LEE-RICHARDS

#396

If you want to make heads turn, show up at the field with this FF Scale model. Surprisingly, it's a remarkably stable flier. For 02 electric power. ■ Bill Warner

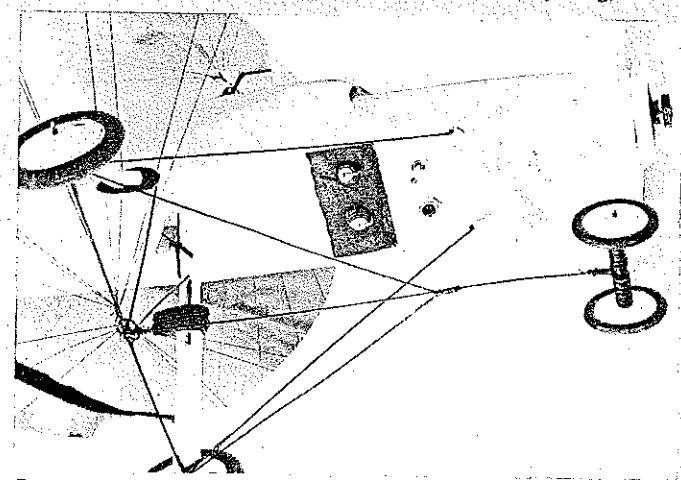
No. 3

"How strange it would be if the solution to the problem of flight presented itself in the form of a wheel!"—Mr. Winston Churchill, 1914.

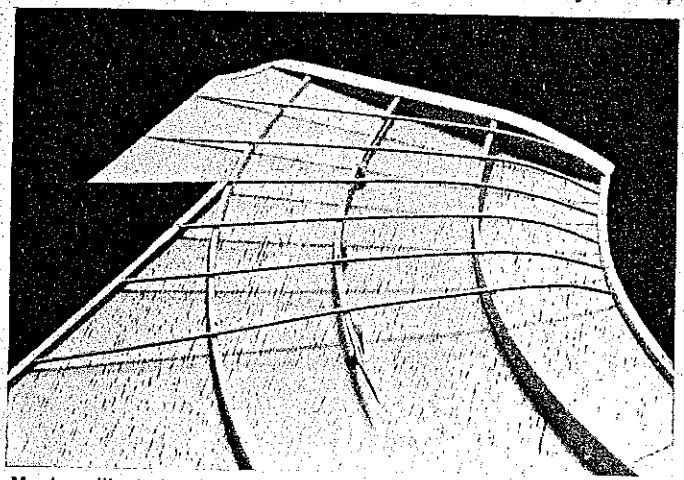
CHURCHILL'S DELIGHT on seeing an aerobatics demonstration flown by the No. 3 doughnut-shaped monoplane was second only to my own as my electric-powered model disappeared into the 4 a.m. darkness at the Sepulveda Basin on its first test flight. Seldom will I get up out of a sleepless bed to do anything, let alone go and test a model airplane, but the L-R was something special.

From its unusual planform to its dead-true takeoff runs to its rock-steady flights, there is nothing quite like it. Besides that, it is really tough to knock off a wing! If *you* are bored with the humdrum of P-51s and Nesmith Cougars, read on.

In 1910, a chap by the name of Kitchen sold a tidy little biplane with two annular superimposed wings powered by a 50-hp

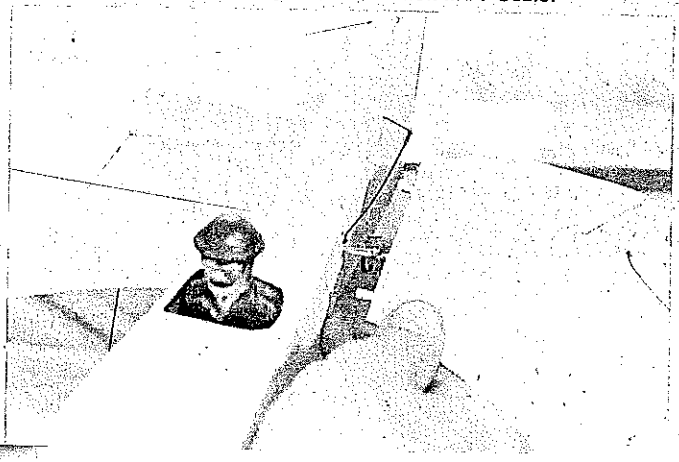


Bottom view shows location of charging receptacle, toggle switch, and undercarriage details. Rectangular black area is the location of the rotary engine that powered the original full-size plane.

