Electric Challenge The Bipe

By Charles D. Evans

Bi-planes have long been a favorite type of aircraft among modelers. I am certainly not an exception. Remembering the days of the barnstormers, wing walkers, daredevils, etc., I hope to have captured some of the magic of yesteryear.

My Electric Challenge theme is carried out in this endeavor as well as all the other creations to this point. An effort was made to keep the craft's construction as simple and functional as possible. You will notice the lack of compound curves and flat bottom rear portion of the wing ribs, thereby eliminating wing construction problems. 900 sq. in. of wing area allows a good wing loading, necessary to carry the 21 Sanyo N1700SCRC cells. The Astro Flight 40 geared Cobalt motor pulls Electric Challenge — The Bipe around the sky with authority and permits all the aerobatics this old boy can handle. A more proficient or professional pilot could coax a lot more from the "Bipe" than I can. My old reliable Aristo-Craft radio, which has served me well, does the controlling chores. The motor controller designed by friend Phil Thayer, bossman at FlightTec, doesn't miss a beat. Smooth is the word for its control ability. I have a fleet of these controls and haven't had failure to date. Try them, I feel you will like them.

Remember two valuable formulas while building Electric models. KISS -- (Keep It Simple Stupid) and KILS -- (Keep It Light Stupid). Anything you can do to cut down on the weight without compromising the structural integrity of Electric Challenge — The Bipe is acceptable.

CONSTRUCTION

It is my habit to make a kit of parts for

NAME
ELECTRIC CHALLENGE
– THE BIPE –
Designed by:
Charles D. Evans
TYPE AIRCRAFT
Sport Biplane (Electric)
WINGSPAN
50" Top — 50" Bottom
WING CHORD
9-1/8 Inches
TOTAL WING AREA
900 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Modified 2412 (Semi-Symmetrical)
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
3/4" Top — 1-1/4" Bottom
OVERALL FUSELAGE LENGTH
39-1/2 Inches
RADIO COMPARTMENT SIZE
Ample
STABILIZER SPAN
22 Inches
STABILIZER CHORD (inc. elev.)
5-1/2 Inches (Avg.)
STABILIZER AREA
121 Sq. In. (Approx.)
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
8-1/2 Inches
VERTICAL FIN WIDTH (inc. rud.)
5-3/4 Inches
REC. MOTOR SIZE
Astro Flight Cobalt 40 (Geared)
BATTERY SIZE
21 Sanyo N1700SCRC Cells
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
C.G. (from L.E.)
3-1/2 Inches on Top Wing
SIDETHRUST
0 Degrees
DOWNTHRUST/UPTHRUST
0 Degrees
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage . . . . . Balsa, Ply, Pine
Wing . . . . . Balsa, Ply, Hardwood Dowels
Empennage . . . . . Balsa, Ply
Wt. Ready To Fly . 116 Oz. (7 Lbs. 4 Oz.)
Wing Loading . . . . . 18.5 Oz./Sq. Ft.

The author's granddaughter, Elizabeth, with the Electric Bipe.

A MIDSIZED BIPLANE THAT'S NOT ONLY QUIET, IT HAS PLENTY OF PERFORMANCE

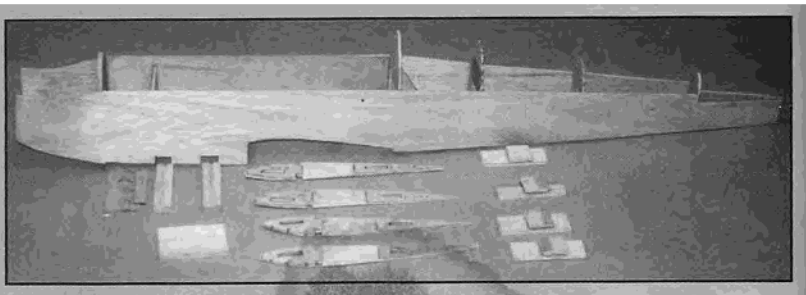
The author with his completed model.

scratch-built model. Next, I construct subassemblies such as landing gear blocks, sides with their doublers, wing ribs with doublers, and any other parts requiring reassembly with the exception of the strut mounts attached to the wing ribs.

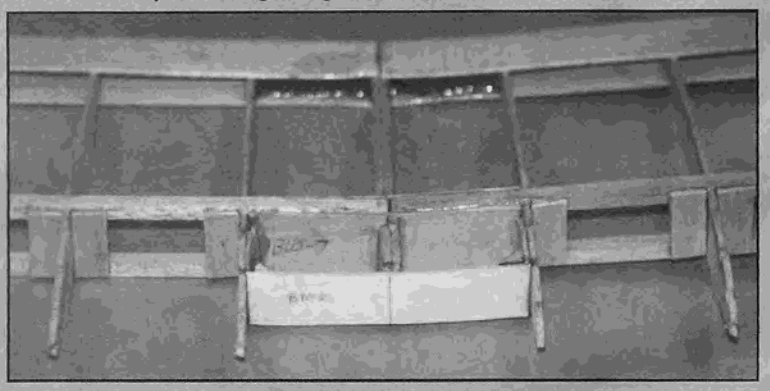
Wings:

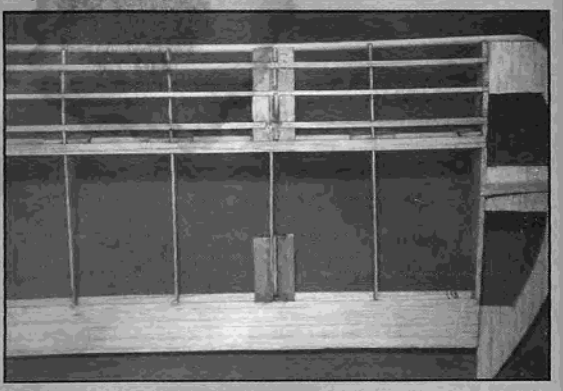
Let's start with the wings because there are two of them. There are no problems here to give anyone with a bit of building experience any trouble.

