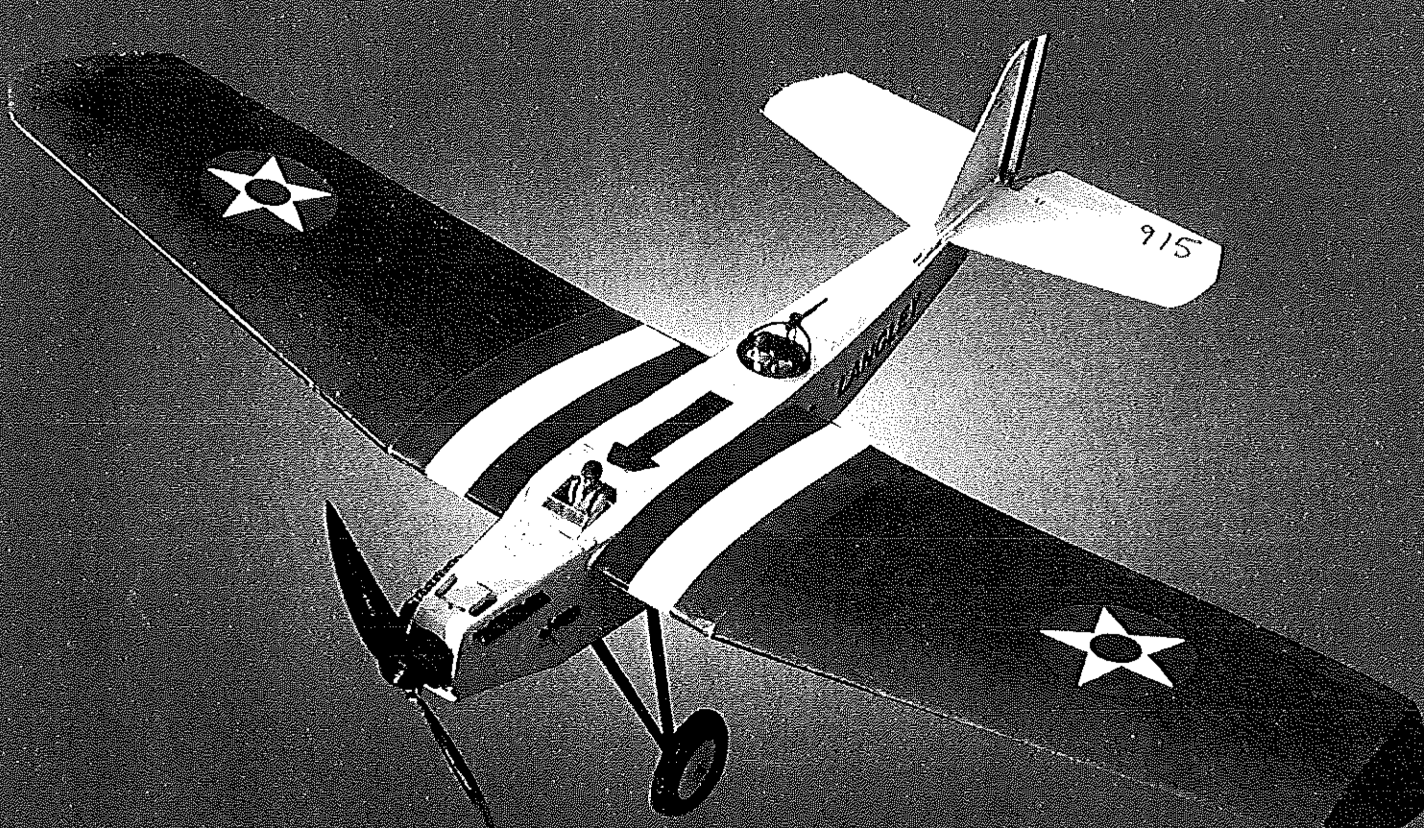
■ William Higgins and Donald Skiff



Martin MO-1

Little-known Navy observation airplane is a natural for Speed 400 motors

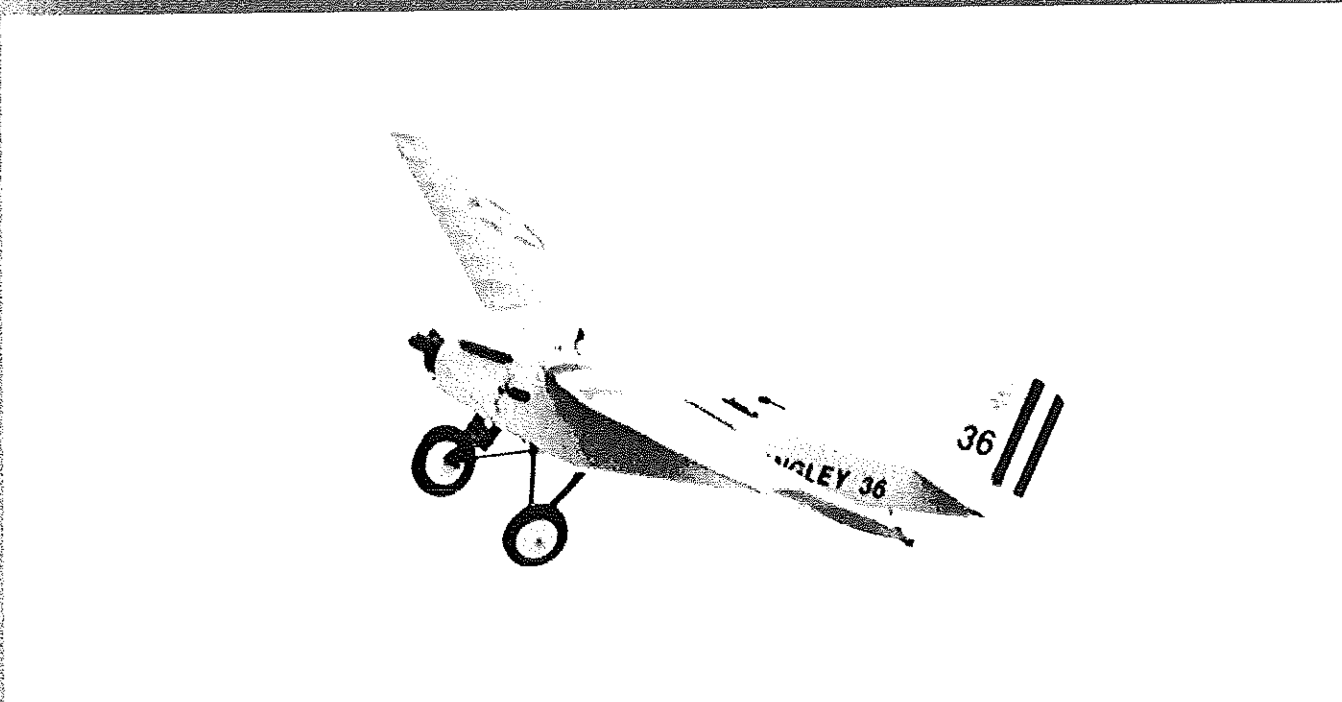
THIS AIRPLANE is easy to build, gentle to fly, and hasn't been modeled much for Radio Control (RC)! (The profile version has long been a Control Line Navy Carrier favorite.)

