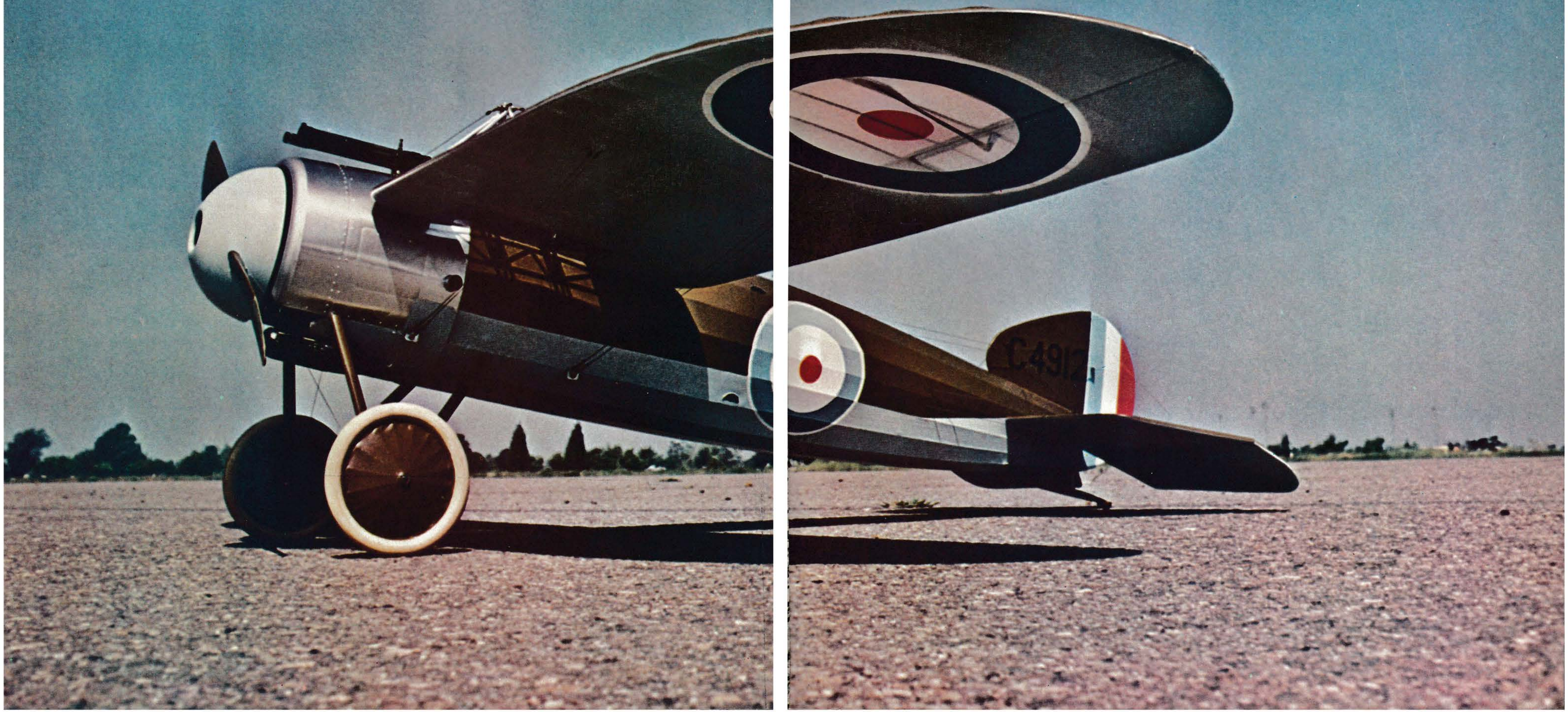
FASTER THAN A SPEEDING(?) BULLET!

A quarter-scale WW I monoplane for those who love slow, majestic flight.

By Harry Apoian J. R. Naidish photos



The Bristol "Bullet" was, for the World War One era, an advanced airplane that was well liked by the pilots. The prototype was completed in July of 1916, based on the design of Captain Frank Barnwell. On trial flights, the M.1A (with the 110 hp LeRhone rotary engine) reached a maximum speed of 132 mph and proved to be very maneuverable. Being a monoplane, it was the cleanest airplane that was possible to build, by 1916 standards. The "Monoplane Committee" of the Royal Flying Corp was convinced that the monoplane design was inherently dangerous, and did not buy them. This was mainly the reason that the M.1A was not used on the Western Front.

Subsequent improvements to the M.1 (Models M.1B and M.1C) included better visibility by adding wing windows, mounting a synchronized gun, and providing for better engine cooling. Static tests proved the wing was capable of 8.8 Gs. But, in spite of the advantages over contemporary airplanes, the M.1C was not ordered into production until August 1917, due to official indifferences. "Limited endurance . . ., Difficult to fly . . ., Excessive landing speed . . .", these were noted as deficiencies that stalled production and relegated the M.1C to noncombat assignments. Of the 125 that were built, 35 were sent to the Middle East where they were involved in minor combat activities. The remaining M.1Cs were used at flight training schools.

After the Armistice, civilian versions of the M.1C were used quite successfully for training and for racing, as late as 1932.