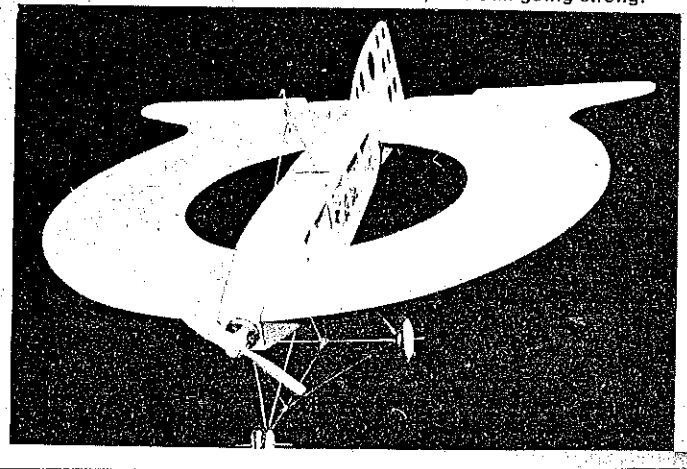


Mock-up illustrates the method of wing construction which involves Hinoki wood strips for the ribs and tapering (in opposite direction) spars. Hinoki ribs are formed over a heated soldering iron.

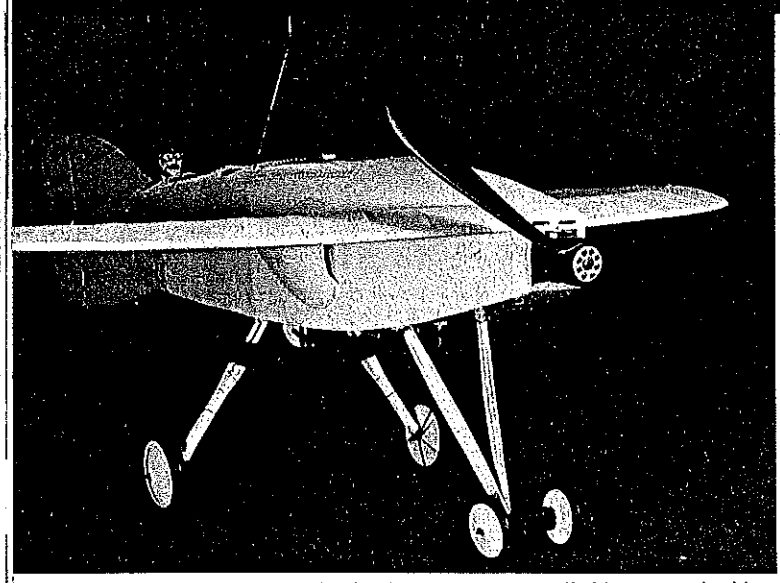
A small rubberband or two hold the wings to the fuselage, while locating dowels keep wings in proper attitude. Paper tube through the fuselage houses rubberbands. This system is common in FF Scale.



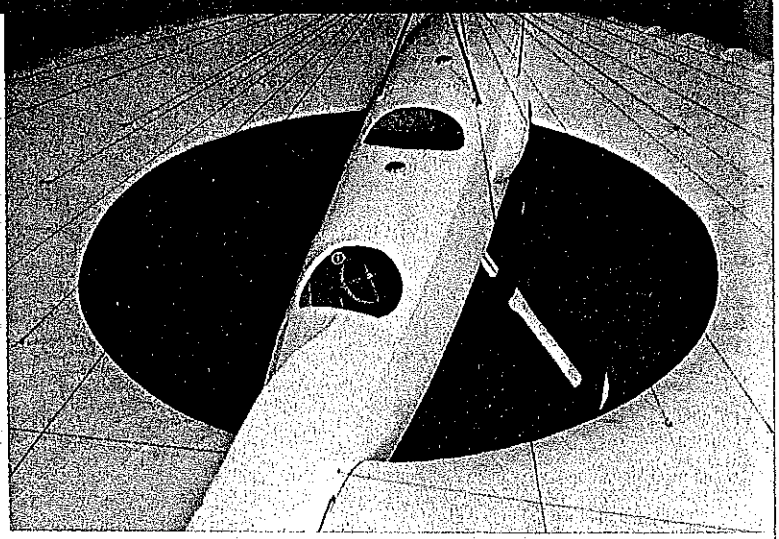
The completed but uncovered structure gives the impresssion of indestructibility. Actually, author's model has been mauled by gusts, has run into and under cars and an aluminum tent pole. Still going strong.