Bill Higgins (2131 Chaucer Dr., Ann Arbor MI 48103) designed it from three-views and other information collected from the Martin Museum, the Naval Air Station at Pensacola, Florida, and aviation history books.

The model's stand-off scale lends itself to your imagination. You can build it stripped down for everyday flying or add detail to your heart's content, to give it a real scale look without making it too heavy.

Bill found some pilots at Toys "R" Us® that just fit, and he built the machine gun from a few scraps of balsa.

Photos courtesy the author. Graphic Design by Carla Kunz



The first Martin MO-1 prototype in the air. It has a great deal of wing area, and it flies in a very scalelike manner!

THE ORIGINAL AIRCRAFT: In 1922 the US Navy Bureau of Aeronautics ordered from Glenn L. Martin Company six model MO-1 naval gun-spotter aircraft, designed for operation using wheels or floats.

This three-place cantilever shoulder-wing monoplane was one of the first all-metal (although fabric-covered) aircraft built in the United States, and was one of the first airplanes designed for aircraft carriers. Several were assigned to the newly commissioned USS *Langley*.

Another 30 MO-1s were ordered the following year. Some were fitted with floats for catapult launching, and at least one was assigned to the battleship USS *Mississippi*.

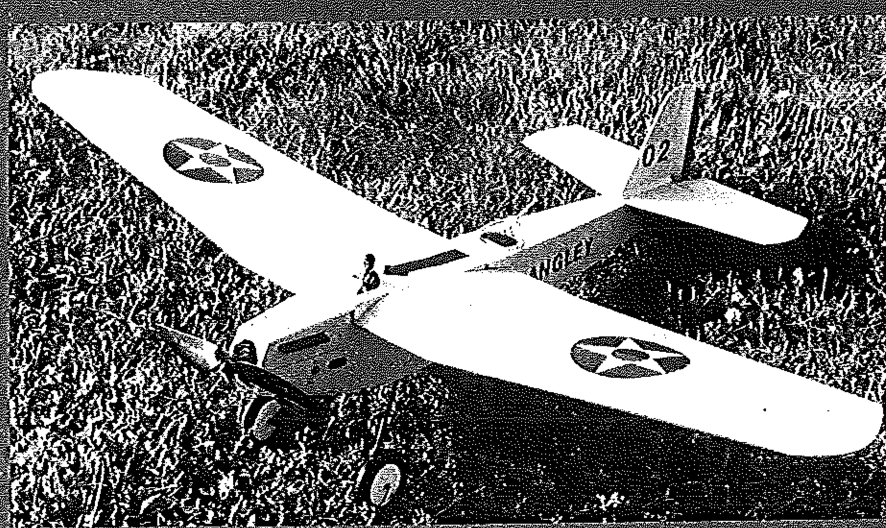
(However, the aircraft didn't work out too well, and all were eventually reassigned to land bases. They were too heavy for the shipboard catapults of those days, and didn't have enough lift to launch safely.)

The MO-1's wingspan was 53 feet, and the length was 38 feet. With a wing area of 488 square feet and a weight of 3,481 pounds empty, the wing loading was 7.13 pounds per square foot.

The Curtiss D-12 350-horsepower engine gave the aircraft a top speed of 105 mph. It could climb to 4,700 feet in 10 minutes (wow!), and land at 51 mph. Service ceiling was listed at 10,500 feet.

The pilot and gunner sat in open cockpits, and the spotter rode inside the fuselage under the wing, with windows on both sides for observing and photographing objects below.

The Model: Bill designed this model for a geared 400-size electric motor. It has a wingspan



The second MO-1 prototype is designated by the "02" on the fin; that is not a scale marking. This is an easy-to-build model that is easy to fly.

of 43 inches and a wing area of 325 square inches.

The all-up weight of the prototype was 20 ounces, providing a wing loading of less than nine ounces per square foot that makes it ideal for small fields. (See "Equipment" section.)

The MO-1 flies very scalelike, and is stable enough for new fliers. The RC controls are elevator, rudder, and motor.

The easy-to-build box-structure fuselage, solid-sheet-balsa tail, and three-piece wing go together quickly. The wing is mounted with a positive incidence of 1°.

What's been changed from the full-scale airplane?

The fin is a bit taller, the stabilizer is wider, and the nose is simplified to accommodate the geared motor drive.

The wing is thinner (a Clark Y airfoil is used), and dihedral has been increased. The ailerons have been left off this model.

The full-width axle of the original has been omitted, to give more spring to the landing gear.

CONSTRUCTION

Fuselage: Trace the side panels onto two sheets of 1/16 balsa, and cut out. The triangular indicators on the plan show the edges of the panels.

Using a smooth tool, lightly score each side of the cowl along the angled line so that the panel can be bent during assembly.

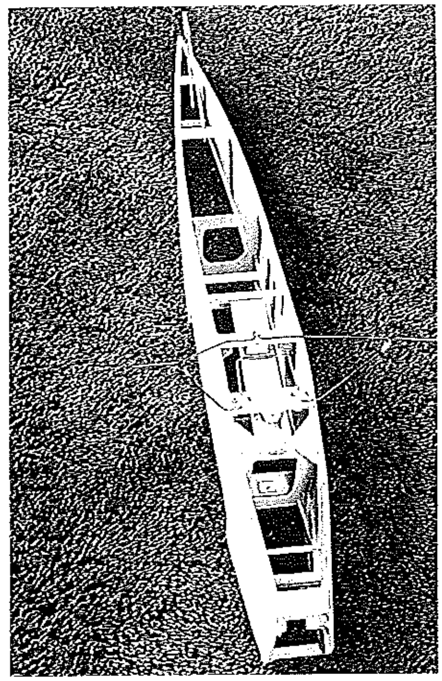
Glue the spruce thrustline longerons to the insides of the panels, positioning carefully since these parts locate several attaching parts. Mark the locations of all the formers.

