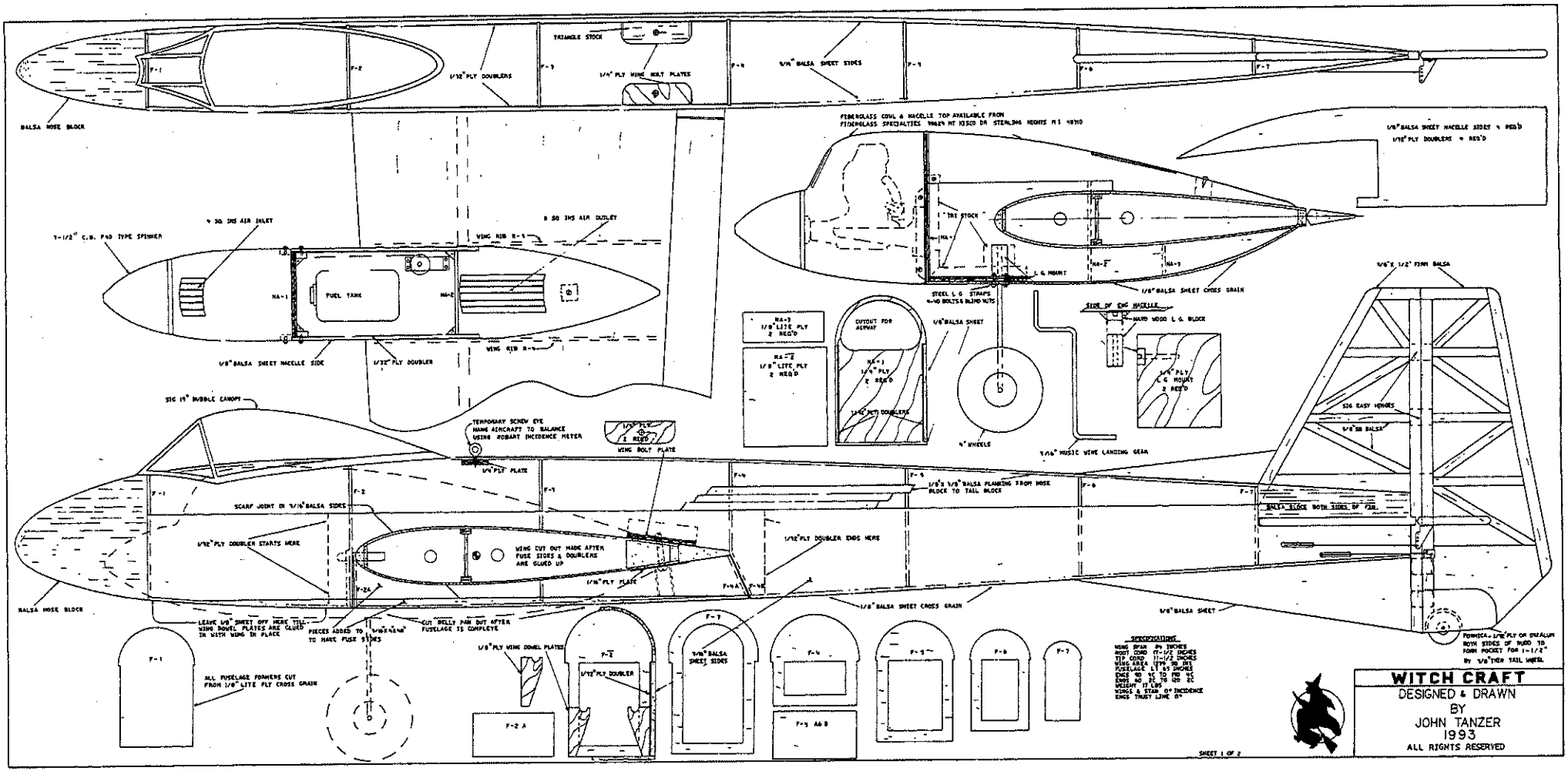
Covering/finish: Hobbypoxy and UltraCote

Takeoff was straight—no veering. After climbout, I turned to the right and put the nose down to make a pass over the field when I heard that awful sound: aileron flutter. *(Editor's note: See the article on flutter in this issue.)* I immediately cut power and made an emergency landing to a good smooth touchdown. The Witch handled very well, even with only one aileron partly working.

Checking for damage, I found one S148 servo had stripped gears and both 2-56 pushrods were bent. Back at the workshop, I installed two new S9201 HD servos and 4-40 pushrods. I also counterbalanced both ailerons using 1/16 music wire imbedded in the aileron at mid-span with a 3/4-ounce lead slider sinker epoxied to the wire end forward of the hingeline. This cured the flutter problem.