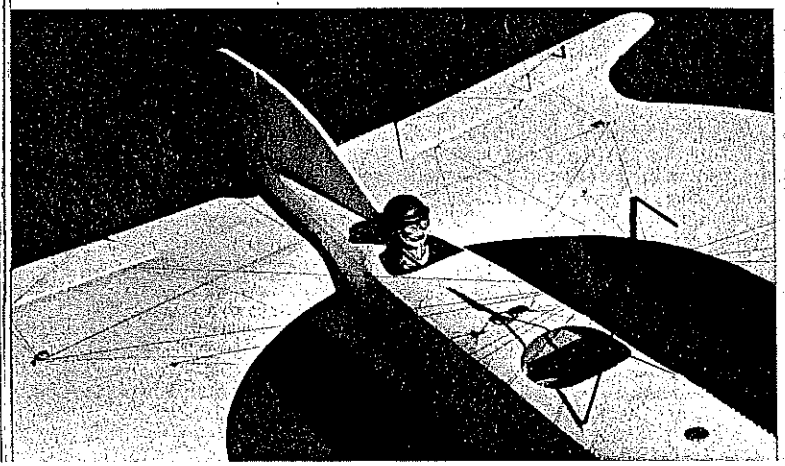
It's certainly a most unusual airplane, you'll have to agree. Yet it flies extremely well. The scale prop adds much to the realism. It's finished in flat black, burnished with a thumb. Protruding bolt/nut assemblies in the hub are plastic from a model railroad shop.

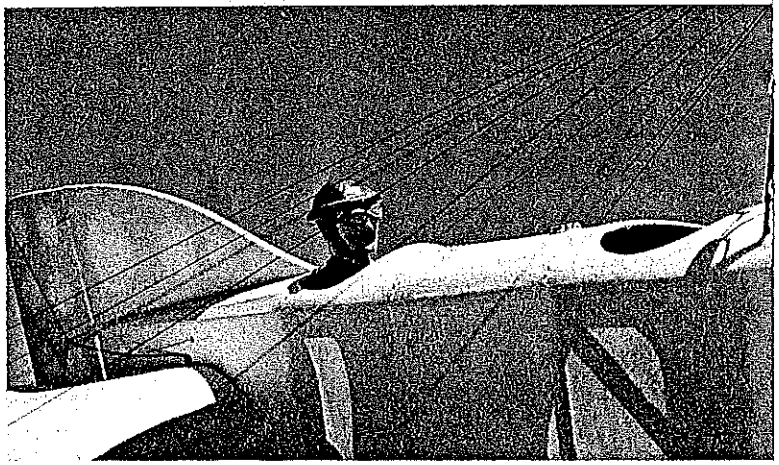


Below: In the early 1900's, elevons were controlled by external cables. The Lee-Richards No. 3 has a huge fin and rudder, which helps make the plane not only stable, but excessively so.



Above and below: Any Scale model benefits from a model pilot figure of the proper size, and this one is no exception. Cockpits in pre-WWII days were sparsely furnished, often by the pilot, himself, who carried with him his own altimeter and compass. Science Museum in London has much documentary info.





Gnome rotary to a well-to-do textile manufacturer and engineer, Cedric Lee. Lee, a member of the Manchester Aero Club, asked George Tilghman Richards to lend his engineering expertise to the project of developing the Kitchen machine. This dynamic duo embarked on four years of work which produced model and full-size aircraft with the annular wing concept culminating in the very successful No. 3 which Churchill saw in flight.

Unfortunately, the outbreak of World War I ended the partnership (with Lee's death) and the firm, due to the traditional conservatism of the British government. Lee's machines were always wrapped in secrecy, due to his . . . "Orwellian vision of hosts of annular aeroplanes guarding the shores of Britain against an enemy."

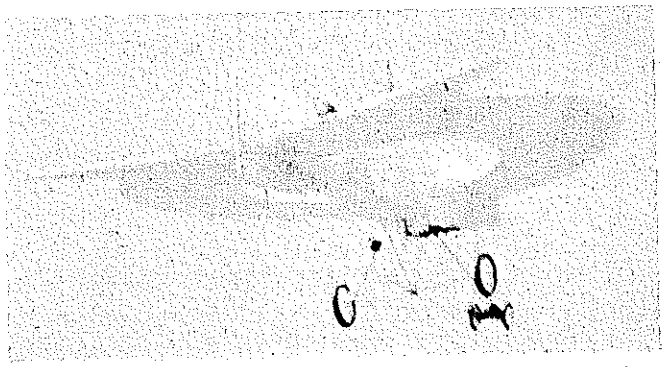
Believe it or not, the greatest fault they found with the plane was its "excessive lateral stability!" What is amazing is that someone has not pounced on the design long ago as a standby model or homebuilt and given it the popularity of the Lacey M-10 or the Vari-Eze. There is plenty of information on the L-R and the research that preceded it in the Science Museum in London—due to the fact that Richards was associated with the museum for over 30 years. Even "in-flight" films exist. In the future, Lee's ghost will, I hope, be happy to see scores of annular-wing models purring contentedly among the clouds!