Glue the top and bottom *rear* longerons to the panels; hold the front longerons until later. (Notice that the bottom longerons extend through former E to match the notches in the plywood doubler.)

Taper the tail ends of the top and bottom longerons so that they just meet when the panels are joined at the tail post.

Trace the bottom doublers, and cut them from Lite Ply. Glue them in place between the locations of formers B and E. The bottom edge should be flush with the side panel.

Trace formers B and E, and cut them



The construction of the fuselage is the normal sheet sides with formers. It is simple, yet rugged and accurate.

Building Your Airplane to Be Light

The Martin MO-1 came out light without sacrificing a great deal of strength by paying attention to some details.

1) Use light components, such as miniservos and receiver. The little Pixie or Sprite speed controls are light, and they have BEC to save the weight of radio batteries.

Some fliers are using lighter-weight Nickel Metal Hydride (NiMH) batteries in place of the Ni-Cd 600AEs originally used in this design.

The drag of the design limits the speed of the airplane anyway, which will be almost as fast at half throttle as at full bore.

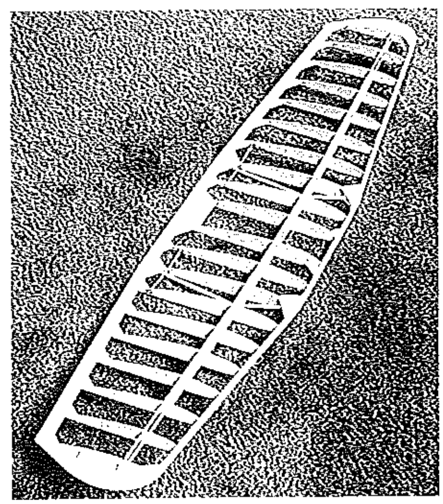
2) Use light wheels. Bill's foam wheels weigh eight grams apiece, and with the "hubcaps" they don't break so easily.

3) Litespan covering on the wing saves weight compared to a material such as MonoKote®.

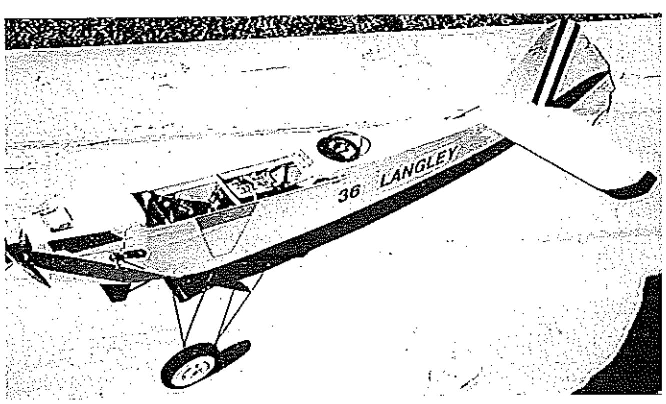
Bill paints solid-balsa surfaces by first sealing with a light mist of clear Krylon®. After sanding, he lightly applies a thinned coat or two of acrylic paint with a ball of cotton.

If you need more luster on the surface, give it another light spray coat of clear Krylon®. MA

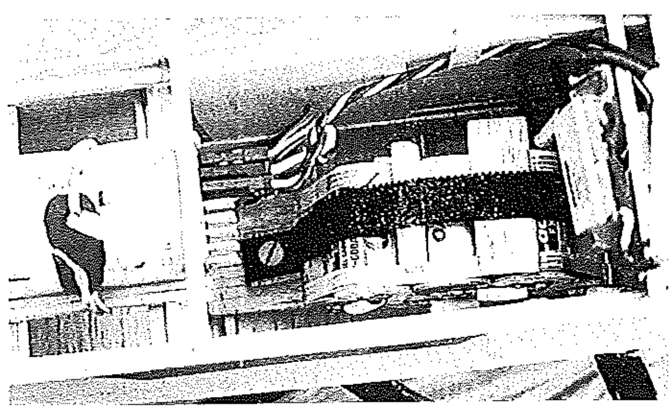
—*Donald Skiff*



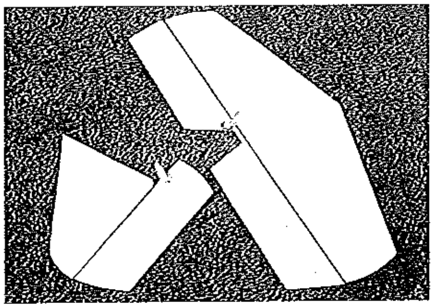
The framed-up wing reveals the bracing at the dihedral joints. Notice the constant-chord center-section.



With the wing removed, access to the radio compartment is obtained. This model is easily maintained.

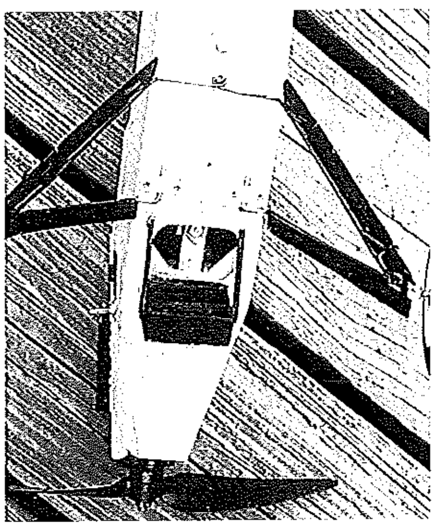


This is a closer look into the equipment compartment. Notice the battery hold-down strap and neat wire routing.



The fin, rudder, and horizontal tail surfaces are made from 3/32 sheet balsa.

The control-rod exit and the plywood elevator control horn.



The torsion bend in the main landing-gear strut allows flexing during hard landings.

from Lite Ply. Notice that the top part of former B is made from balsa. Draw a vertical centerline on each former.

Support the sides vertical, with the tail ends supported by a block 2 3/8 inches high. Glue formers B (plywood segment only) and E in place between the sides, making sure they are square and vertical.

Install the components that are between the two formers, including die wing hold-down plywood and the members that will support the landing gear, battery tray, and servos. These will help strengthen the assembly for the next step.

To make sure the fuselage comes out straight, draw a line on the work surface and the tail-support block to mark the exact centerline. Line up the centerline of each former to the drawn line. Block the assembly in place.