Starting with the top wing for a beginning point, you will notice that the cabane anchor points require a bit of work. Wing ribs TW-2 have cutouts in the rib and are one



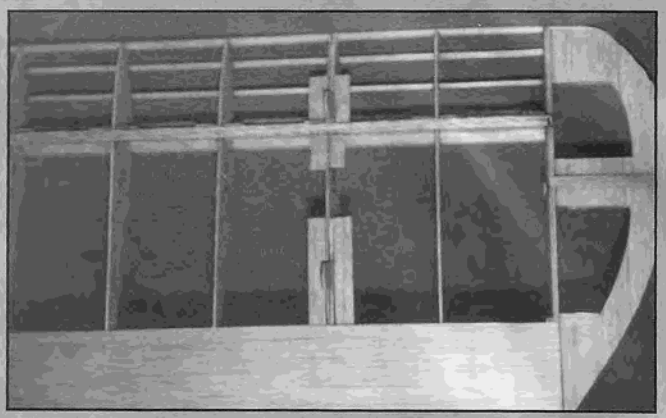
Parts kit is cut prior to beginning assembly. RIGHT: Subassemblies are completed prior to main construction.



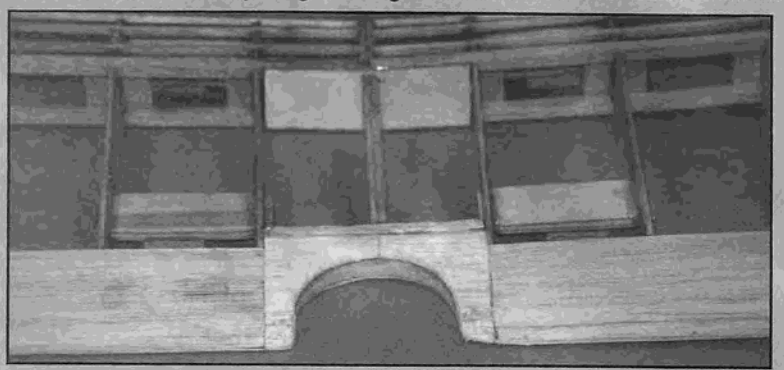


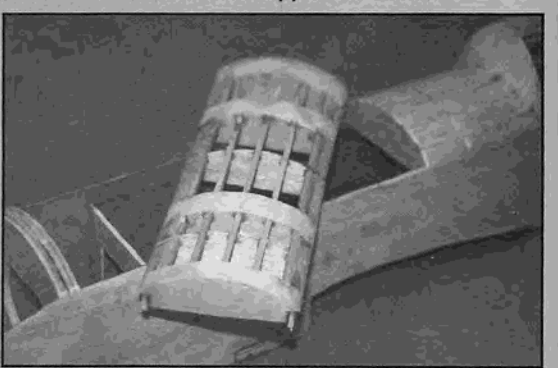
LEFT: Center section trailing edge is filled in to provide anti-crush for wing bolts. RIGHT: Top view of bottom wing with strut braces in place. 1/16" balsa sheet is to aid in covering.

of those subassemblies that is made prior to installation. TW-2A and TW-2B doublers made of 1/32" plywood should be assembled and glued. Notice the lite ply assembly for the blind nut anchor, refer to detail "S". Hold off drilling the anchor bolt hole until mating the wing to the cabane, this is the time to install the blind nuts. After the blind nuts are securely installed, the assembly can be glued into your wing. TWS-1 and TWS-2 are installed when the wing is completed. Just a side note, be sure you keep the grain running in the direction noted on the plans for the wing strut TWS-1 and TWS-2 pieces. Also, saturating the strut mounts with thin CA increases their strength. Drilling of the mounting bolt holes will be done after the craft is completed, but before covering and the "N" struts are built. Notice the 1/16" balsa installed parallel to the strut mounts TWS-1 and TWS-2. Nothing structural here; I do it to aid in covering the wings — this is optional. Speaking of "N" struts, let's build them, they're simple — 3/16" x 3/8" spruce cut per the plan with epoxy glued joints. The holes for the 4-40 blind nuts are drilled at the same time as you drill TWS-1 and TWS-2. Relieve the hole on the inboard side to accept the shank of the blind nut. Press into position and secure the nut with CA. Be careful not to get any CA in the threads. If you do, be sure to run a tap through to clean the threads after the CA sets up. After all structure building is complete, add the balsa filler to the center section aft of W6 and W6-A. Carve to a pleasing shape.

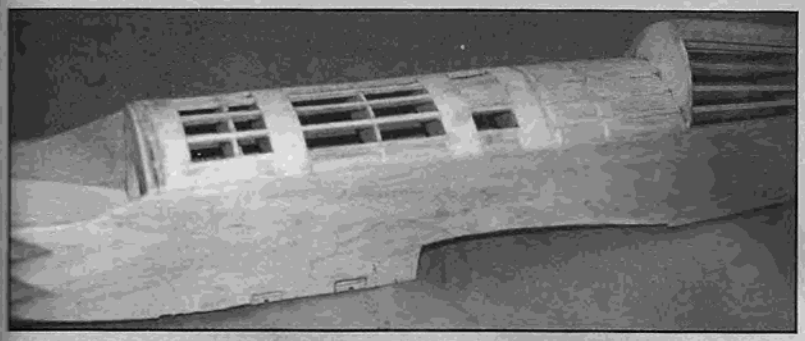


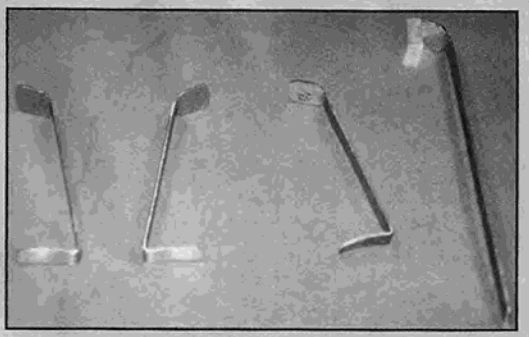
LEFT: Bottom side of top wing showing strut braces and 1/16" balsa sheet installed. RIGHT: Cabane strut supports installed.