Prior to the electric version, I built the L-R in Peanut Scale size and flew it with both the Brown CO-2 and with rubber power. Having satisfied myself that it had no serious faults, it seemed only natural to try an electric one. Bill Hannan says there is a diesel-powered L-R in the London Science Museum, though I have not seen it, which would suggest another form of power for those who like really long and high flights.

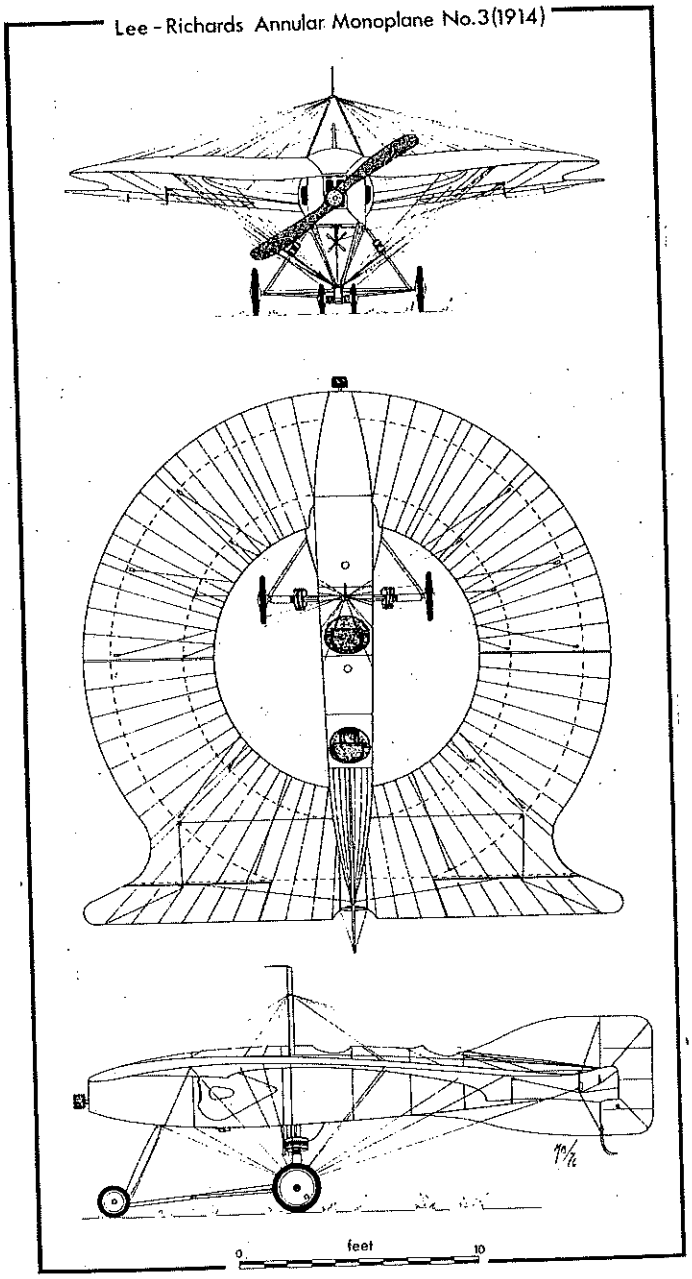
Fuselage construction. A normal "box" fuselage, using medium ⅛ sq. stringers with light cross-strutting and *lightweight,* inset sheeting on the sides (⅛-in. 4-lb. balsa typical, or thinner if you have access only to harder stock). The fuselage need not be as strong as you would think due to the bracing effect of the wing. A soft balsa block forms the motor mount, with the rather large hole being made using a round rasp with a screw-threaded tip that doesn't even need a drill to get started. Once this block is in place between the sides, the box is finished and the "f" formers can be added to the top.