That step is important; if the side panels don't bend exactly the same and you simply glue the tail ends together, the fuselage will not be symmetrical.

Press the tail ends together so that they join right at the centerline. (Even if the ends are uneven, it's better to trim a little bit than have a banana-shaped fuselage.) Double-check alignment, and glue.

When the glue is set, fix the 1/8-inch-thick tail post to both panels, and taper it with sandpaper until it's flush with the sides.

At the nose, cut a 1/8 square strip of balsa for a top crossmember, as shown on the plans. Cut two more crossmembers from 1/16 x 3/16 balsa strips, for the crossmembers that go on top of the thrustline spruce strip.

Mark the center of each piece with a pencil. (Die marks must align with the centerline on your work surface in the next step.)

With all three crossmembers in position but unglued, gently pull the sides together at the nose and hold them with clamps. Check the alignment of the whole fuselage once more. Glue the members in position.

Trace the motor-gearbox mounts onto 1/4 balsa sheet, and cut them out. Check the mating surfaces inside the cowl for a proper match, then glue the two pieces in position against the bottom of the thrustline spruce strip. (Be sure you have the correct piece on each side, to provide sidethrust for the propeller.)

Cut the crossmember for the bottom of the nose from 1/8 x 1/4 balsa, bend the side panels at the score marks, and glue in place. (The crossmember will be sanded to shape later.) Add a bead of cyanoacrylate glue (CyA) inside along the score marks, to strengthen them.

Glue 1/8 square balsa longerons along the top and bottom of each side panel from the nose back to former B. You may have to shape the ends to fit.

Trace and cut the two pieces of former A, and glue in place. Glue a crossmember at the bottom of former A, between the 1/8-inch longerons.

The cowl top piece is 1/4 balsa, sanded to shape. For strength, Bill glued it in place, then cut a segment as a hatch for access to drive mounting screws. The hatch can be held in place with small screws, tape, or a dab of silicone glue.

Glue the top part of former B against the rear edge of the cowl top piece.

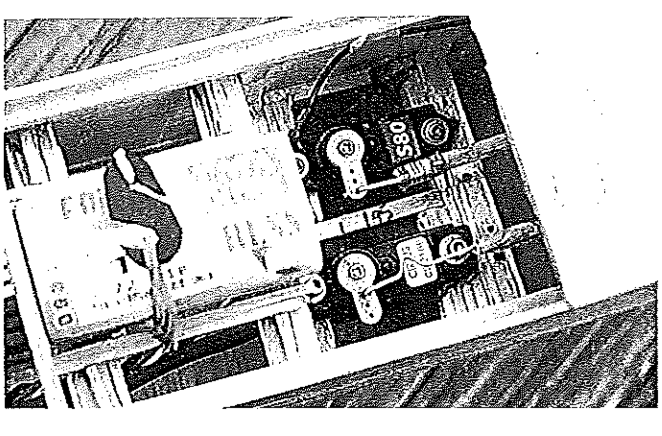
Add the remaining internal parts to the fuselage: the 3/32-inch stiffener, the supports for the RC receiver and servos, and the vertical stiffening strips aft of the gunner position.

Cut the fuselage bottom from cross-grain 1/16 sheet balsa, using the fuselage assembly as a template.

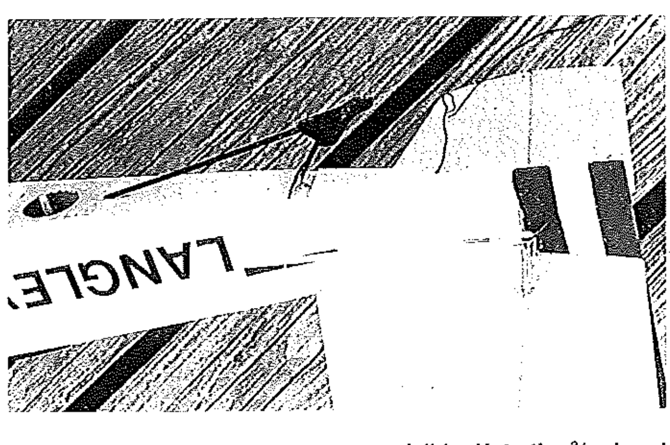
Continued on page 67

Martin MO-1

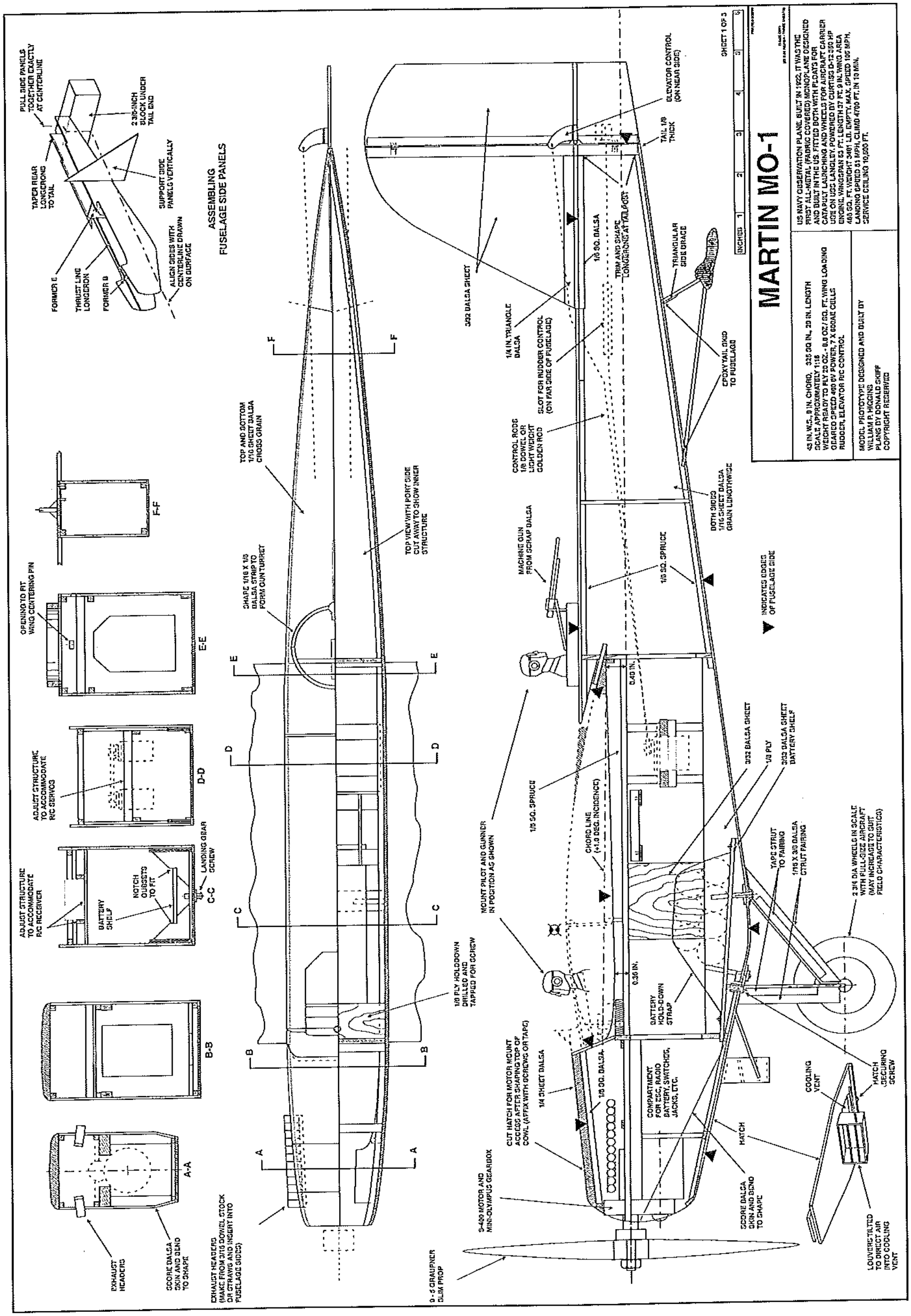
Type: Stand-Off Scale
Wingspan: 43 inches
Motor: Geared Rocket Speed 400 six-volt
Functions: Throttle (with BEC) rudder, elevator
Flying weight: 20 ounces
Construction: Sheet balsa and plywood
Covering/finish: Litespan and model paint

