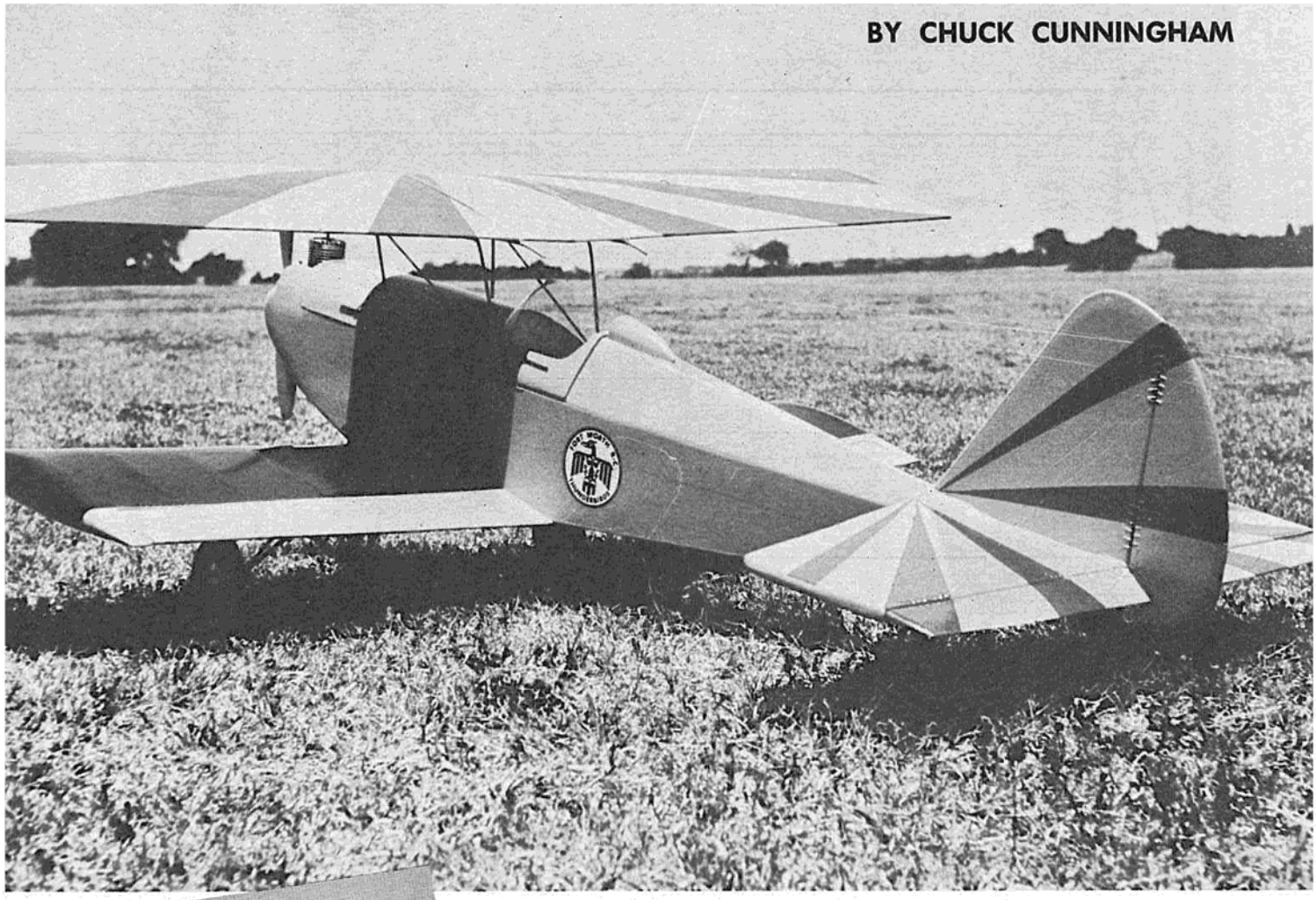
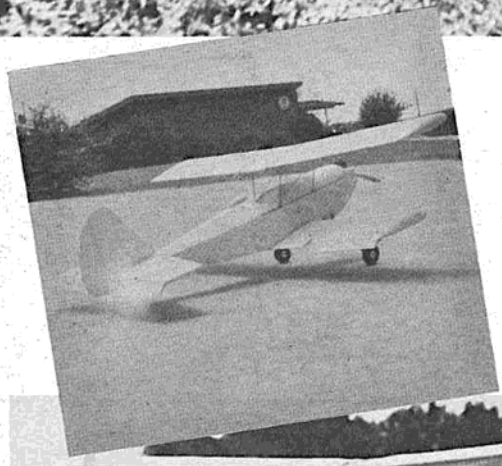
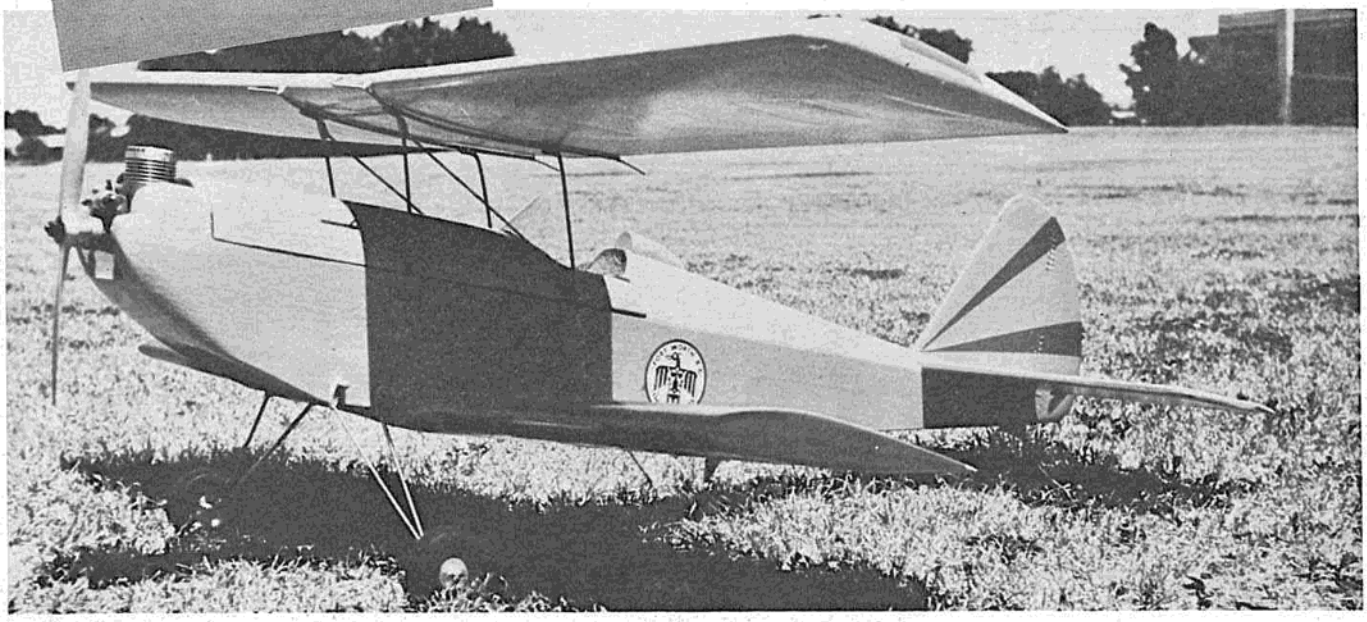
BY CHUCK CUNNINGHAM