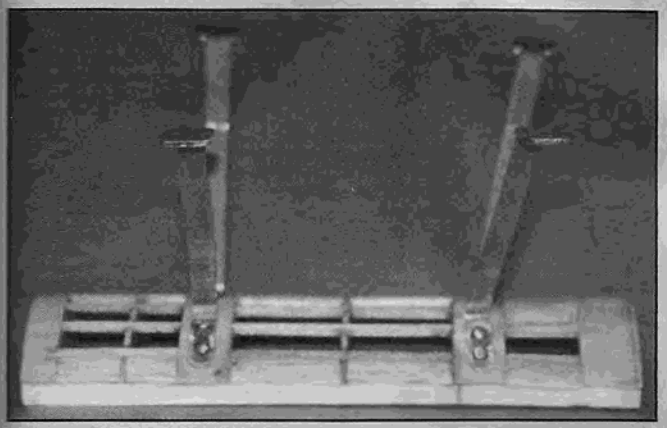


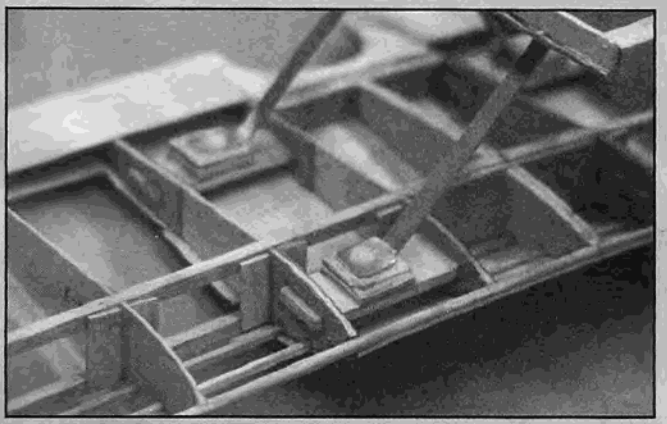
LEFT: Rear center section is filled with balsa, then cut out and sanded to shape. RIGHT: Battery hatch and cabane support. Note 3/4" x 1/2" formers.





Battery hatch installed on fuselage. RIGHT: Cabane struts are made of aluminum. Note lower portion is curved to match the pine formers in battery hatch.





LEFT: Cabane struts mounted to battery hatch. Note angle of rear struts. RIGHT: Cabane is mounted to top wing using 10-32 nylon screws with blind nuts.

Bottom Wing:

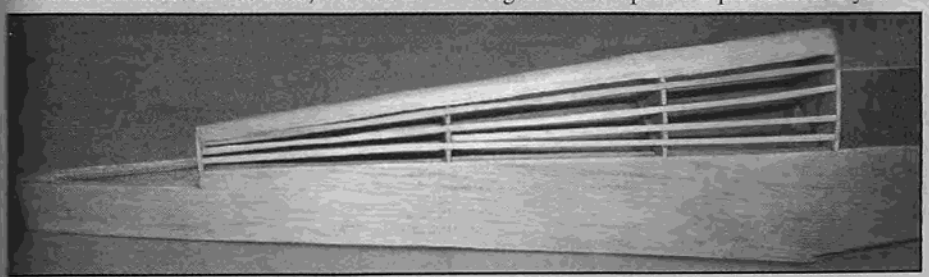
There is nothing out of the ordinary here -- just a few suggestions. Be sure to use the 3/16" sq. hinge backup blocks. The trailing edge is kind of thin and the backup piece supports the hinges very well. Fill in the trailing edge center section with soft balsa blocks. Believe me, you will like the lack of crush when cranking down on the wing mounting bolts. Do not drill the wing hold-down dowel holes at this time, we will do this when the fuselage is being built.

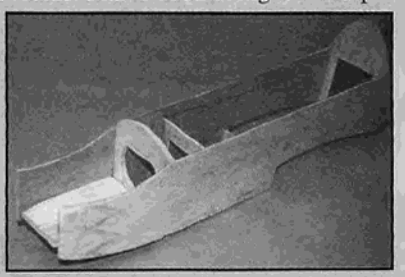
When the assembly of the lower wing is complete, mount BWS-1 and BWS-2. As with the top wing, don't drill the mounting screw holes until mating with the top wing mounted on the fuselage and the "N" struts.

You will notice the short span vertical (shear web) braces between the two 1/4" sq. wing spars. I have found this to be sufficient bracing, and besides it helps to reduce weight. This is a personal preference. If you feel uncomfortable, by all means use whatever is your personal preference.

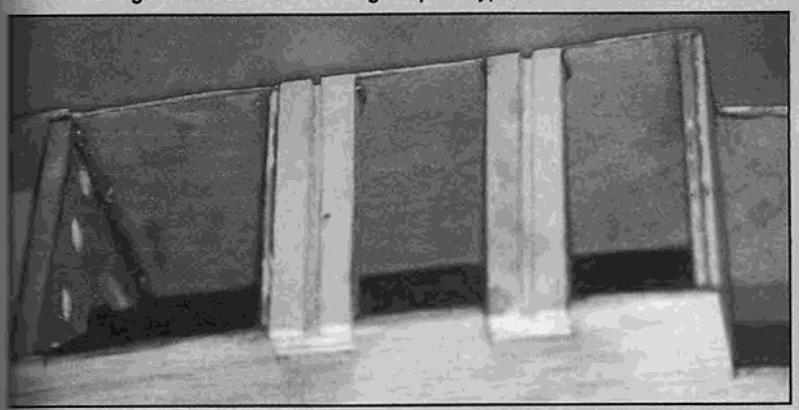
Stab-Elevator-Fin-Rudder:

3/16" sheet balsa is required for all these parts. The only deviation from the norm is the 1/32" plywood on each side of the elevator and rudder to assist in mounting the horns securely, and to give a little extra support for the tail wheel. Mounting the tail wheel as per the plan causes absolutely no problems. I have been using this simple

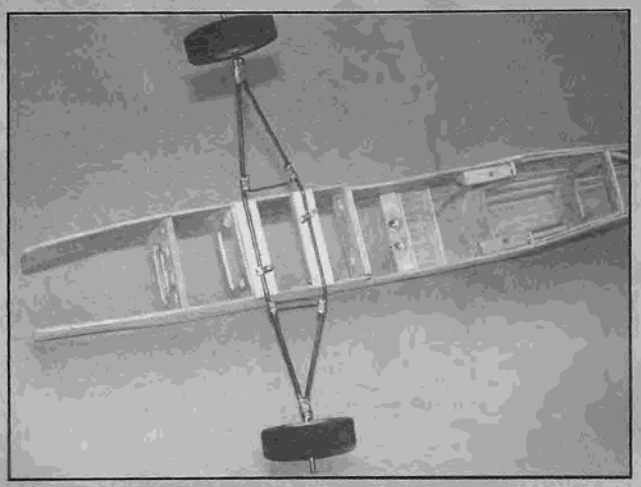


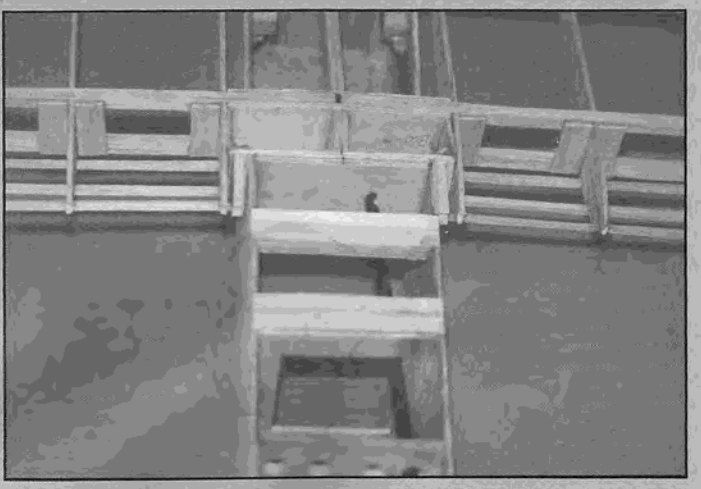


LEFT: Fuselage turtledeck. RIGHT: Original prototype needed to have the nose extended; plans show the correct length for a geared 40 motor.

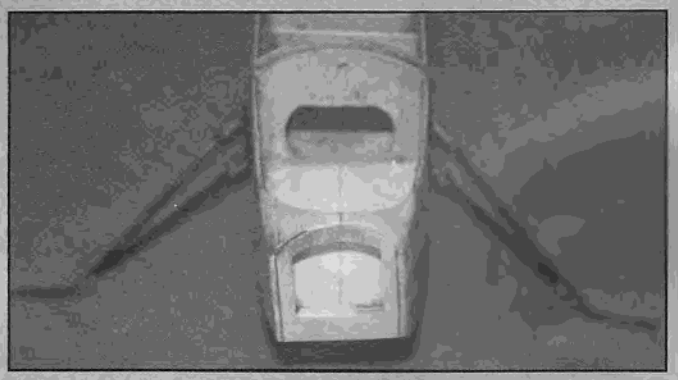


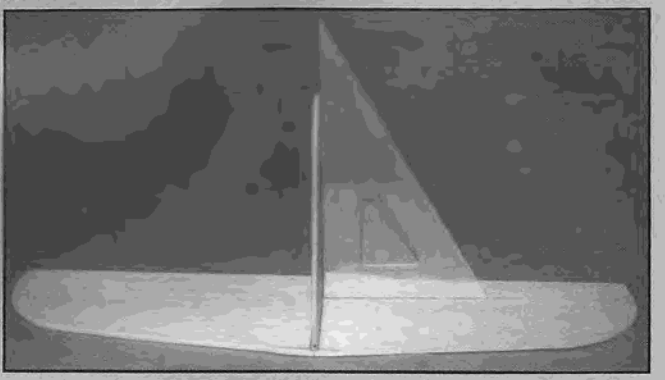
LEFT: Landing gear blocks are installed in the fuselage with epoxy. RIGHT: Prebent landing gear is installed on fuselage, then soldered together with silver solder and copper wire.





LEFT: Wheel should have 2°-3° of toe-in to help assure good ground handling. RIGHT: 12" long drill is very helpful when drilling F3 for wing dowels.



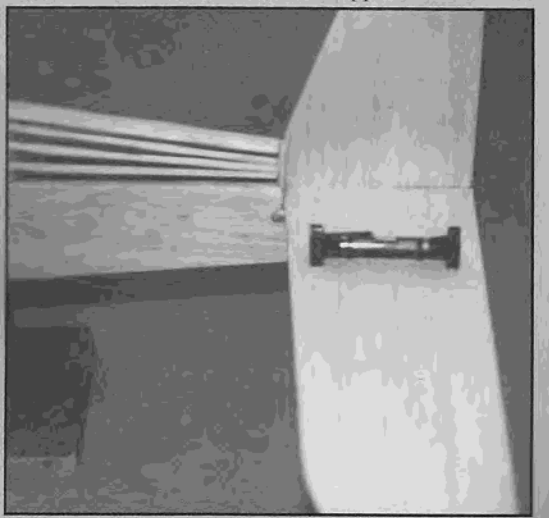


LEFT: Forward end of fuselage. Note 1/8" filler on top. RIGHT: A 90° triangle is used to ensure that the vertical fin and stabilizer are square and true.