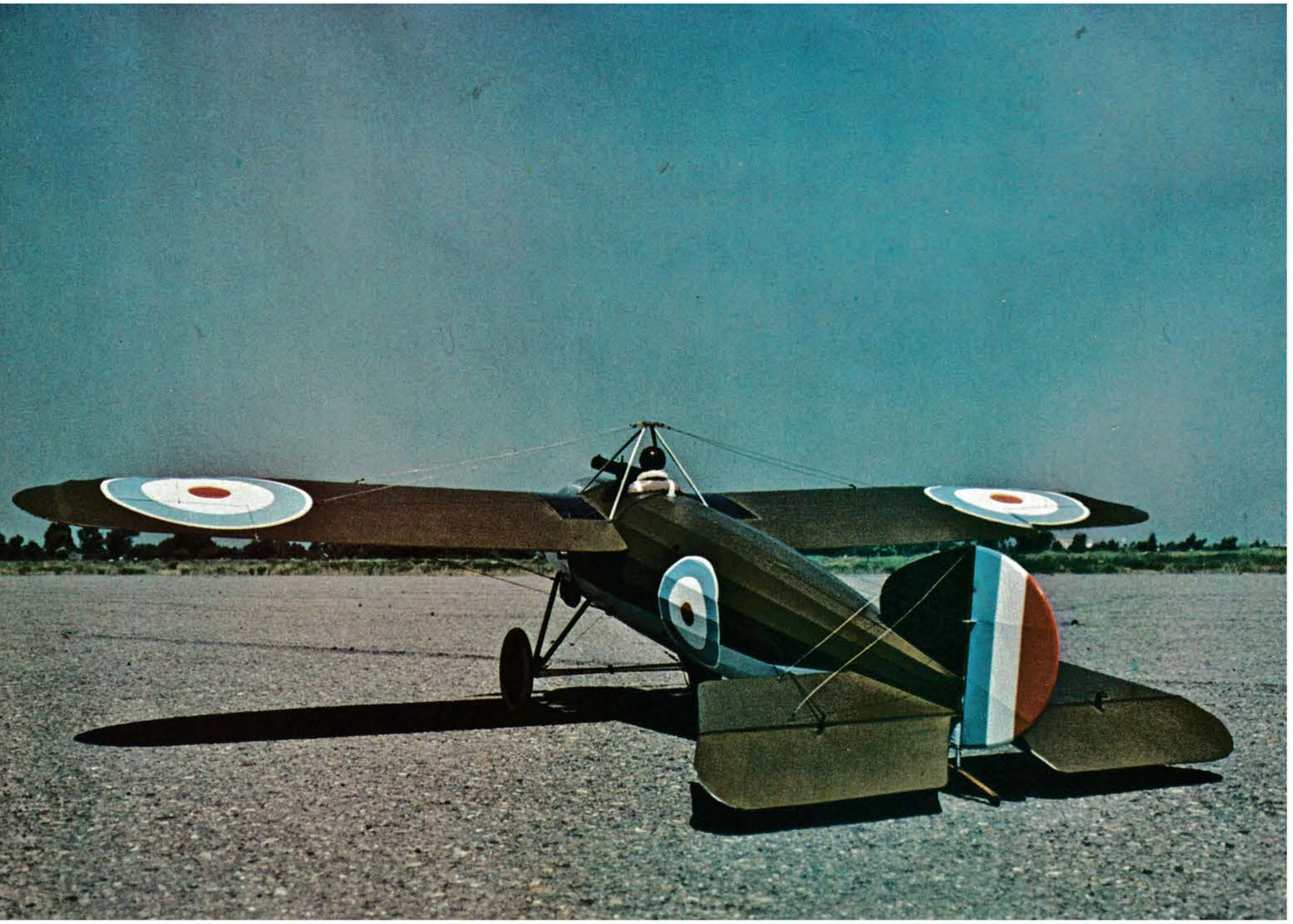
Before discussing any details about building the model, there are some specifics that are important in achieving an optimum performance airplane. First, the M.1C model is relatively complex, because there's lots of handmade hardware peculiar to the plane. These will be itemized in the appropriate construction sections. Secondly, model weight is very important . . . don't overbuild and don't consider using chainsaw engines. A 12-pound model with a Tartan 1.3 or a SuperTigre S 2000 will give you a 22-ounce-per-square-foot wing loading. Thirdly, Profile Publication #193 shows many color schemes that can be used to give you a personalized Bristol M.1C.

