TWISTER SISTER

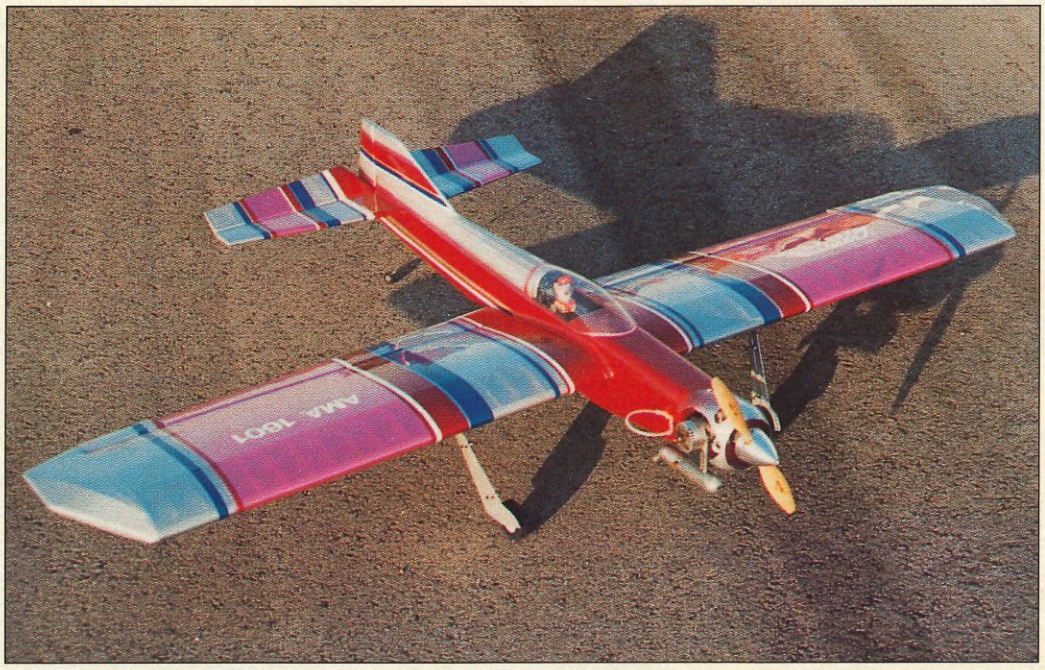
The author has done quite well in CL Precision Aerobatics competition with this full-fuselage stunter, based on the popular Sig Twister.

BY JOHN MILLER

In the early '60s I never was a top-rated flier, just one of many kids in Southern California who flew "toy airplanes." It was 1984 when I decided to come back to CL Stunt. My first plane this time around was a Top Flite Tutor. It flew well and I used it to polish off a lot of rust that had accumulated over the years.

Later, at the advice of a friend, I built a Sig Super Chipmunk. Now the Chippy is a pretty decent airplane. Powered right and built light, it will perform with the big boys. Unfortunately I lost mine (pilot error) in the fourth contest I entered—June 1987.

I had already started on a Sig Magnum but was nowhere near completion, and I needed a new ship fast. It was then that I received the August issue of *Model Aviation* and of course turned right to Ted Fancher's column, "Control Line Aerobatics." There at the top of the page was a real slick-looking plane, obviously a stunter, and underneath was a picture of the Sig Twister. I was familiar with the Twister; I had flown against them several times, and they had flown pretty well except for a tendency to "bobble" in hard maneuvers. I realized that Ted had modernized the Twister into a much more competitive plane.



Here you see the latest version of the Twister Sister. Changes include an engine cowl (part of a plastic soda bottle), sexy wingtips (more area for better performance at high altitudes), switching to an O.S. .40 FP (ditto), and going to a wing-mounted wire landing gear (saves weight). Sharp-looking model, no?

I just happened to have a Twister in my collection of kits. In a few weeks the new plane, Twister II, as Ted had named it, was ready to fly. I had a lot of fun and even won a few contests with it. I still have it, in fact, and use it as a backup for the new ship I call Twister Sister.