THE SHOWOFF



THE SHOWOFF

chuck cunningham

HOW often have you heard someone say – "Boy! I'd sure like to build a biplane!" Quite possibly you might have said that very thing, yourself, since almost every RC'er, at one time, has wanted to build a bipe, but for one reason or another, puts it off as a project for "tomorrow." This has been my own reaction for a number of years, but finally, the lure of the new free-style aerobatic event was the impetus that finally gave birth to the Showoff.

This is not a scale biplane, but rather my own interpretation of a 1930 vintage bipe. It has the looks of an air show craft, sitting on the runway, and you can't help but wish that you could jump into the cockpit and buzz off with the sharp feel of wind in your face and the singing of rigging wires in your ears. All in all, it's a biplane fanciers' biplane – and one that will perform the exotic maneuvers of the free style aerobatic event that is currently skyrocketing in popularity. A few "pulses" for the Showoff are the ease of construction, economy of materials, plus a parachute hatch and bomb drop for that "extra touch" of airmanship. Now that you've read this far, and possibly have an incurable case of bipe fever, let's take a journey into the why's and wherefore's of biplane design as related to R/C models. Even if you don't build the Showoff, you can apply the same principles to the WW I masterpiece that is flitting around in the back of your head.

Design

One of the factors that we must recognize in biplane design is that the good old double winger just isn't as efficient as our standard monoplane, so our design must incorporate certain standards that will allow it to fly as well as the more conventional monoplane. As an example, the wings of the biplane are only 80% as efficient as a monoplane – so to arrive at the size of our bipe, let's first decide on a size for a single wing ship and then take it from there. In the case of the Showoff, we wanted a ship that would stay in the same league as most of today's multi stunt ships, thus a monoplane size of 720 square inch wing was chosen. Since the biplane is only 80% efficient, we multiply the 720 by 125% and arrive at 900 square inches.