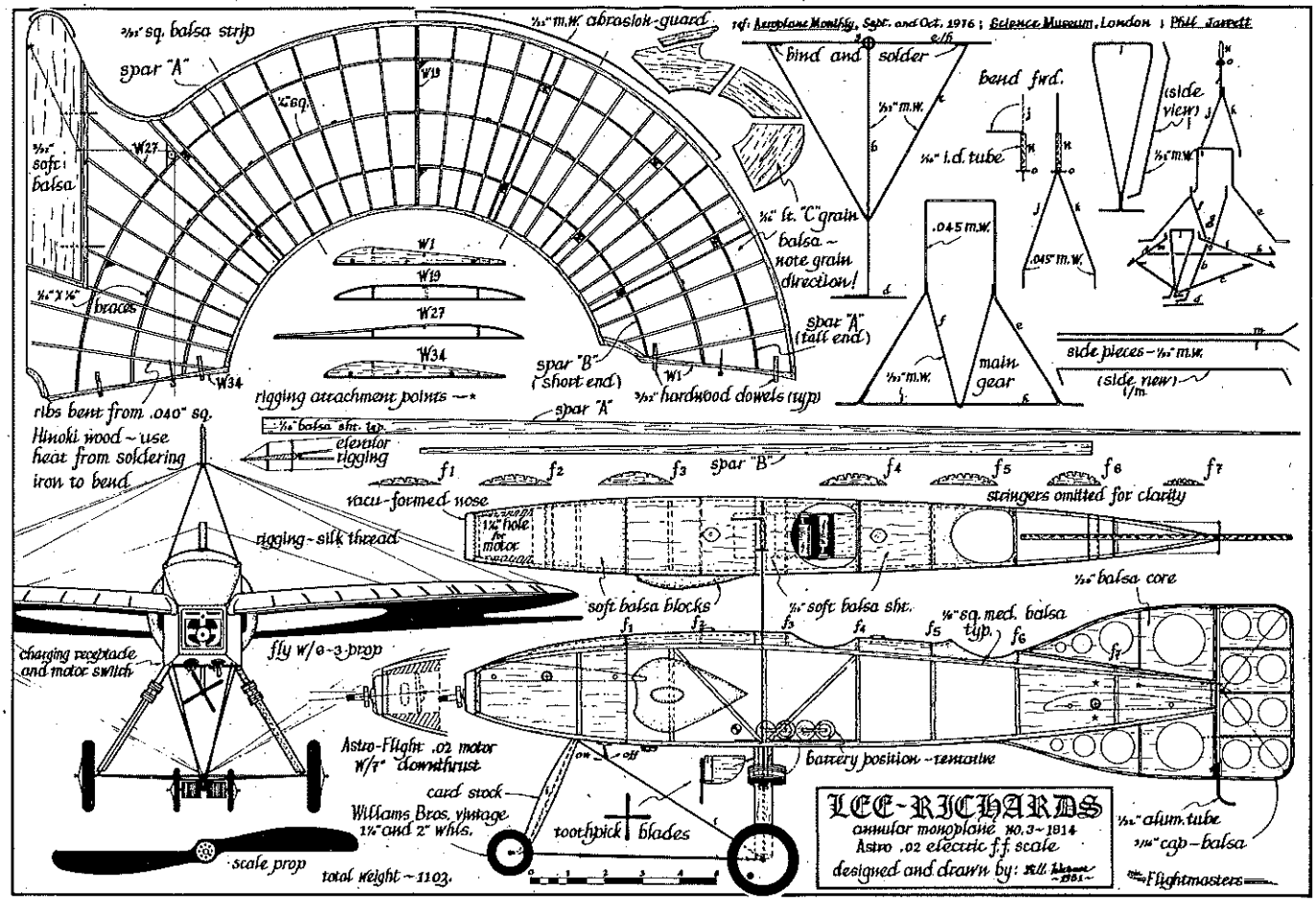
Using soft A-grain balsa, sheet the area on top from f-1 to f-5. Tack-glue soft balsa blocks on top at the nose and rear cockpit. Shape, remove, hollow-out, and re-install permanently. The bottom from nose to the charging receptacle and toggle-switch location can be sheeted after the undercarriage is in place.

The nose piece was vacu-formed over a balsa block, but it could be built-up easily from thin plastic or card stock. Make sure the openings in the front and behind the motor are not obstructed, as electric motors need lots of cooling air. We threaded a couple of nylon ¼-in. screws into the block, reinforcing the balsa threads with Hot Stuff.