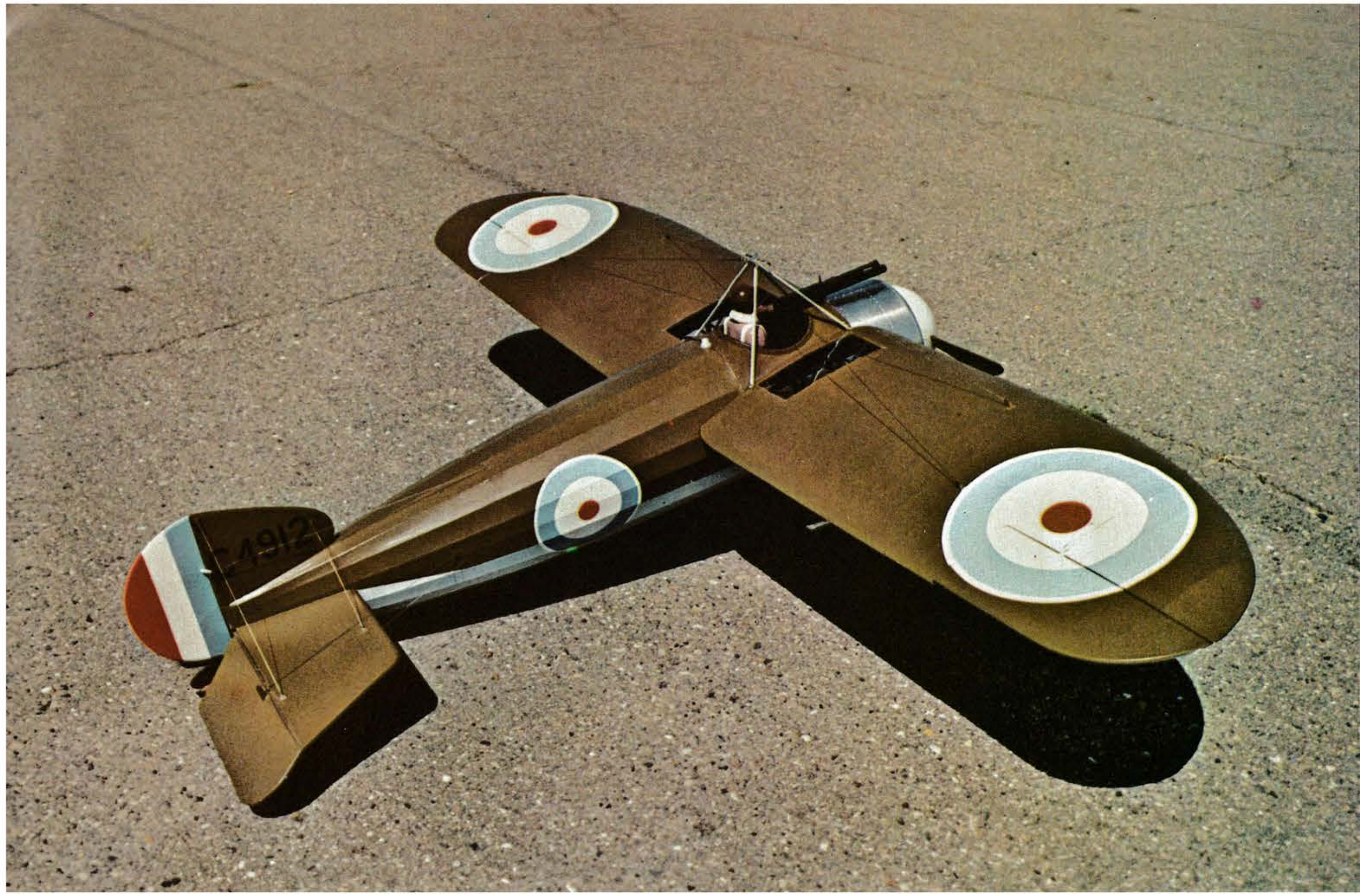
Finally, give your model a break —performance depends on the right combination of prop/engine. Try different diameter and pitch props (and different manufacturers, too), move the C.G. forward or aft to get the mode of flying you like. The model is very tolerant and tries very hard to please the pilot. An added bonus —put floats on it. You don't have to prove there ever was a Bristol with floats . . . just do it, it's a blast! That's what it's all about folks!

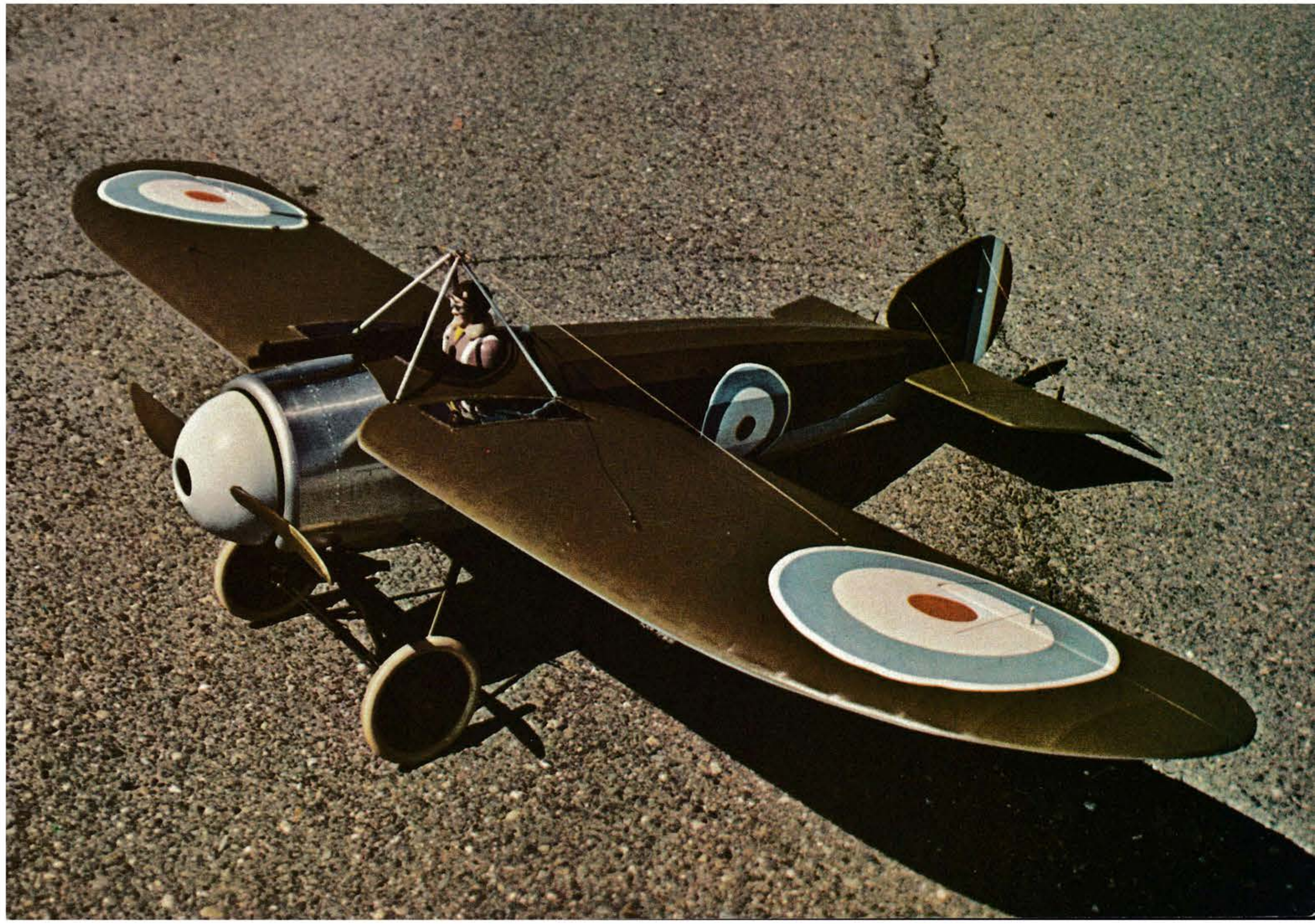
Construction-wise the model is a conventional box fuselage with stringers and standard built-up wing. The shoulder wing monoplane is easily assembled in spite of the flying and landing wires. Also, the horizontal and vertical surfaces are permanently attached. The landing gear is made to be easily removed, if required. It's easy to change to floats. In all, the model is designed for easy transportation and modest assembly for flight readiness.