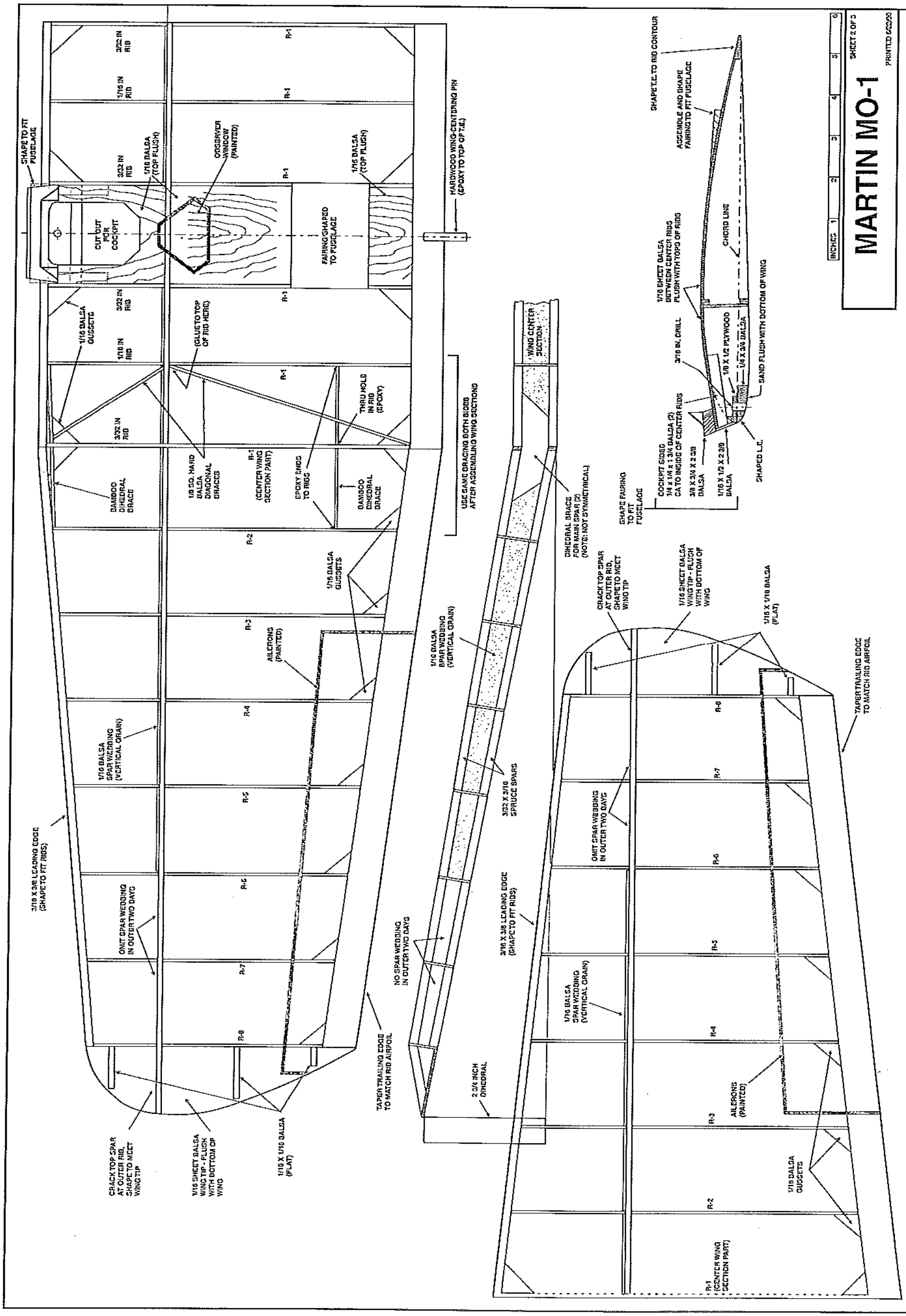


There's plenty of room for the receiver and two flight-function servos. Control rods are made from 1/8-inch-diameter dowels.