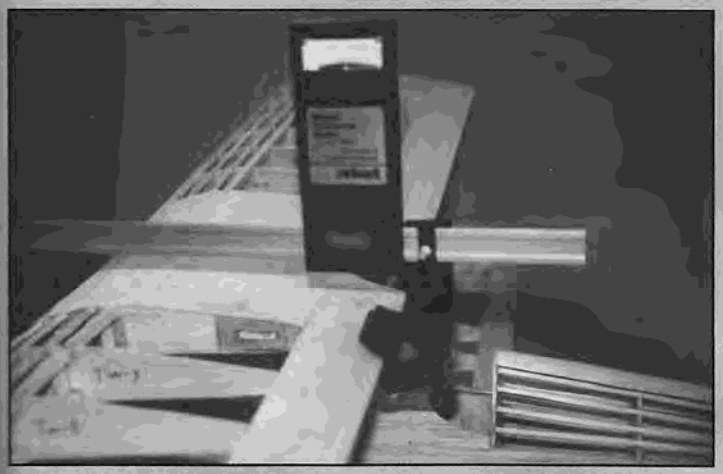
mounting method for years. The lightening holes are for balance — large for tail heavy, small to none for nose heavy.

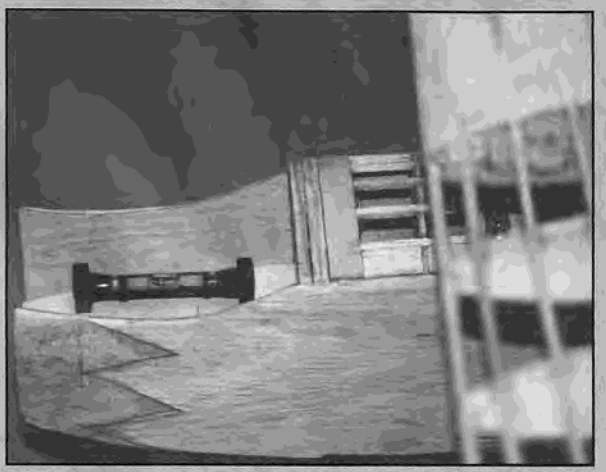
Fuselage:

The first step in the fuselage assembly is to make sure when you glued the doublers to the sides that you made a left and right hand assembly. Now find former F4 and glue it to one side in the position indicated on the plan. Use a 90° triangle to be sure F4 is aligned properly. Next, glue the F3 assembly to the same side, again utilizing the 90° triangle. Now glue the opposite side to F3 and F4. Be sure that the sides are aligned squarely. Let the glue cure. Mate the lower wing to the fuselage, so you will be able to drill the two holes for the wing hold-down dowels. Drill through F3, BW6, and the first BW7 using a 1/4" diameter drill about 12" long. After drilling, glue the fire wall and F2 to the fuselage. Mount the landing gear blocks with the triangle stock called for. Next soak the fuselage sides at F4 with ammonia/water to aid in bending. Add the rest of the formers. Please notice the separation of the doubler at the fire wall and at F4. On the prototype I had trouble bending both the doubler and side, resulting in a crooked fuselage. This fix seems to have solved the problem. Glue the tail post made from trailing edge stock to the rear of the fuselage. Watch for twists and warps. Don't forget to glue the 1/8" square balsa along the aft edges of the fuselage from former to former, both top and bottom. Glue the 1/8" sq. stringers to F4 to F7. Note that F4 and F7 are not notched, requiring a butt joint. A piece of 3/16" medium balsa sheet is now fit between the inside edges at the top of F4 to F7 and forms the top of the turtledeck. Glue into position, then sand to a pleasing rounded shape. The nose section should be soaked to be bent when installing the motor mount. After the motor mount has cured, add the motor mount supports. No need to



LEFT: Alignment begins by setting the bottom wing at 0°. A Robart Incidence Meter works great for this. Note the homemade stand for holding the aircraft. RIGHT: After wing is set at 0°, use a line gauge/level to set the stabilizer at 0°. (Cut, file, or sand as required, but do not disturb the 0° wing setting.)





LEFT: With the bottom wing and stabilizer set at 0°, set the top wing in place and set it at 0° also. RIGHT: The motor mount is also set at 0°-0°.