Let's talk fuselage construction. Note that balsa wood (the best strength-to-weight ratio of any *wood!*) is used throughout. The basic box/truss construction is the core of the fuselage and is the "building block" for attaching all other components. Starting from the nose, the engine bulkhead is made of plywood facings, with a balsa core as indicated on the plans. Important: the balsa grain must be vertical between the plywood facings, otherwise, it will crush where the engine bolts are installed.

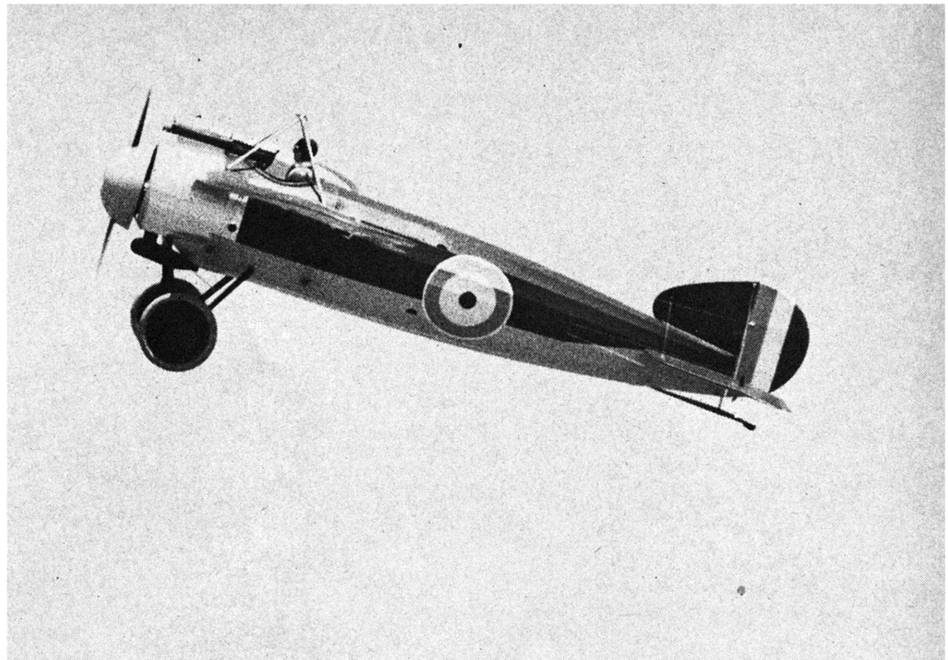
Pre-coat the balsa end grain surface with glue and let it dry first, then glue on the front and back plywood facing. Note: the five-ply forward face sheet is 1/8-inch thick, and the three-ply rear face is 1/16-inch thick. This bulkhead is very important, because it will hold the wing leading edge dowel. It supports the front landing gear struts, and it holds the fittings for the wing cables. The engine mount and the aluminum cowl attached to this bulkhead. After gluing this bulkhead to the fuselage box/truss, the rest







Climbing out after a touch-and-go, the Bullet is amazingly aerobatic, especially with the Tartan engine.



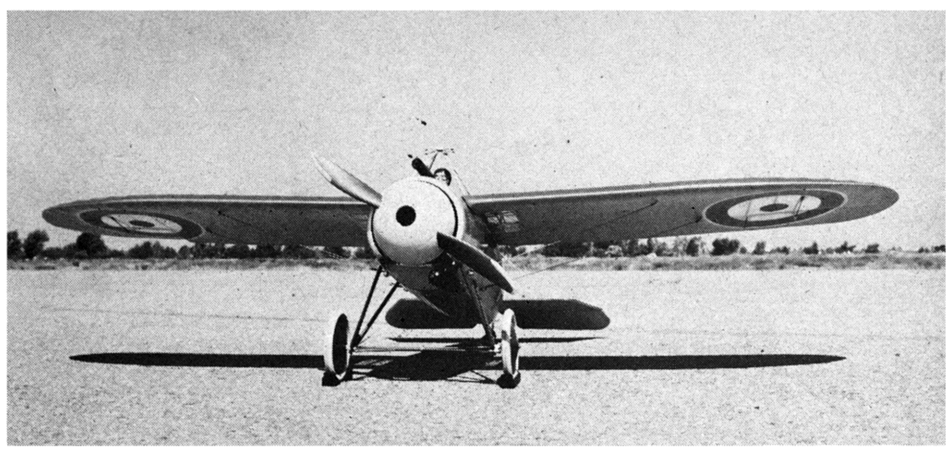
of the balsa bulkheads may be glued in place. For ease of assembly, do not glue all of the stringers in place . . . a few on the top, bottom and sides to stiffen the fuselage while handling it is all that's required. Access is necessary to install the control cables, radio gear, fittings and the tail skid . . . more on the fuselage construction after the horizontal and vertical surfaces are built.