In reality, the Showoff has 880 square inches, plus tips. The two wings of a biplane do not support the load of the air equally, but rather, the top wing is responsible for approximately 58% of the load while the bottom holds up the remaining 42%. Therefore, the top wing should be larger than the bottom wing. If the two are the same size, the lower wing does less work and adds more drag. Since the Showoff has a total wing area of 880 square inches, 58% of this is 500 square inches and 42% is 380 square inches. In order to keep to the general design that I wanted, I disgressed slightly from these figures and wound up with a tip wing of 48" span (plus two one inch tips) and a 10" chord for an overall area of 480 square inches. The lower wing evolved to a span of 40" plus tips with a 10" chord – an area of 400 square inches.

The elevator of a bipe is a single surface, and therefore is acting in the same manner as a monoplane. Since 25% of the wing area is standard for the elevator on a monoplane, then 20% of our biplane wing area will be the formula – in this case, 176 square inches. The rudder is similar, and 7.5% of the monoplane area equals a total of 54" of area.

Most of us know that the gap between the two wings should be at least the same distance as the width of the chord – this gap being measured at the zero datum line of each wing airfoil. The stagger, to be most efficient, should be in the neighborhood of one-half of the wing chord. To find the correct balance point on a biplane, assume that the two wings together make one wide wing chord, measuring from the leading edge of the top wing to the trailing edge of the bottom wing. The correct C.G. location is then 33% to 40% of this overall chord.

There you have, in a nut shell, the basic design reasoning behind the Showoff. If you've had enough of theory and the "why's" and "what's" of a bipe, then put aside your current hot stunt ship, grab your leather helmet and goggles, and let's get on with it!

Construction

Wings. Since I hate to build them (and I suspect you do, too), let's start with the wings and get them out of the way. Don't be overly alarmed about the amount of materials and time involved – my own Scottish blood runs deep, so plan ahead and we'll save a bit of wood as we go along.

These wings employ a 15% airfoil (a slightly modified 2415), and use the planked leading and trailing edge, plus cap strip, method of construction. First, cut out all of the sheets necessary for the leading and trailing edge planking. You will need eight sheets of 1/16" x 24" balsa for the top wing, and eight sheets of 20" long material for the lower wing. After cutting these from 3" wide by 36" long sheets of Sig's finest, you will have 16 pieces of balsa remaining – varying from 12" to 16". If you are careful in placing your rib template, you should be able to get all of the wing ribs from the drops from these sheets.

Make the rib template in any manner that suits you. I have found that a template made from hard balsa works just as well as one fabricated from plywood or aluminum sheet – and a heck of a lot easier to make! Use a ball point pen to outline the ribs, then go back and cut them all out. Stock the completed ribs together and sand to final shape. Leave this stack pinned in one big lump, put a razor saw blade in your X-acto knife, and saw out the slots for the spars. The latter are made from hard 1/8" balsa and are full depth. We are going to use the "egg crate" method which will give you a very strong wing with only 1/16" balsa used for the ribs and sheeting. Cost wise, this is a substantial savings over 3/32" sheet.

Mark the location of each rib on the full depth spar and then slot the spars with the razor saw to accept the ribs. Notch the ribs at the center section for the dihedral brace – in this case, again simply hard 1/8" balsa. This is not cut to a dihedral angle, but rather, is one long piece of straight wood, trimmed on the bottom edge only to the dihedral angle. Wings built in this manner are extremely strong. I have used this construction technique on many large, high-powered multi's and have never had a wing fail from structural weakness.

Use a good, flat, non-warped building board, lay out the plans, cover with wax paper, carve out the "prop-up" blocks as shown on the plans, count out the correct number of ribs for each wing half, and get set to build a very easy and true wing.

First, pin down the bottom trailing edge sheet on the plan. Now assemble the ribs on the two spars – don't glue them as yet, but simply slip into place. Now lay a bead of white glue on the trailing edge sheet at the place where each rib is to be located. Pin three prop-up blocks along the leading edge of the wing, smear glue along the front top of the trailing edge sheet, and place the rib/spar mess on to the trailing edge. Put glue on each rib at the leading edge location, pin the leading edge in place on the ribs and on to the prop-up blocks, and then be sure that the entire assembly is properly aligned. If everything is in its correct location, dip a small brush into your white glue bottle and brush white glue on every joint and on each side of the rib and spar joints.