After a few years of flying the "Fancherized" Twister, as they soon became known, I felt it was time to get back to a full-bodied plane. I was assured by all the local Stunt Gurus that the "full fuselaged stunter" was the only way to go; that even though I was doing OK in Intermediate, to do well in Advanced I would have to make the switch. So in March of 1991 I sat down and drew the first sketches of my new ship.

I wasn't surprised by what came out. Years ago as a teenager the thought of a stringered-fuselage stunter had intrigued me. I also wasn't surprised to see the familiar Twister wing because I knew how easy it is to build. The moments came from the earlier modified Twister and the horizontal stab had the same shape.

I'd replaced the Fox .35 on the original Twister II with K&B's .28 Sportster after experimenting with a .20 Sportster converted to diesel. The diesel has some promise, but the .20 didn't have quite enough power. The .28 with the Davis diesel head runs almost like a piped engine, hardly varying in speed throughout the entire pattern. Naturally the new plane was designed around this same engine.

I took it to the Willow Grove, Illinois contest in May. It was blowing pretty hard and I only had about 10 flights on the plane, so I flew the profile Twister II instead. I got 1st in class, only because I didn't crash in the wind.

I next took it to Sig's big contest in Iowa and dorked it in on a wingover—pilot error again. The damage wasn't bad and was easily repaired once I got home. I also added about 1-1/2 inches to the nose to correct a slight tail-heaviness. The next contest was

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This photo illustrates the Twister Sister's ancestry. In the background is a Twister II, otherwise known as a "Fancherized" Twister; it's a Sig Twister kit with modifications as outlined by CL Stunt legend Ted Fancher. In the foreground is the author's prototype Twister Sister, built per the plans presented here. Power is a K&B .28 Sportster with a Davis diesel conversion head.

at Peoria; everything went well and the new plane chalked up its first win in Intermediate.

I moved to Salt Lake City, Utah last fall and am experiencing the effects of high altitude (nearly a mile high), so the drawing shows a slightly stretched wing for better high-altitude maneuvering. The local pilots swear that the trick is to lower the wing loading with more area. At lower altitudes, their planes still fly very well.

NOTES ON CONSTRUCTION

There are a few rules to follow when building competition airframes.

Rule #1: Build it light.

Rule #2: Build it only as strong as it has to be.

Rule #3: Build it straight. A straight airplane will usually fly well even if it's a bit heavy, but a crooked, light airplane will never fly right.

Looks plenty cold out there! John Miller with his Twister Sister at the new Jordan River Model Port, near Salt Lake City, Utah.

Start by reading and studying the plans very carefully, then choosing materials that are appropriate for the intended job. Light, straight balsa can be used in areas where the main concern is shape. For areas that must carry a load or are subjected to torsion, slightly harder, stronger balsa should be used. Lite-ply is not much stronger than balsa, in my opinion, so I use balsa. Where I use plywood, it is birch aircraft plywood. Carbon fiber strips, though not called out on the plans, can do much to strengthen areas such as wing spars or the fuselage longerons.

WING

There are two ways to build the wing. You can either purchase a Sig Twister kit and use the wing (you will have to make two ribs, all of the half-ribs, and modify the flaps, but it will save some time), or build from scratch. Either will work well, but you have a better chance of having a lighter finished piece by using your own selected wood and parts.

The wing is built in halves. Start by pinning down the bottom wing spar over the plans. Now set the ribs in their places; remember that the center ribs are different. Set the top spar in place and use scrap pieces of balsa to jig up the 1/4 square balsa trailing edge. Keep it straight! Tack glue everything together with thin CA. Check again to make sure everything is straight, then finish gluing all the joints with CA.

Set the top 1/16x1 trailing edge sheet in place and just tack it down. Glue the 1/2-inch square leading edge permanently in place. Don't use anything but perfectly straight leading edge stock, as we don't want any warping stresses built in. Glue the top half-ribs in place.