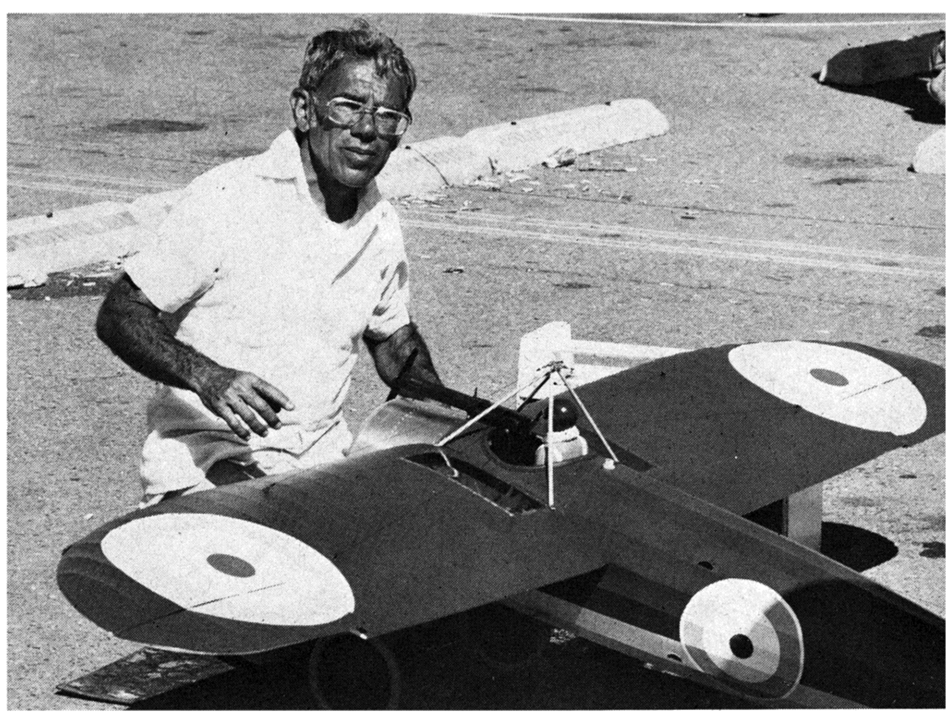
Before the fuselage structure is completed, the empennage must be glued in place. The cable attachments are added and the tail control cables are installed. Also, easy access to the fuselage box/truss structure is required to install the tail skid assembly.

To build the fin and rudder, first make the curved outline by laminating 1/32-inch strips to get a 3/8x3/8 cross section, after trimming the excess. Make a tip outline from ¾-inch hardwood, and use this to form the laminations. (*Model Airplane News* [October 1983] has an article giving a step-by-step description on how to make these bow tips.) Make the tip in one piece, then cut at the hinge line after building the fin and rudder together. Use medium hard balsa for the fin post and rudder post . . . the strength is necessary to preclude crushing if the model flips over. Wait! Don't glue these to the fuselage. It must be fitted to the horizontal surfaces first—more later. Note that the fin has a gap at the fuselage, it is held in place at the front end with a ¼-inch dowel and at the back by the fin post. Important: the fin post goes to bottom of the fuselage, and is the basic support for the tail skid.

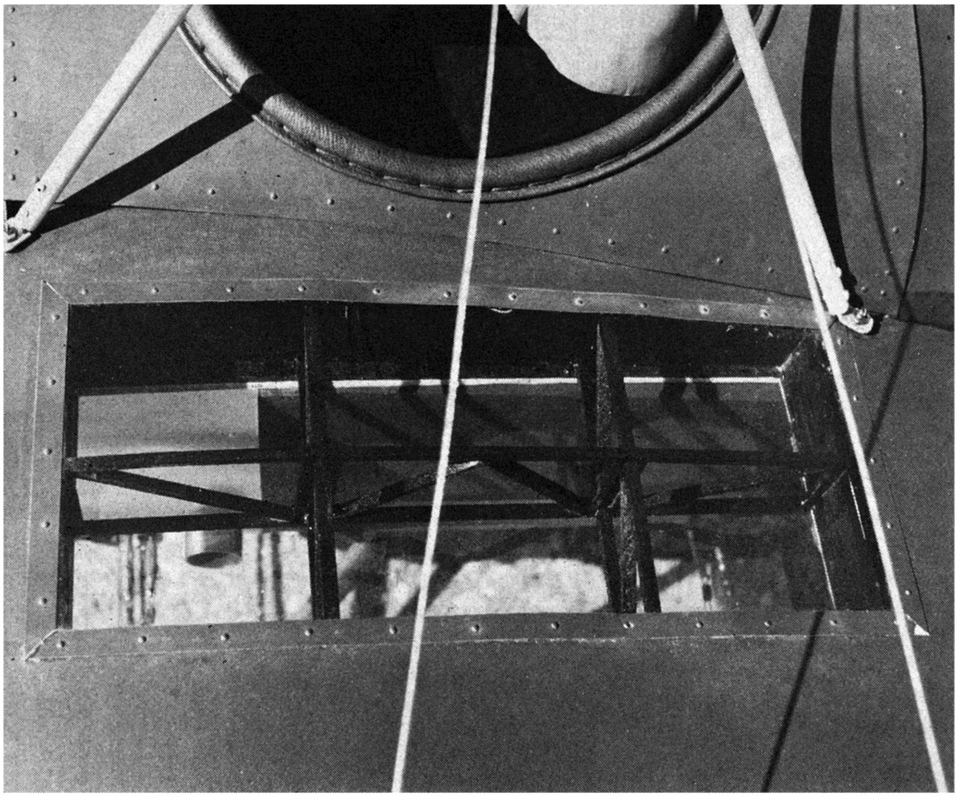
The tail skid is made of 3/32-inch piano wire, to which is brazed the skid.