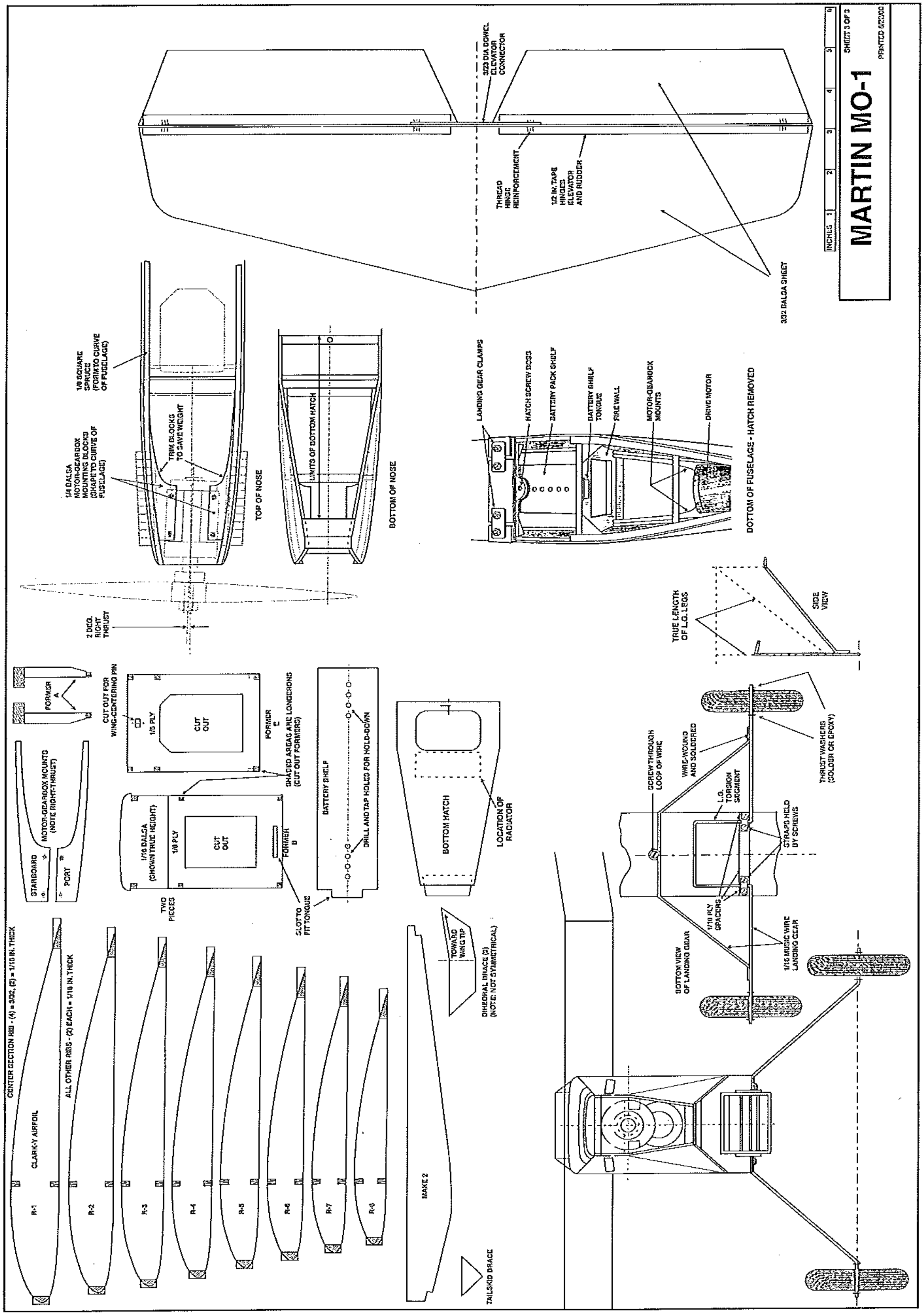


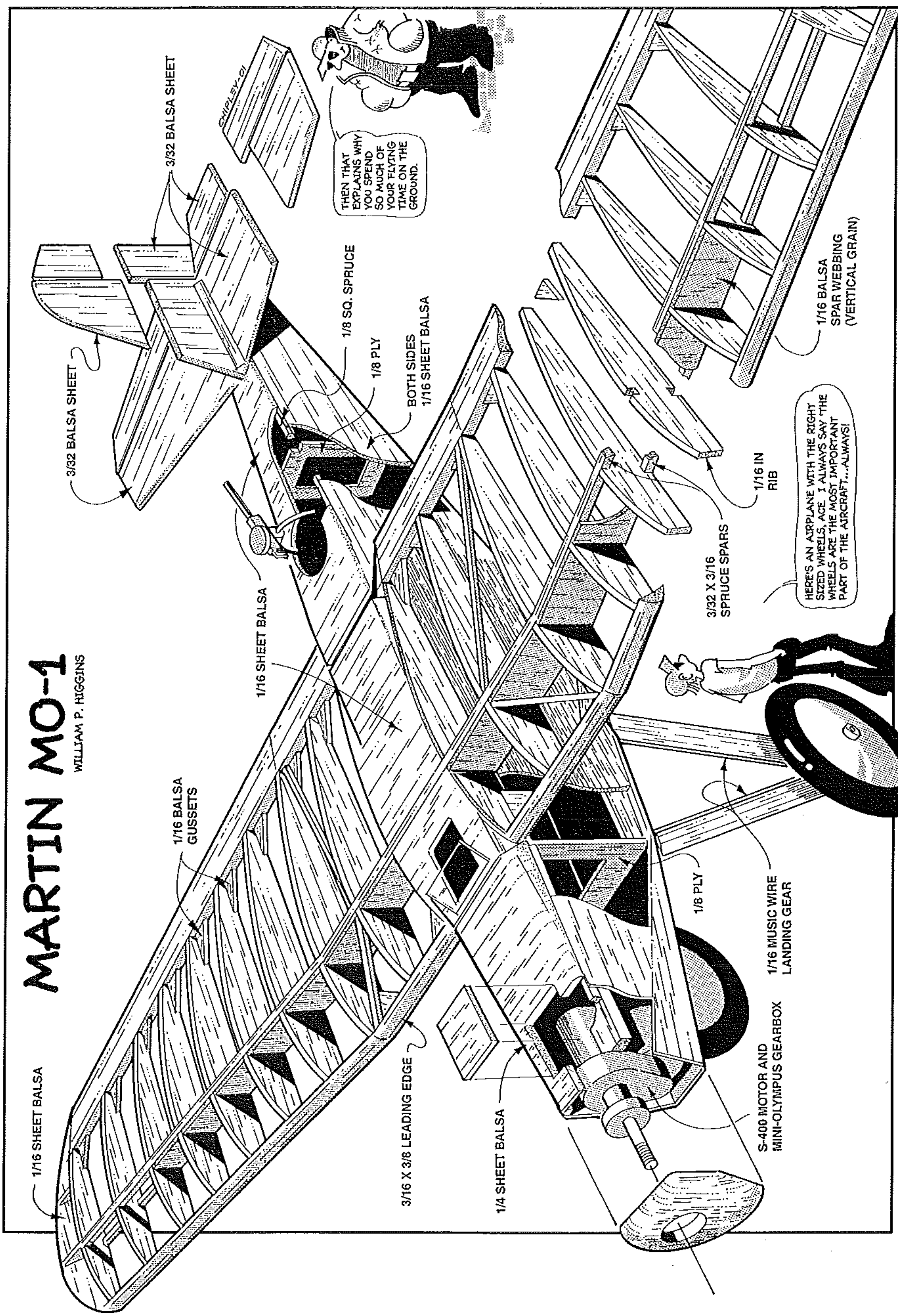
The rudder control rod and horn are visible. Note the 3/32 dowel that connects the elevator halves and the tail skid.