The next flights were uneventful. The Witch is very stable, and will do all the standard maneuvers. Takeoffs and landings are a breeze. I am confident the Witch will fly with one engine out. So if you would like to build a fine flying twin, send for a set of plans. You can't beat the sound of a twin. ✈


WITCH CRAFT
JOHN TANZER
3/32 SHT. BALSA
3/32 BALSA CAP STRIPS
3/8 x 2 1/4 AILERON STOCK
1/8 x 3/8 BALSA PLANKS
3/8 SQ. BALSA
3/8 x 1/2 HRD. BALSA
3/16 BALSA SHT.
3/8 SQ.
3/8 x 1/2 HRD BALSA
1/8 BALSA SHT.
1/8 LITE PLY FORMERS
1/32 x 2 BALSA SHT. (ROLLED)
3/32 BALSA SHT.
3/32 BALSA RIBS
3/8 x 3/4 T.E.
1/4 x 1/2 SPRUCE SPARS
3/32 BALSA WEB
BALSA BLOCK
FUEL
1/8 BALSA SHT.
1/8 SHT. BALSA
1/4 PLY.
1/8 x 1 BALSA
3/16 MW
3/8 x 1 L.E.
3/32 BALSA SHT.
WHA'DA YA SAY, ACE, DON'T THIS THING LOOK A WHOLE LOT LIKE A MOSQUITO TO YOU? SHOO! SHOO!!
WELL, SPINNER, IT SURE AIN'T NO LAZY BEE!
CAREFUL!!


BALSA NOSE BLOCK
1/32" PLY DOUBLERS
TRIANGLE STOCK
1/4" PLY WING BOLT PLATES
1/8" BALSA SHEET SIDES
FIBERGLASS COWL & NACELLE TOP AVAILABLE FROM
FIBERGLASS SPECIALTIES
1/8" BALSA SHEET NACELLE SIDES
1/16" PLY DOUBLERS
1-1/2" C.S. PAD TYPE SPINNER
WING RIB R-1
FUEL TANK
1/8" BALSA SHEET NACELLE SIDE
1/32" PLY DOUBLER
TAIL STOCK
L.G. MOUNT
1/8" BALSA SHEET CROSS GRAIN
STEEL L.G. STRAPS
1/8" BALSA SHEET
CUTOUT FOR AIRVAT
SIDE OF ENG NACELLE
HARD WOOD L.G. BLOCK
1/16" PLY L.G. MOUNT
4" WHEELS
1/16" MUSIC WIRE LANDING GEAR
1/8" X 1/2" PINN BALSA
SIG 19" BUBBLE CANOPY
TEMPORARY SCREW EYE
WING BOLT PLATE
1/4" PLY PLATE
SCARF JOINT IN 3/16" BALSA SIDES
1/32" PLY DOUBLER STARTS HERE
WING CUT OUT MADE AFTER FUSE SIDES & DOUBLERS ARE GLUED UP
1/16" PLY PLATE
1/32" PLY DOUBLER ENDS HERE
1/8" BALSA PLANKING FROM NOSE BLOCK TO TAIL BLOCK
BALSA BLOCK BOTH SIDES OF FIN
SIG EASY HINGES
1/8" BB BALSA
1/8" BALSA SHEET CROSS GRAIN
1/8" BALSA SHEET
LEAVE 1/8" SHEET OFF HERE TILL WING DOWEL PLATES ARE GLUED IN WITH WING IN PLACE
PIECES ADDED TO MAKE FUSE SIDES
CUT BELLY PAN OUT AFTER FUSELAGE IS COMPLETE
ALL FUSELAGE FORMERS CUT FROM 1/8" LITE PLY CROSS GRAIN
1/16" PLY WING DOWEL PLATES
1/32" PLY DOUBLER
3/16" BALSA SHEET SIDES
F-1
F-2
F-2 A
F-3
F-3 A & B
F-4
F-5
F-6
F-7
SPECIFICATIONS
WING SPAN 84 INCHES
ROOT CORD 17-1/2 INCHES
TIP CORD 11-1/2 INCHES
WING AREA (FTH) 80 SQ INS
FUSELAGE LT 65 INCHES
ENGS 90 CC TO 120 CC
ENGS 40 TO 70 CC
WEIGHT 11 LBS
WINGS 6 STAB 0° INCIDENCE
ENGS THRUST LINE 0°
WITCH CRAFT
DESIGNED & DRAWN
BY
JOHN TANZER
1993
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SHEET 1 OF 2

Full-Size Plans Available–See Page 160