Above: Author's Lee-Richards No. 3 in flight at the 1980 FAC Nats, snapped by Tom Schmitt. Except as identified, other pics by the author. Below: Artwork for T-shirt that Bill Noonan presented to the author prior to 1980 FAC Nats. Right: Three-view from *Aeroplane Monthly.*





They held the motor OK, but wedging the motor in (using masking tape or balsa shims) would probably be less trouble and work just as well.

Fin and rudder. Use light (4 to 6-lb.) C-grain sheet for the cores. Cut out the lightening holes, and then build up the framework on both sides using 1/16 sq. with 3/16 x 1/16 around all edges. Attach the rudder with three lengths of 1/32-in. music wire. The 1/32-in. aluminum tube tail skid was bent with a piece of 1/32-in. wire inside to prevent collapsing. Epoxy the tail skid to the rudder. Add a bit of scrap at the place the control horn goes through, and sand the entire tail assembly flush, leaving at least 1/32-in. clearance on each side to keep the tissue from sticking to the core when it is covered.

Undercarriage and kingpost assemblies. All wire assemblies on the plan are shown true length. Everything with the exception of the main gear (e) and kingpost parts "j" and "k" were made from 1/32-in. music wire. The aforementioned parts are .045-in. dia. If you crash a lot, take the gamble and use .045-in. for parts "b," "i," and "d," also. Bind all joints with fine brass wire, and solder with Sta-Brite, remembering to wash off all the acid flux to prevent rusting later. Epoxy the undercarriage in place; add triangular gussets on the underside at the main gear for strength. Sheet the area underneath from the nose to conform with the area covered by the side sheeting.

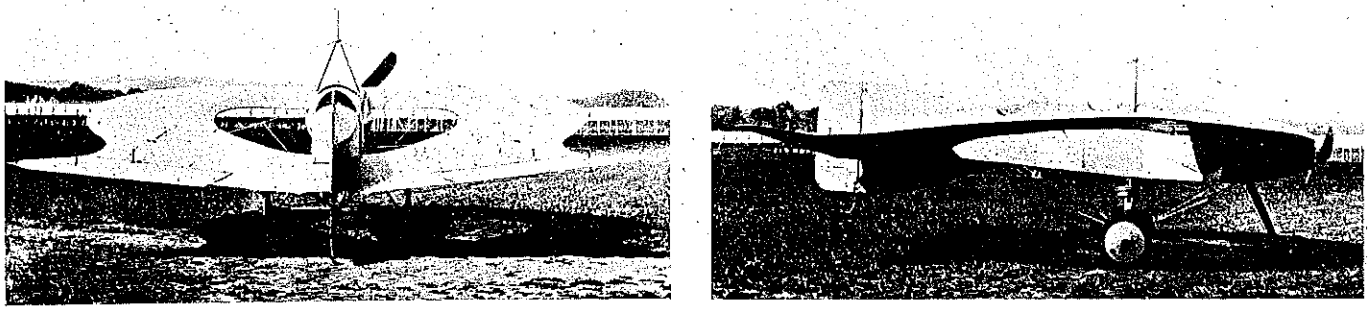
You can now install the charging receptacle and engine toggle switch. The front landing gear legs are built-up by sandwiching the wire between two pieces of card stock. The rear landing gear legs are thicker; a balsa sandwich is glued on, then streamlined to a teardrop section.

The kingpost upper ends are inserted in a 1/16-in. brass tube which is then flattened a bit and soldered. The purpose of the ring "O" is to facilitate rigging, and it may be left off if you wish. Insert the kingpost through the sheeting, and epoxy it in place. Bend the top portion above the brass tube 90° forward, and you are home free.

The wing is made from three parts which form a "floor" on which everything else is built (see diagram on plan). Use 1/20 or 1/16 lightweight C-grain sheet for this, paying attention to the grain directions as shown. Add the 3/16-in. solid ribs at each end, and build up the leading and trailing edges by cementing on flexible 3/32 balsa strip. Mark the positions of the spars on the "floor," and glue them in place. Super Jet or Super-T cyanoacrylate cements are ideal for the installation of the spars.

The *tall* end of Spar A goes against Rib

Continued on page 88



Dihedral in the original plane, plainly visible in the left picture, made it too stable. Shown here is 5° in each side—later is was reduced to 1½° for better pilot control. Side view at right shows lighter coloration in areas housing the oil and fuel tanks. Photos from Science Museum, London.