The assembly is then sandwiched with maple hardwood to stiffen it. The forward end of the 3/32-inch wire slips into a hole in a 1/8-inch plywood bulkhead, which is glued to the fuselage box/truss structure. After the horizontal and vertical surfaces are mated and glued in place, the tail skid aluminum tube is glued to the vertical post on the fin. Be sure to glue the aluminum tube and





The author prepares to fire up. Note that the Bristol is not a small airplane.



The "fake" observation window has dummy truss structure inside the wing.

fin post securely, because the side loads on the skid can be severe.

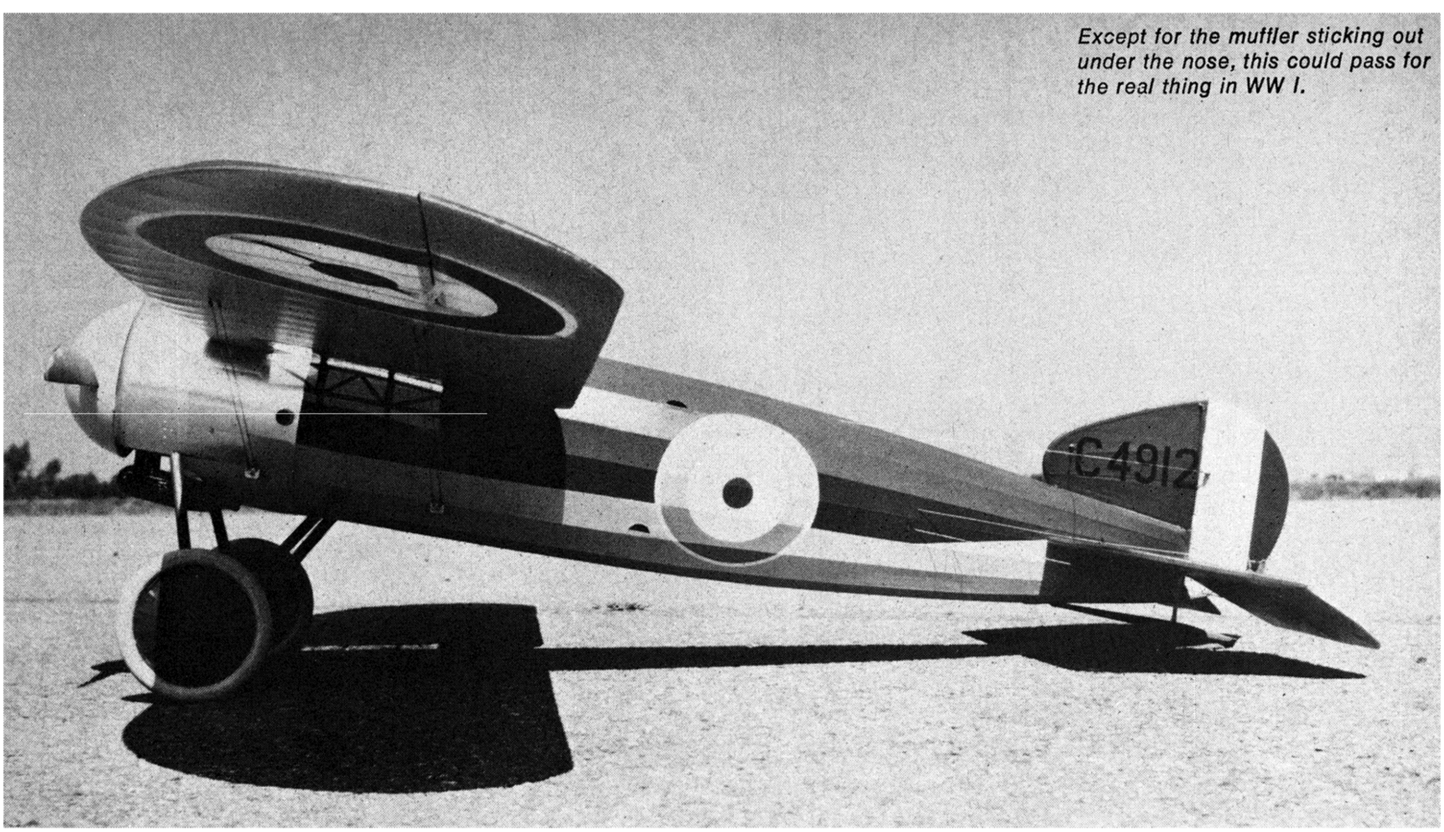
Note that the whole assembly can be removed by taking the pivot pin out and sliding the tail skid out of the fuselage. Aside from being removable for repair, the tail skid is removed when floats are used. The reason is that directional stability is drastically reduced when floats are added thus requiring a large subrudder to maintain stability. The subrudder (about 50 percent of the vertical area) is attached to the tail skid hardware.

Construction of the horizontal surfaces is similar to the vertical surface, except at the elevator trailing edge. As before, bow tips are made by laminating 1/32-inch balsa strips that will mesh in with the 1/64-inch plywood at the trailing edge. The section view on the plans shows how this is made.

Don't glue the empennage onto the fuselage until these parts are mated and are interference free in all control surface deflections. The model needs lots of rudder and elevator travel for better control through all flight maneuvers.