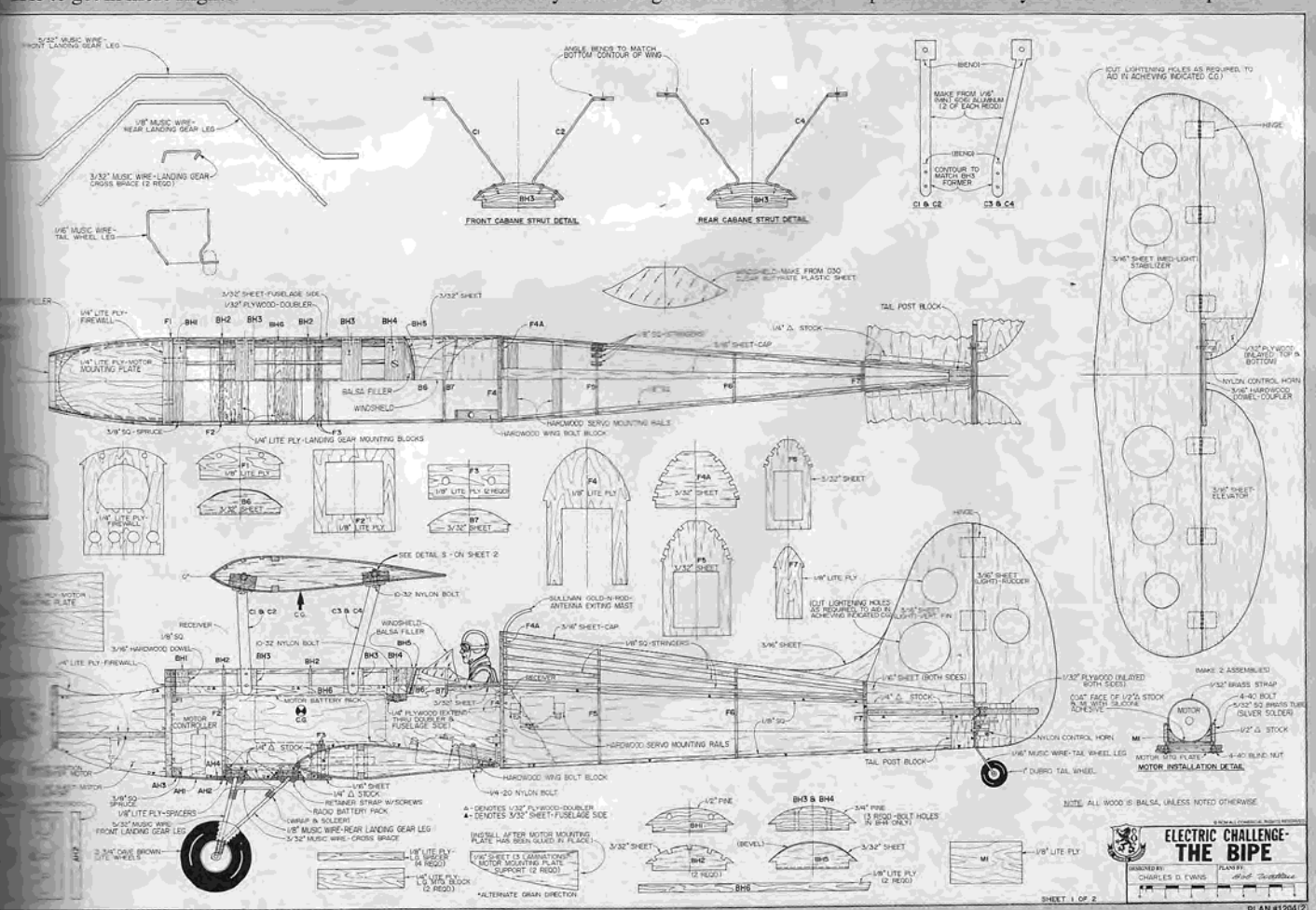
sheet the bottom of the fuselage, this design doesn't need it. Add B6 and B7 that make up the cockpit area. Sheet cockpit area with 3/32" sheet balsa, then sand and cut out the cockpit area. Add the 3/32" balsa cockpit floor. Glue the nose ring in position and sand as required. Install the hardwood wing hold-down blocks for the 1/4-20 nylon screws. After tapping the block to accept the screws, I treat the threads with thin CA to harden the threads.

The battery hatch is next; however, this is not required if you are not a battery changer like I am. I usually have two or three packs and like to exchange them between flights to cool the packs and to be able to get in more flights.

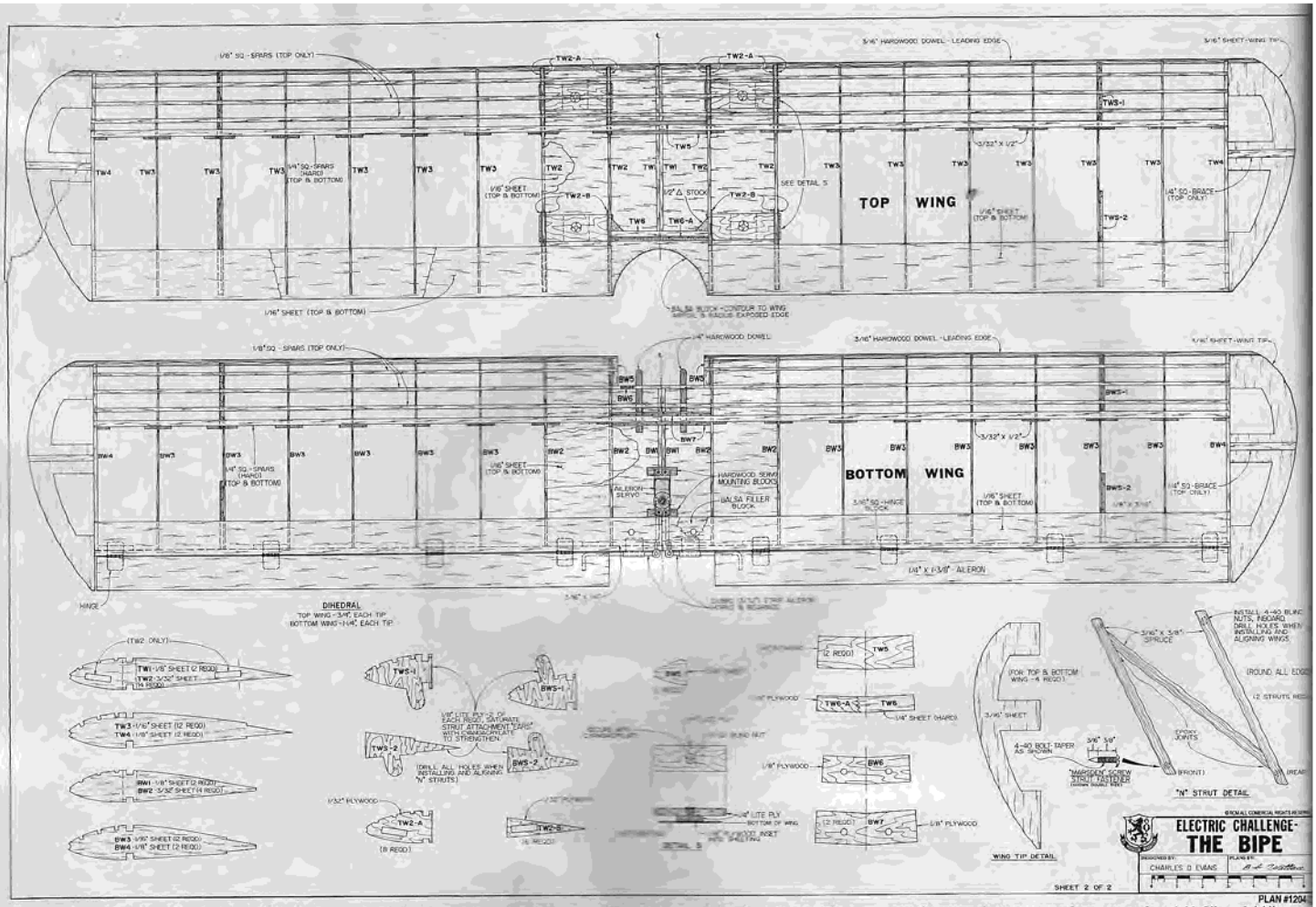
Use the fuselage as an assembly fixture. Line the hatch area sides with plastic wrap or wax paper to keep the hatch from sticking to the sides. The rear hatch hold-down is 1/4" thick ply. Cut the sides and doublers and insert the hold-down in position. When the battery hatch is completed, drill the two holes for the 10-32 nylon hold-down screws. Remove the rear 1/4" ply hold-down block and relieve the two holes to be able to press fit the 10-32 blind nuts into the holes. Attempt to depress the blind nuts so they are level with the block's surface to ease the reinstallation into the fuselage. Glue and sand the fuselage sides as necessary. I find it helpful to run a tap through the blind nuts to clear out any burrs or glue. CA the blind nuts in position.