W-1. The *short* end of Spar B goes against W-1. This makes for a happy arrangement whereby the airfoil has a smooth and constant transition, so that one winds up with the nose of the rib pointing forward in the front of the wing—and also in the rear. The original plane had a more abrupt transition, with the shift of the high point toward the center hole well in advance of the point 90° to the airflow. The model is a bit simpler. Purists may obtain the data from the Science Museum and tackle the problem on their own.

Just in case you are out of Hinoki wood, you can send a check for $2.50 to Mike Mulligan's Old-Timer Models, P.O. Box 913, Westminster, CA 92683. A packet of 25 strips, 17 in. long will arrive on your doorstep in a few days. That is barely enough, so be careful with it. Hinoki wood is strong, light, and bends well when wetted. Wet one end of the Hinoki strip, and form it over the large diameter of a heated soldering iron—pulling it back and forth while bending it so as not to burn it.

Cut each rib to proper length, and glue in place between L.E. and T.E. and down onto the spars. After all the Hinoki strips are in place, add a length of 1/16 sq. balsa up under the center of the ribs (equidistant from the spars), and glue to each rib in turn. Scrap balsa glued in at the starred locations will give you places to install your rigging after covering. Sand wing so that the airfoil shape continues around a nicely-contoured L.E. and T.E.

The "elevator-cum-aileron" can be added with the help of two pieces of 1/32-in. music wire and sanded to the correct tapered profile.

The locating pegs and rubber hooks can now be added at W-1 and W-34. Bend the far end of the hook wire (1/32-in. music wire) down 90° to better hold it from pulling out. Build the second wing "back to back" with the first so you won't be tempted to make two left wings. Music wire "abrasion guards" can be added before covering to protect the L.E. and tip of the elevon if you are going to be flying over asphalt.

Power plant. Follow instructions carefully for hooking up the Astro-Flight 02 electric motor. I prefer to arrange the batteries longitudinally on the bottom of the plane rather than in the little "four-pack," holding them together with Magic Mending Tape and Hot Stuff. Don't glue the batteries down just yet. That is the last thing you do before going out to fly. The location of the batteries determines the correct center of gravity without adding any additional weight to the model.

Leave a couple of inches of wire at the motor and at the batteries so that each can be extracted for service. A clever little air-conditioned battery box would be nice, but I do things the hard way and have to cut into the tissue to replace batteries. I take a portable soldering iron to the field and make sure everything is soldered on. I do

Continued on page 144

Lee-Richards/Warner

Continued from page 88

not like push-on connections, having had some bad luck with them. Test the motor/battery system before covering the model!

Wing attachment. Using a paper template, mark the position of the bottom of the wing on each side of the fuselage lightly in pencil. Push the wing gently inward at that place so as to leave the indentations from the alignment pegs and wire hook in the sheeting. Remove the wing, and drill receiving holes for the pegs in the fuselage. Roll a typing-paper tube around a length of 3/16-in. dia. brass tubing using Testors wood glue (or similar) to hold it together. Make a hole of sufficient size to accommodate one of these at the front and one at the rear of the fuselage, and glue them in, trimming flush with the sides.

The rubberbands which pull the wings together onto the fuselage are then passed through these tubes with the aid of a piece of stiff wire with a small 90° hook bent on the end so as to slide easily out of a tightly-stretched rubberband once the attachment is made to the opposite wing. Don't worry about the wings drooping, as the rigging will take care of that.

Covering. We used silkspan (lightweight) and covered wet, leaving only the bottom of the wings uncovered to save weight. The only difficulty you may encounter will probably be in the area of the hole of the doughnut. Covering in segments of a few ribs at a time and covering wet will solve any difficulties which you may encounter in this regard.

Finishing. Seal the tissue with nitrate dope, the fewer coats the better. I guessed at the finish, trying to give the impression of the period rather than trying to approximate the original. The rivet heads were simulated a la Dave Platt with a tiny drop of white glue applied for each with the squared-off tip of a hypodermic. If you haven't done this before, practice a while before doing your model.

I decided to make rivets around the panels covering the fuel and oil tanks and around the nose as well as down the panel from f-1. It adds some variety to an otherwise bland model finish which lacks the easily-obtained visual interest of WW I markings. The "metal panel" areas were additionally sealed with talcum powder/nitrate dope mix and sanded smooth with 400-grit wet-or-dry paper.

I decided on cream color for the sheeted areas, dull-gloss white for the panels around the cheek cowls and on the sides between the cockpits, with the rest of the model finished to simulate unbleached muslin. This concoction involves adding instant coffee which you have mortar-and-pestled very fine to some white dope with just a touch of brown added. When painted on, the texture can be enhanced by going over the surfaces lightly with a dampened bit of cloth to give a light "streaking" effect—vertically on the sides, radially on the wings. Spray lightly with Testors Dullkote, if you live in a damp area, to prevent further action.