After adding the hinges, control horns and support cable hardware, the surfaces can be glued in place. Be sure to have two degrees of positive incidence in the stab. (*i.e.*, up two degrees at the leading edge) when gluing it to the fuselage. Cables for the control surface may be added now, but do not attach them permanently because the cables go through the fabric.

Back to the fuselage . . . with the tail surfaces in place and the tail skid attached, the radio gear can be installed. Helpful notes: Install the 16-oz. tank first, then put the servos, battery and receiver as close to the nose bulkhead as practical. *But,* the battery may have to be moved to get a proper center of gravity location. As shown, the C.G. is nominally at mid-chord, approximately 1½ inches below the wing. (Just about the bottom of the pilot's bot-

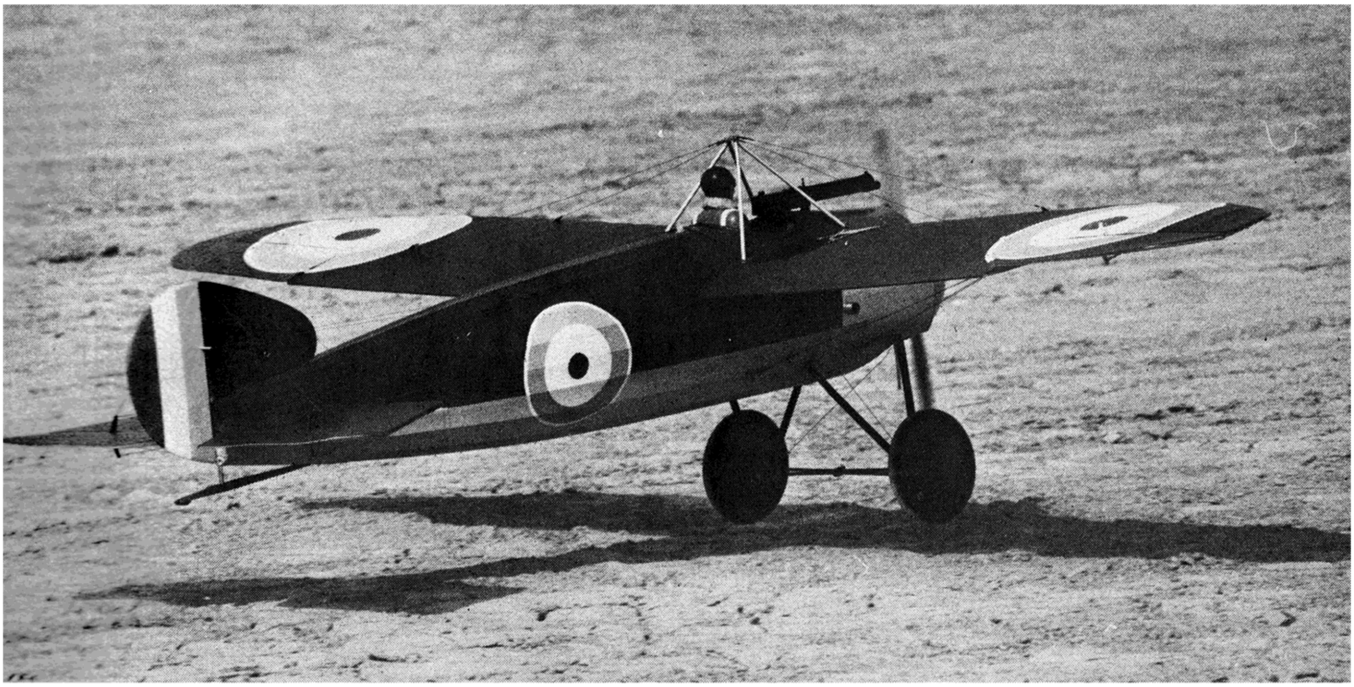


Except for the muffler sticking out under the nose, this could pass for the real thing in WW I.

BULLET!

(Continued from page 45)

Tail high, and ready to take off, the Bullet has surprisingly good ground handling characteristics.



tom—which, incidentally, is realistic for pre-WWI flying machines.)

At any rate, the stability margin can be controlled with the battery. Static balance at C.G. shown is neutral, while aft will decrease stability and forward will "stiffen" flying stability (of course, this is all approximate and will depend on flight check-out to suit the individual pilot/plane combination).

Finally, install the miscellaneous hardware, such as landing gear supports, the wing hold-down dowel, the aft bolt and wing cable attach fittings. Also fit and mount the engine to the plywood bulkhead. To complete the fuselage, the aluminum cowl and laminated nose ring can be added. The fuselage is now essentially completed; however, the wing has to be mated to the fuselage and "closed up" with the cockpit enclosure.

Construction of the wing is quite conventional, *i.e.*, spars, ribs and cap strips. The wing tips are made of laminated "tip bows" and cut at the aileron hinge line to form a nicely contoured, continuous tip. At the wing root, the fuselage/cockpit area is integrated into the wing upper surface to conform with the fuselage shape. The front and rear spars fit between the fuselage bulkheads and rest on the fuselage box/truss structure. Use 5 mil aluminum (offset printing stock) to form the cockpit sides, which can be glued to the wing/cockpit bulkheads with rubber cement. It is preferable to first glue 1/64-inch plywood sheet to the bulkheads, then cement the aluminum to the plywood. To get the rivet effect, slightly indent the aluminum from the back side, by laying out the rivet pattern and indenting with a 1/16-inch punch that has been shaped like a rivet head. That's how you make "rivets" simply and effectively . . . on the cowl, wing window frames, windshield frames and other miscellaneous parts. Looks realistic and very simple to do! Your local print shop, newspaper, vocational school and even the local college print shop will give the aluminum stock to you.