The cabane struts are the only part of this plane that requires extra care in their fabrication. The aluminum used was easily bent and twisted into the required shapes. First item is to saw the blanks. I used my Sears scroll saw with a metal cutting blade. This sure saves a lot of hacksawing and filing. Next is to bend as shown. Care must be taken to assure the 0° incidence in relation to the lower wing. A good suggestion is to bend and install the front legs C-1 and C-2, then bend and twist C-3 as per plan and install. Make your adjustments to get the 0° and then make C-4 to match.

The landing gear is bent as shown on the plans. Assembly is done on the airplane



FULL-SIZE PLANS AVAILABLE – SEE PAGE 224



using the landing gear blocks as a holding and soldering fixture. Hold in position with Du-Bro metal landing gear straps. Move the front 5/32" gear into proper position, then bend the rear 1/8" diameter gear to fit and match the front gear. Clean with steel wool or sandpaper until shiny, wrap with cleaned copper wire and silver solder. Stay-Brite works very well with a soldering iron. Put the top braces in position and prepare in the same way and silver solder.

The motor hold-down is next with the "V" block first. Glue the triangle balsa pieces to M-1. Coat the inside of the "V" block and the bottom of M-1 with clear silicone sealant to aid in anti-slip. Set aside until cured. As per plan, cut the 1/16" x 1/4" brass strips and form around the motor. Cut four pieces of the 5/32" square brass tubing as per plan. Shine the strips and the tubing and apply a drop or two of flux to each. Clamp the two components together using a clothespin and silver solder. Mount your motor in the M1 assembly, installing your soldered mounting straps in position and drilling the four holes in the motor mount. Relieve the underside of the holes to be able to press in the 4-40 blind nuts. CA the nuts, being careful not to get any CA in the threads. Run a tap through the nuts to eliminate any burrs or CA.

Bill Of Materials

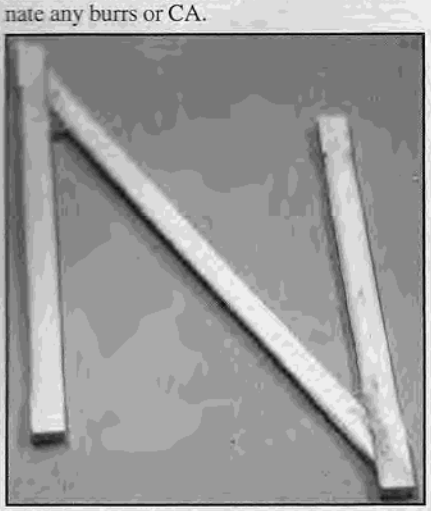
Wings:
8 — 1/4"x 1/4" x 36", hard balsa, Sig
12 — 1/8" x 1/8" x 36", balsa, Sig
6 — 1/16" x 3" x 36", balsa, Sig
4 — 1/16" x 4" x 36", balsa, Sig
1 — 1/4" x 8" x 12", lite ply, Sig
1 — 3/16" x 4" x 36", balsa, Sig
1 — 1/8 x 6" x 12", lite ply, Sig
2 — 3/8" x 3/16" x 36", spruce, Sig
1 — scrap 1/4", balsa, Home Depot
1 — 1/4" dia., dowel, Home Depot
4 — 3/16" dia., dowel, Home Depot
1 — 1/32" x 6" x 12", ply, Sig
7 — 10-32, blind nuts, Home Depot
7 — 10-32, nylon bolts, Sig
8 — hinges, Sonic-Tronic Nifty Hinges
2 — 1/4" x 1-3/8" x 36", aileron stock, Sig
1 — pair, strip aileron horn wires, Du-Bro
1 — pair, strip aileron horn set, Du-Bro
1 — 1/8" x 3" x 36", balsa, Sig
1 — 3/32" x 3" x 36", balsa, Sig

Fuselage
2 — 3/32" x 4" x 48", matched balsa, medium, Sig
1 — 1/32" x 12" x 24", ply, Sig
1 — 3/4" x 12" x 12", clear pine/fir, Home Depot
1 — 1/4" x 12" x 12", lite ply, Sig
1 — 1/8" x 12" x 24", lite ply, Sig
1 — 3/32" x 3" x 36", balsa, medium, Sig
1 — 1/16" x 8" x 12", ply, Sig
1— 3/16" dia., dowel, Home Depot
1 — 3/8" x 3/8", scrap spruce, Home Depot
12 — 1/8" x 1/8" x 36", balsa, Sig
3 — 10-32, blind nuts, Home Depot
3 — 10-32 nylon bolts, Sig
2 — 1/4-40, nylon bolts, Sig
1 — pkg. Gold-N-Rod, Sullivan
1 — 1/16" x 3" x 36", balsa, Sig
1 — 1/16" x 12" x 12", aluminum sheet
1 — 1/32" x 1/4" x 12", brass strip, K&S
1 — 5/32" x 5/32" x 12", square brass tube K&S