After you have taken the kinks out of your back, it's time for the next step. Brush a coat of contact cement on to the wing ribs and the corresponding place

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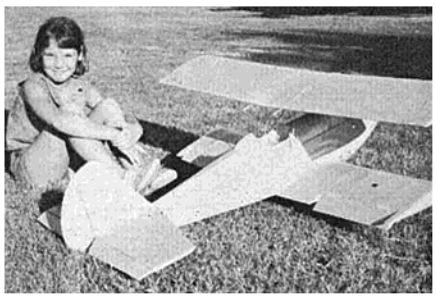

on the top leading and trailing edge sheets, let dry, then very carefully put these sheets in place. Cut out the cap strips to fit, brush on contact cement, and when dry, put these in place. Now allow the wing panels to dry overnight. If you used a large building board, you were able to build all four wing panels at one time.

When all is dry, remove the panels from the board and glue in the dihedral brace, blocking up the two halves of each wing the amount shown on the plans. When this has dried thoroughly, return to the contact cement can and install the bottom leading edge sheets. Glue the tip blocks in place and carve to shape. Now sand the wings lightly, remembering that it is then wood, then cut out the ailerons where shown on the bottom wing. Add the 1/16" plywood reinforcement for the aileron horns. Sheet the front of the aileron servo in the lower wing. Be sure to cut the holes for the aileron push rods. Now take a piece of very strong cloth, cover it with white glue, and wrap around the center section of the wing. Use pinking tape, if you have it around the shop. When all of this is dry, we can sand with fine paper, apply two coats of dope, and set aside for covering later on.

Empennage. The stabilizer is made much the same manner as the wing, using contact cement whenever possible. Build the framework of balsa and white glue and then contact cement the top sheets in place. Remove from the plans and contact the bottom sheets to the frame. Install the tip block, carve, sand, and set aside for covering.

The rudder is constructed from 1/4" sheet and presents no problems.

Fuselage. A few different construction ideas are used in the Showoff fuselage. Almost all "box-type" bodies turn out to have an alignment problem by the time they are finished. This can be eliminated in a variety of ways, but I use one that has proven to be both fast and easy. For lack of a more glamorous name, we'll call it simply "crutch construction." Pin down, on the top view of the plans, a crutch of hard 1/4" x 1/2" balsa. You'll have to splice them to get enough length, so put these splices at the nose. Cut the cross pieces to fit and glue in place. At the same time, cut cross pieces for the bottom, making sure their length is correct, as shown on the plans.

While the crutch is drying, saw out the firewall from 1/4" aircraft plywood. Mark the center and thrust lines on it and drill the holes for attaching the radial engine mount. Use either the mount shown on the plans or a standard Tatone mount. Next, cut the fuselage sides to shape from either 1/8" or 3/32" balsa. Frankly, I prefer the 1/8" sheet. Cut the 1/4" balsa and 1/16" ply doublers to size. The latter can be of 1/32" ply, if you desire, but again, the 1/16" material is stronger and not too much heavier. Which ever you use, either will be much stronger than the usual balsa doublers – as can be proved by a hard landing!

Now, lay the fuselage sides down on the table, making sure you have one right and one left, open the can of contact cement, and glue in the doublers. Make sure that the plywood doubler does not extend into the 1/2" space reserved for the crutch. Cut out 1/4" square pieces for the lower tail braces and glue in place with white glue. Cut out the "truss" pieces for the tail braces from 1/8" x 1/4" hard balsa and glue these in place. Remember – save space for the crutch!

When this has set up, and your nerves are steady, apply contact cement to the outside of the crutch as well as to the sides, then allow to dry. Take one side and very carefully place it against the crutch. Start at the nose and make certain that the alignment is perfect. It isn't hard to do – just don't rush it! With the nose pressed together, smooth the body to the rear. Do this with each side. If you've made a mistake at this point, get some more wood and start again because contact cement just ain't forgiving!

Reach in with a pair of long nose pliers and remove the pins holding the crutch to the table. Slide the plans and crutch to the edge so that the firewall area is just sticking over the table. Now glue the firewall in place with epoxy glue. Add all of the bottom cross pieces and sheet over the rear of the bottom. Put on the plywood landing gear mount and the 1/16" plywood nose.

Remove the Showoff from the table and add in the extra nose doublers and blocks. The top of the fuselage is formed from expanded bead polystyrene board and then covered with 1/16" balsa sheet. Glue a block of bead board to the top of the body, using white glue. Glue the rear portion solidly, but only tack glue the front part from the cockpit forward, since this will become a removable hatch.