MARTIN MO-1
US NAVY OBSERVATION PLANE BUILT IN 1922. IT WAS THE FIRST ALL-METAL (FABRIC COVERED) MONOPLANE DESIGNED AND BUILT IN THE US. FITTED BOTH WITH FLOATS FOR CATAPULT LAUNCHING AND WHEELS FOR AIRCRAFT CARRIER USE ON USS LANGLEY. POWERED BY CURTISS D-12 350 HP ENGINE. WINGSPAN 53 FT. LENGTH 37 FT. 9 IN. WING AREA 460 SQ. FT. WEIGHT 3461 LB. EMPTY. MAX. SPEED 105 MPH. LANDING SPEED 51 MPH. CLIMB 4700 FT. IN 10 MIN. SERVICE CEILING 10,600 FT.
MODEL PROTOTYPE DESIGNED AND BUILT BY WILLIAM P. HIGGINS
PLANS BY DONALD SKIFF
COPYRIGHT RESERVED
SHEET 1 OF 3
ASSEMBLING FUSELAGE SIDE PANELS
INDICATES EDGES OF FUSELAGE SIDE
A-A
B-B
C-C
D-D
E-E
F-F



MARTIN MO-1
SHEET 2 OF 3
INCHES 1 2 3 4 5 6
SHAPE T.E. TO RIB CONTOUR
ASSEMBLE AND SHAPE FAIRING TO FIT FUSELAGE
CHORD LINE
1/16 SHEET BALSA BETWEEN CENTER RIBS FLUSH WITH TOPS OF RIBS
SAND FLUSH WITH BOTTOM OF WING
3/16 IN. DRILL
1/8 X 1/2 PLYWOOD
1/4 X 3/4 BALSA
SHAPED L.E.
COCKPIT SIDES 1/4 x 1/4 x 1 3/4 BALSA (2) CA TO INSIDE OF CENTER RIBS
3/8 X 3/4 X 2 3/8 BALSA
1/16 X 1/2 X 2 3/8 BALSA
SHAPE FAIRING TO FIT FUSELAGE
HARDWOOD WING-CENTERING PIN (EPOXY TO TOP OF T.E.)
USE SAME BRACING BOTH SIDES AFTER ASSEMBLING WING SECTIONS
WING CENTER SECTION
DIHEDRAL BRACE FOR MAIN SPAR (2) (NOTE: NOT SYMMETRICAL)
CRACK TOP SPAR AT OUTER RIB, SHAPE TO MEET WING TIP
1/16 SHEET BALSA WING TIP - FLUSH WITH BOTTOM OF WING
1/16 X 1/16 BALSA (FLAT)
TAPER TRAILING EDGE TO MATCH RIB AIRFOIL
1/16 BALSA SPAR WEBBING (VERTICAL GRAIN)
3/32 X 3/16 SPRUCE SPARS
OMIT SPAR WEBBING IN OUTER TWO BAYS
NO SPAR WEBBING IN OUTER TWO BAYS
3/16 X 3/8 LEADING EDGE (SHAPE TO FIT RIBS)
2 3/4 INCH DIHEDRAL
AILERONS (PAINTED)
1/16 BALSA GUSSETS
R-1 (CENTER WING SECTION PART)
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
SHAPE TO FIT FUSELAGE
3/32 IN RIB
1/16 IN RIB
1/16 BALSA (TOP FLUSH)
OBSERVER WINDOW (PAINTED)
CUT OUT FOR COCKPIT
FAIRING SHAPED TO FUSELAGE
(GLUE TO TOP OF RIB HERE)
THRU HOLE IN RIB (EPOXY)
BAMBOO DIHEDRAL BRACE
1/8 SQ. HARD BALSA DIAGONAL BRACES
R-1 (CENTER WING SECTION PART)
EPOXY ENDS TO RIBS


MARTIN MO-1
SHEET 3 OF 3
PRINTED 8/22/00
INCHES 1 2 3 4 5 6
3/32 DIA DOWEL ELEVATOR CONNECTOR
THREAD HINGE REINFORCEMENT
1/2 IN. TAPE HINGES ELEVATOR AND RUDDER
3/32 BALSA SHEET
1/8 SQUARE SPRUCE (FORM TO CURVE OF FUSELAGE)
1/4 BALSA MOTOR-GEARBOX MOUNTING BLOCKS (SHAPE TO CURVE OF FUSELAGE)
TRIM BLOCKS TO SAVE WEIGHT
TOP OF NOSE
LIMITS OF BOTTOM HATCH
BOTTOM OF NOSE
LANDING GEAR CLAMPS
HATCH SCREW BOSS
BATTERY PACK SHELF
BATTERY SHELF TONGUE
FIRE WALL
MOTOR-GEARBOX MOUNTS
DRIVE MOTOR
BOTTOM OF FUSELAGE - HATCH REMOVED
2 DEG. RIGHT THRUST
TRUE LENGTH OF L.G. LEGS
SIDE VIEW
FORMER A
CUT OUT FOR WING-CENTERING PIN
1/8 PLY
CUT OUT
FORMER C
SHADED AREAS ARE LONGERONS (CUT OUT FORMERS)
BATTERY SHELF
DRILL AND TAP HOLES FOR HOLD-DOWN
BOTTOM HATCH
LOCATION OF RADIATOR
MOTOR-GEARBOX MOUNTS (NOTE RIGHT-THRUST)
STARBOARD
PORT
1/16 BALSA (SHOWN TRUE HEIGHT)
1/8 PLY
CUT OUT
FORMER B
TWO PIECES
SLOT TO FIT TONGUE
SCREW THROUGH LOOP OF WIRE
WIRE-WOUND AND SOLDERED
L.G. TORSION SEGMENT
STRAPS HELD BY SCREWS
THRUST WASHERS (SOLDER OR EPOXY)
1/16 PLY SPACERS
1/16 MUSIC WIRE LANDING GEAR
BOTTOM VIEW OF LANDING GEAR
CENTER SECTION RIB - (4) = 3/32, (2) = 1/16 IN. THICK
ALL OTHER RIBS - (2) EACH = 1/16 IN. THICK
CLARK-Y AIRFOIL
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
TOWARD WING TIP
DIHEDRAL BRACE (2) (NOTE: NOT SYMMETRICAL)
MAKE 2
TAILSKID BRACE