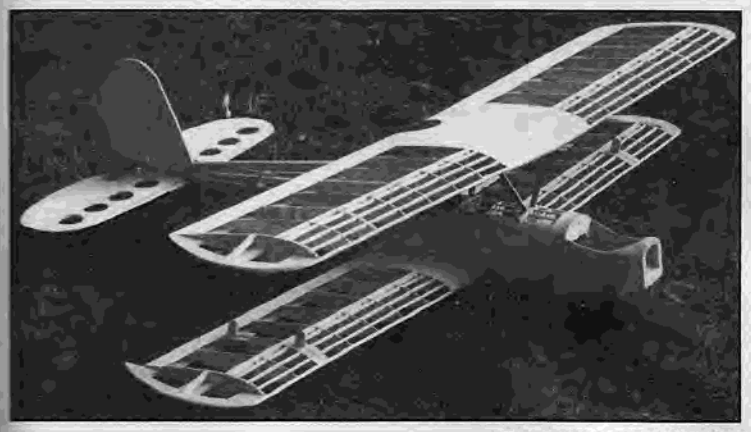
Stab-Elevator-Fin-Rudder
2 — 3/16" x 4" x 36", balsa-medium, Sig
9 — hinges, Nifty Hinge, Sonic-Tronics
1 — 1/32", ply, Sig
1 — 1/16" diameter x 36" music wire, K&S
2 — 1/4" x 1/4"Δ triangle stock, balsa, Sig
1 — 3/16" dia. dowel

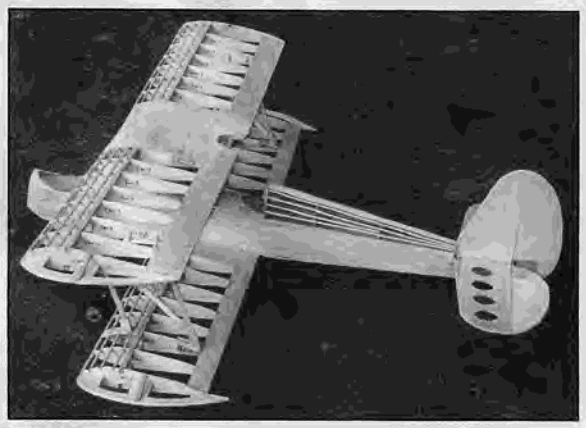
Landing Gear
1 — 5/32" dia. 36" , music wire, K&S
1 — 1/8" dia. x 36", music wire, K&S
1 — 3/32" dia. x 36", music wire, K&S
a/r copper wire, Home Depot
a/r silver solder and flux Stay-Brite

Miscellaneous
1 — pair 1/16" wheel collars, Du-Bro
2 — pair 5/32" wheel collars, Du-Bro
1 — pkg. steel landing gear straps, Du-Bro
1 — Motor controller, SEC-2, FlightTec
21 — N1700SCRC batteries, Sanyo
3 — pair connectors, Sermos
1 — 4-channel radio
1 — pair 2-3/4" dia., Lite wheels, Dave Brown
1 — 1" dia. tail wheel, Du-Bro
CA — as needed, thin and gap filling, Bob Smith Industries
Epoxy — as needed, 5-minute, Bob Smith Industries
8 — 4-40 screws 1" long, flat head used to bolt "N" struts to wing
8 — washers, to fit 4-40



LEFT: "N" struts are made up from spruce pieces, epoxied together, then sanded to shape.





The bare bones! Ready for covering.

Mounting Stab And Fin:

Calculate the center of the stab, then using 90° triangle, draw a straight line from leading edge to trailing edge. Mount the fin on this line and glue. Use the 90° triangle to assure proper alignment. Mount the lower wing to the fuselage, then using a Robart Incidence Meter, level the lower wing to 0° and temporarily mount the stab and fin to the fuselage. Using a line level, adjust the stab to 0°. Sand or shim as necessary, then glue into position. By the way, be sure the stab is parallel with the lower wing before gluing.

Now would be the opportune time to mount the upper wing. The holes for the 10-32 bolts need to be drilled and the blind nuts installed in the cabane uprights and the mounting points. After this is done, hard mount the top wing and, using a Robart Meter, bring the wing to 0°. Shims may be necessary under the upper plate of the cabane struts.

With both wings hard mounted to the fuselage, we can now drill the "N" struts. Put the struts on the inboard side of the strut supports. Drill 1/8" diameter holes through the wing tabs TWS-1 & 2 and BWS-1 & 2 and the "N" struts all at the same time. Be sure the "N" struts are inboard of the strut support. This is the time to make any adjustments should they be necessary. Relieve the inboard side of the holes in the "N" struts so the 4-40 blind nuts can be pressed in. CA the blind nuts securely in position, running a 4-40 tap through the nuts to clear any burrs or glue.

Covering:

Any covering can be used. My prototype models were covered with MonoKote, and the self-stick type for the trim. As mentioned before, the bottom of the fuselage doesn't need any balsa sheeting. Cover all but one bay on the bottom. You no doubt noticed the openings in the fire wall, this is to keep all the working parts cool and the cooling air has to be exited somewhere. I chose to eliminate the bay in which the servos are mounted.

Flying:

Trimming the aircraft is sometimes best left up to the individual pilot, but the set-up shown here yields a stable and controllable aircraft. Toeing the wheels inward a few degrees greatly enhances the tracking under power.

I am very happy the way Electric Challenge — The Bipe has turned out. Believe me when I say, "It flew right off of the drawing board." In all my years of designing models I haven't had one perform as well on the first flight. I hope yours turns out as well as mine.

Post Script.

The Marsden Screw

The 4-40 screws that are used to join the "N" struts to the wings can be a bother to install. I was suffering through the installation and muttering to myself that there must be a better way, when friend and fellow Martin Marietta retiree and club member, Jim Marsden, heard me and came up with the screw shown on the drawing in the "N" strut detail. This really works and is simple to make. Thanks Jim.

From RCModeler Dec. 1995