Next, you can cut the foam block to shape with a hot wire or saw, or alternately, carve it with a knife. At any rate, shape the block at the rear to a triangular shape, using the view at Station C, and working toward the rear. Round off the forward portion to a half circle. This all sounds much more complicated than it really is, and I'll guarantee you that when you have tried it, you will find it much easier to form complicated superstructures. In addition, it's one heck of a lot stronger than the conventional built-up balsa method. You can also sand the foam just as if it were balsa, although carving it to shape is certainly much easier. Don't bother to hollow out the foam as the weight is next to nothing. Apply the covering sheet with either white glue or a contact cement designed expressly for foam. The usual contact cement that we have used on the other parts of the ship is not to be used on foam as the solvents will destroy the plastic. The 3M company makes a contact called Adhesive #34, and the Borden company makes a contact cement called Elmers Water Base Contact Cement, both for use with styrene foams. If you have one of the commercial foam contact cements, such as Core-Grip Kwik-Stik, they can be used for the laminating of doublers and sheeting as well as for the foam-to-balsa bond.

When the top hatch is completed, cut apart at the cockpit line and install the "bird cage" braces, made from 3/8" x 1/2" hardwood motor mount stock. Install all of the extra gussets where shown and be sure to use epoxy glue for this application. Smear it on liberally, as we need all of the strength that we can obtain at these points.

Now for the Great Adventure – bending the wire "bird cage." As others have said, this separates the bipe fan from the "wishers." Nevertheless, with a few scraped knuckles and a good solid cuss word here and there, it can be done. A small wire bending jig, sold in most hardware stores, will be an immense help in this part of the project. Wrap the wire-to-wire joints and solder securely. I found that in doing this my soldering gun just wasn't adequate, so after lightly soldering the joints, take the wire dingus you have made and heat over a gas flame, flowing on the solder. You find your own gas flame – our Fearless Leader Editor used a Bernz-O-Matic torch, I use the gas lighter in the fireplace, and if you're a brave soul, you might try your wife's stove when she isn't looking.

While you're doing all of this, you might as well make the landing gear from 5/32" and 1/8" wire and solder at the same time. You can use an aluminum sheet type of gear if you wish, but the wire will probably add more strength. I have tried both types on the Showoff

and prefer the wire landing gear.

Now fit the bird cage in place on the body braces, drill holes for the "J" bolts, and bolt the assembly in place. Turn the body over and solder the nuts to the J bolts.

Epilogue. At this point, you are ready to apply the covering and paint your bipe. Use either silk or double cover with silkspan. The original Showoff used the double covering method – remember to cross grain the second layer to the first. Several coats of dope will make the silkspan much stronger than the silk with much less weight build-up and many less coats of dope. Cover the body and the tail surfaces in the same manner. When dry, peel off the silkspan at the elevator and on the lower wing where these two items contact the fuselage, and glue them with plenty of epoxy.

If you are not going to couple the ailerons to the rudder for control, then you can leave the lower wing removable. If you desire to utilize the fifth servo to trigger the bomb and parachute mechanism, then glue it on, couple the controls, and bomb your buddies with water bombs. The chute hatch can also serve as a bomb holder if you intend to make a maximum strike effort! I'll be the first to agree with The Dewey that this bomb and chute rig is "Mickey Mouse," but it **will** work, and the bomb drop clamp can be used to pull streamers aloft, which are released to drift on the wind while you make passes at them. It's worth the extra effort, and for those of you who have never tried coupling ailerons to rudder, you have a surprise in store! It works **well** – landing control is much more precise and you have control at slow speed where the normal aileron-only becomes mushy.

Finishing off the Showoff is up to you. I have been searching for a long time to find a finishing that would be quick and easy. This ship was finished in synthetic automobile enamel – colors, yellow and red. Old Editor in California uses spray cans of Great Western enamel – these are fuel proof, applied over Great Western gray hot rod primer, dry rapidly, and are quite good looking. Try dope or acrylic lacquer (from local auto paint stores), or HobbyPoxy if you wish.

Flying the Showoff is no different than any other multi – the wings and stab are set at zero-zero to allow it to stunt with the rest. Your real thrill will come when it breaks ground, hums into the air, and suddenly – there you are, in the cockpit, turning back the pages of time, and having a ball.

Don't forget to eject the chute over the field, drop a water or flour bomb on your best friend, do a complicated freestyle aerobatic maneuver complete with colored smoke bomb, and above all – tell every one how easy it really is to build and fly a bipe.