MARTIN MO-1
WILLIAM P. HIGGINS
1/16 SHEET BALSA
3/16 X 3/8 LEADING EDGE
1/16 BALSA GUSSETS
1/4 SHEET BALSA
1/16 SHEET BALSA
S-400 MOTOR AND MINI-OLYMPUS GEARBOX
1/16 MUSIC WIRE LANDING GEAR
1/8 PLY
3/32 X 3/16 SPRUCE SPARS
1/16 IN RIB
BOTH SIDES 1/16 SHEET BALSA
1/8 PLY
1/8 SQ. SPRUCE
3/32 BALSA SHEET
3/32 BALSA SHEET
1/16 BALSA SPAR WEBBING (VERTICAL GRAIN)
THEN THAT EXPLAINS WHY YOU SPEND SO MUCH OF YOUR FLYING TIME ON THE GROUND.
HERE'S AN AIRPLANE WITH THE RIGHT SIZED WHEELS, ACE. I ALWAYS SAY "THE WHEELS ARE THE MOST IMPORTANT PART OF THE AIRCRAFT....ALWAYS!
CHIPLEY-01

Martin MO-1

Continued from page 62

After checking to make sure all internal parts are in place, glue the bottom in position and sand the edges flush with the sides. Hold the fuselage top-rear piece until later, to make assembly of the control rods easier.

The fuselage should be strong and square at this point.

Fabricate the bottom hatch and the radiator. (Note the deflector vanes inside the radiator that direct cooling air into the opening and around the battery pack.) The hatch allows access to the space behind the motor for Electronic Speed Control (ESC), switches, and jacks.

Wing Leading-edge Hold-down Assembly: Construct the wing center-section on the plan. Do not add the sheet balsa between the center two ribs ahead of the spar yet. Check the fit of the section with the wing cutout in the fuselage.

Cut 1/8 x 1/2 plywood strip and 1/4 x 3/4 balsa backing strip to fit accurately between the center two ribs and against the leading edge. Glue carefully in place. (These joints keep the wing and fuselage together in flight!) Shape the backing strip and the leading edge to fit the ribs.

Cut 1/4 x 1/4 x 1 3/4 balsa pieces, and glue to the insides of the center two ribs, as shown on the detailed view. They should be 1/16 inch below the tops of the ribs at the rear end, and should rest on the leading edge in front.

Cut the front surface of the assembly from 1/16 sheet balsa. Glue the top sheet in place, then add the 3/8 x 3/4 balsa-cockpit front piece. Sand the assembly to match the shape of the fuselage cowl.

The wing hold-down screw hole should be drilled and tapped after the wing and fuselage are finished. (We'll deal with this in the following.)

Wing: Construct the outboard wing sections on the plan.

Notice that the rib at the inboard end is part of the center-section, and the 1/8 square hard-balsa diagonal braces are added when the wing is assembled.

Assemble the three sections, using 2 3/4-inch-high supports at the wingtips to determine dihedral.

The 1/8 plywood dihedral braces are glued to the rear of the spar webbing, between the top and bottom spar. Notice that the dihedral braces are not symmetrical; the thicker end fits in the center-section.

Add the 1/8 square hard-balsa diagonal braces as shown, and glue bamboo cocktail sticks at the leading edge and near the trailing edge through holes in the joining ribs. (Use epoxy on these, since CyA does not wick well into bamboo.) These strengthen the wing joint without adding much weight. Add gussets as shown.

Epoxy the hardwood wing-centering pin to the top of the trailing edge, exactly at the center point.

Check the wing's fit in the fuselage before covering.

Landing Gear: The landing gear is of typical construction, except for the added torsion segment in the front leg and loop in the wire at the center of the rear leg.

Bill turned the lightweight wheels in a hand drill from blue Styrofoam® that had been mounted on small wooden spools. Discs of 1/64 plywood provide side-supporting "hubcaps." His wheels weigh roughly eight grams apiece.

Equipment: Bill used an Olympus 2.3:1 gearbox on the Rocket 400 motor, a 9 x 5 Graupner SlimProp, a Sprite ESC with Battery Eliminator Circuit (BEC), and seven 600AE Ni-Cd cells for power.

The battery tray is drilled and tapped along its length, so the battery pack can be strapped down where necessary for center of gravity (CG) adjustment. (See following instructions for tapping the wing hold-down.)

Mini-size servos were used, and 1/8-inch-diameter doweling was used for the control rods. Bill made control horns from 1/32 plywood.

Control-surface hinges are Mylar™

hinge tape, reinforced at the ends with a few figure-8 loops of thread stitching.

Finishing: The top of the fuselage aft of the wing is glued on after the servos and control rods are installed. The gun turret is shaped from 1/16 x 1/8 balsa strip.

The wing is held down by a #8 nylon screw. With the wing held in position on the fuselage, drill a pilot hole through the cockpit and the plywood piece in the fuselage. Remove the wing, and enlarge the hole in the cockpit. Apply thin CyA to the inside of both holes to harden them.

Wait several hours—even overnight—then carefully tap the hole in the plywood. (Waiting that long allows the glue to harden and yields cleaner threads.)

Shape the fairing pieces on top of the wing to match the fuselage.

On the second prototype, the wing was covered with yellow Litespan and the fuselage and tail were painted gray, except for the elevator surfaces, which were yellow, and the rudder, which carries the vertical red, white, and blue stripes. The undercarriage was painted black.

Flying: The CG should be right at the spar location.

With its light wing loading, this model is a well-behaved and gentle flier. It takes off easily from short grass, but don't expect 45° climbs until it gets up to cruising speed.

Bill typically clocked eight or nine minutes of flight by keeping an eye on trim levels, flying weight, and motor condition.

Acknowledgments: This project couldn't have been completed without the help of the Ann Arbor Falcons members. Their accumulated years of experience and expertise helped us get a flyable airplane, and their encouragement kept our enthusiasm up through the months of design and flight trials.

This experience proves the theory that *our local clubs are a great resource!*

Thanks, guys! MA

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