The leather cockpit padding is sewn in place, using imitation leather upholstery material. With the windshield and pilot in place (you *must* have a pilot in the cockpit if you intend to fly the model!), the aileron servo can be installed next. To complete the cockpit area, cover the wing bottom with 1/64-inch plywood to close up the wing center structure.

Finally, to complete the wing after it is fitted to the fuselage, glue in the front ¼-inch dowel pin. Add the 40 mil aluminum bracket at the rear spar. The wing windows have simulated built-up ribs and spars inside, which adds a touch of "realism" when seen through the window. And, of course, the 5 mil "riveted" aluminum frame gives it that authentic touch. Also, don't forget to install the 32 mil stainless steel (not aluminum) connectors to which the wing cables are attached. (Use 65 lb. multi-strand, coated stainless wire (fishing leader line is best).

The cabane strut will require some tool work . . . use ¼-inch aluminum tubing and rivet both top and bottom fittings in place. Use a piece of ¼-inch aluminum to form the "H"-shaped fitting for the wing flying wires. The bottom end of the cabane struts have to be bolted solidly into the wing.

After installing all wing hardware (pushrods, bellcranks, cable fittings, etc.), sand the wing and you are ready to cover it. But, before that, pre-dope the balsa wood, (butyrate or nitrate) four coats (medium thinned) on the leading and trailing edges and all of the surfaces that will be in contact with the polyester cloth covering. The article in the May '76 issue of *Model Aviation* gives detailed techniques. Covering the uncambered wing is not difficult if you do it my way . . . one rib at a time! Use aliphatic glue only, it penetrates the cloth and sticks well, without curing too quickly. It allows time to align and tighten the cloth (yes, align the cloth weave spanwise, otherwise you'll be muttering uncouth four-letter words). Glue the cloth to the ribs only between the front and rear spars! The capped ribs will allow plenty of gluing sur-

SPECIFICATIONS
M.1C BRISTOL BULLET

FULL-SIZE
POWER: 110 hp LeRhone
SPAN: 30 ft 9 in
WING AREA: 145 sq ft
WEIGHT: 1,348 lbs

MODEL
1.3 c.i. Tartan
7 ft 8 in (1/4-Scale)
9 sq ft
12 lbs

face. Don't use too much glue, and don't thin it out (you'll thank me for all this good advice)!

To glue the cloth to the remaining structure, use acetone to fuse the dope (by "melting") into the wood. Use extra dope where the cloth overlaps, and also on the excess cloth that will be trimmed off. The extra dope fills the cloth, making it easier to cut (use a sharp razor—the polyester ruins razors rapidly). When shrinking the cloth, use a hotter setting on the iron to fuse the cloth securely at the edges.

Finally, dope the fabric as required. Clear pre-coat the model, then add the final colors. The red, white, blue roundels can be done easily with masking tape. Try painting them . . . it's not difficult and it looks nice. Decals can't be used because they will not conform to the compound curvature of the wing and fuselage.

The landing gear is made from hi-carbon spring steel. The main struts are 1/8-inch diameter, the axle is 3/16-inch diameter and the two spreader bars are 3/32-inch diameter. For the main struts, a 36-inch length is bent at the middle, to form the "V" at the axle.

The front and rear struts are approximately the same length, but when bending the wire at the fuselage, be sure to make a left and right half. Cut off the excess wire, leaving each cross-strut about half the width of the fuselage at the nose and at the cockpit locations. Each main strut has a slotted piece of 1/16-inch steel for the axle to slide in. The steel has to be brazed (or silver soldered) to the bottom of the "V" as shown on the drawing. The 1/8-inch I.D. brass tubing is anchored securely to the fuselage box/truss crossbrace. This will allow removing the landing gear assembly, if required. The wood struts are glued to the 1/8-inch main gear . . .

Look at those gorgeous leather-covered spoked wheels, which are really mods of the Williams Bros. wheels.

use hard balsa wood and make all your landings very gently!!!

Use the 6½-inch Williams Brothers wheels; they are very sturdy and will withstand the hard knocks (and sideways bumps too).

To close, here are a few miscellaneous notes:

While control cables should be taut (not tight) the load carrying rigging cables must not be tight. If they are pre-loaded, any additional maneuver loads could precipitate a failure.

Balance the spinner assembly with special care, first without the prop, then with a prop that has been balanced.

The C.G. is at 45 percent of the mean chord. The plane is stable and will tolerate an extreme range of C.G. travel.

As in all precision machines, periodic regular inspection and maintenance is necessary to prevent accidents. Some areas to check are the wires and cables, where they could loosen or fray at sharp bends.

Periodically, check the rudder and elevator surfaces for cracked or broken spars.

Wheel chocks . . . make a pair; you'll need them! For safety, they will restrain any tendency for the model to move while running the engine. Also, the rubber tires will tend to flatten if they are not supported by the wheel chocks.

In closing, I would like to specially thank Bob "R.C." Sweitzer for getting the Bristol M.1C published. Bob is a magician with drafting tools . . . considering what I gave him to draw from, and the final product, it had to be pure magic. Bob took photos, sketches, drawings, notes, patterns and miscellaneous parts and . . . presto, out comes a beautiful set of plans! Also, I have to thank my wife, Lucille, for her "overtime" effort of proofreading the text.

REFERENCES

Model Airplane News, October, 1983. Articles on making "tip bows" and installing "control cables."

Model Aviation, May, 1976. Step-by-step procedures for covering with 100 percent polyester cloth.

Profile Publications #193. Detailed information on the history and technical aspects of the M.1 Bristol series. □