Detailing. The wind-driven generator, fuel and oil caps, cowl cheeks from hollowed soft balsa, dummy rotary cylinder heads, scrap balsa and cord-wrapped shock absorbers on the undercarriage, control horns, etc., can now be added. The rigging is tedious but simple.

"Wires" that hold the wing up are made from silk thread or surgical suture thread. They run from little upside-down Us of .015-in. music wire Hot-Stuffed down into each starred attachment point (note: don't paint little stars on the model!) to the ring "O" on the kingpost. Holding the wings up with blocks with about 5° dihedral in each side while rigging is about right.

Making a little hook for all the wires on each side to attach to and then hooking them all on at once will make de-rigging and re-rigging easier.

On the bottom of the wing, do the same, except make two hooks for each side—and instead of hooking them directly to the attachment ring "g," attach them with rubberbands to keep tension on the "wires." The reason for two hooks is that you will find the lower threads have to go on opposite sides of the landing gear, and you'll need a hook for each group of "wires."

Rig the control "wires" for the elevons and rudder as shown on the plan. Both sides are the same.

Flying. After locating your C.G. by shifting the batteries as shown on the plan, Hot-Stuff them in place. Charge the batteries about one minute at 2 amps or at the low position on the Astro-Flight charger.

If you have tall grass, hand launch. If you have asphalt, R.O.G. If the elevators and rudder are neutral, the model should fly. Correct any diving tendency with up elevons (bend both up only a *tiny bit*, and equally). Stalling can be cured by adding modeling clay to the front wheel strut intersection.

When the model is flying in a wide left-hand circle, it is happy. If you have to add clay, note the final balance point and move the batteries forward to compensate.

For contest flying and most normal flying, a two-minute charge at 2 amps will be adequate. You can go more, but why risk blowing batteries at today's prices? Improved performance can be gained by using the Sanyo ¾-in. Ni-Cd pencells (4), or using a weak .049 glow engine.

If you have not been able to keep the weight down to somewhere near 11 oz. for the electric model, the glow engine solution might be the way to go—but don't forget the fuel-proofing!

Finally, if anyone makes a crack that it looks like a "flying toilet seat," either poke 'em in the nose, or tell 'em it's really an annular wing, which, in the words of Dr. Dzus of Escondido, means it comes around only once a year!

Orange Box/Smalley

Continued from page 76

sponge rubber. The switch can be mounted just behind F3. Pushrods can be either hard balsa or tube-and-cable with adjustable clevises for fixing to variable-throw horns.

Flying. It is easier to learn to fly this type of model from a slope, but do enlist the help of an experienced pilot if this is your first RC model. This form of flying gives more airspace beneath the model and, hence, more time for errors to be corrected. Longer flight times also help give continuity to embryo piloting—without the panic of constant landings from hand-tow or high-start launching.

Choose a calm day for the initial hand test glides, which should take place on a flat grass field. Check the center of gravity position, and start with the stabilizer packed up under the leading edge with a piece of 1/16 x ½ x 1½ balsa. Gently throw the model into the wind—aimed at a point about 30 ft. ahead, and have the RC switched ON. However, don't use the RC unless something is seriously wrong, as it could give a false indication of the flight path.

Adjust the nose weight or elevator incidence until a steady descent is achieved with the elevator at neutral. When satisfied, first flights from the slope may be attempted.

Wait for a day with a gentle breeze blowing directly at the slope face. Check to see that the controls are working correctly, and launch the model—wings level and nose slightly down—with and smooth push and follow-through. Keep model heading straight out from the slope. If the model does not gain height, or if it sinks below the crest height, do not attempt a turn until at least 50 yards in front of the slope—then make a landing at the bottom of the hill. *Never* turn back toward the slope unless well above crest height, and then only to make a landing on the hill.

Turns should always be made into the wind, and progress forward should be made in a series of "S" turns with the model never more than sideways to the hill. When the model is correctly trimmed, it will slowly penetrate into the wind and gain height in a steady, level manner.

If the conditions vary during an afternoon's flying, don't be afraid to land and adjust the stabilizer incidence or nose weight to give optimum performance. Initially it is always safer to fly the model in a slightly nose-heavy condition. The model will then fly faster and give good control response.

For hand-tow flying, use a 75 to 100-ft. length