When dry, carefully remove the wing from the plans. Lay it upside down and tack-glue the bottom 1/16x1 trailing edge sheet in place. Glue the bottom half-ribs in place, lining them up with the top ones. Carefully turn the wing panel so you can flow CA into the trailing edge sheeting/rib joints, being careful not to warp the panel. Set this wing half aside and build the other half in the same manner.

When joining the wing halves, scarf joints (angled) are probably stronger but I've always used butt joints on the spars and leading and trailing edges. I usually back it up with 1/16 plywood or 1/8 balsa doublers. Use the method of your choice, but make sure the wing is straight.

Install the 1/4-square balsa supports for the plywood bellcrank mount with slow CA or epoxy; make sure they line up flat and level. Install the 1/8-inch plywood bellcrank mount with epoxy and let it dry.

Set up your leadouts, and bolt your bellcrank of choice in place. (I've used the large plastic Sig bellcranks with good results.) Bend the short flap pushrod from 3/32-inch wire, making sure that the flaps are centered when the bellcrank is at the neutral position. Secure the pushrod with a wheel collar if you're using a plastic bellcrank, or solder a

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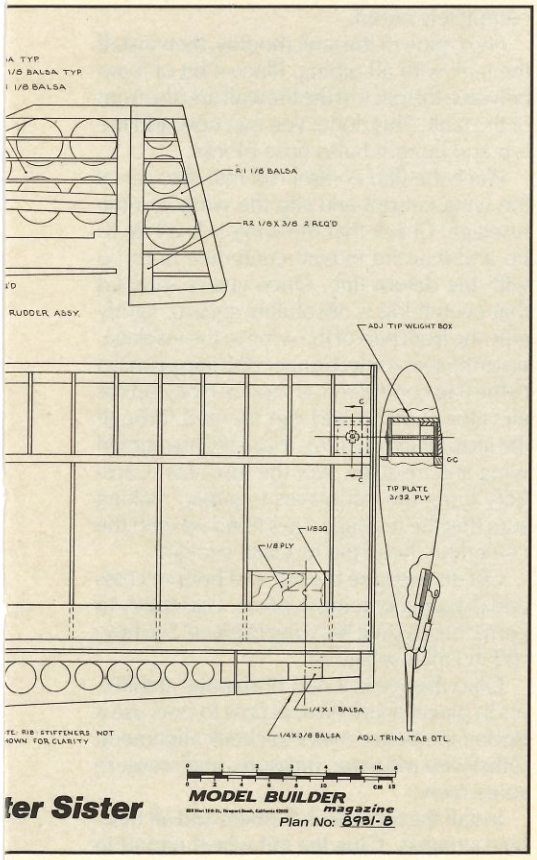
washer to the pushrod if using a metal one. Mix up a small amount of epoxy and swab it over the nut on the bellcrank bolt so it won't come loose. While you're at it, swab some into the set screw area of the wheel collar for the same reason.

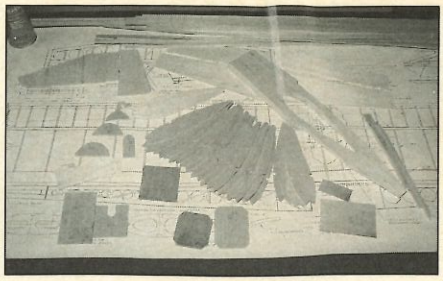
Sheet the top and bottom center section with 1/16 balsa. Build and install the adjustable leadout guide, the wingtip weight box, and the plywood wingtips. If you want fancier tips, by all means add them. Make them any shape you want—just remember to keep them light.

The flaps are laminated to help avoid twists that may be inherent in single sheets. The main piece or core is from 1/8 medium-soft balsa; note that the outboard flap is 1/8-inch wider than the inboard flap. The lightening holes are easy to make using a Dremel tool and a drum sander. Cut the slot for the 1/8-inch flap control rod at each end. Laminate 1/16 plywood on the top and bottom at the root of the flaps. Glue the 1/16x3/8 balsa strips top and bottom, and install the 1/16x3/32 "ribs" on both sides as shown.

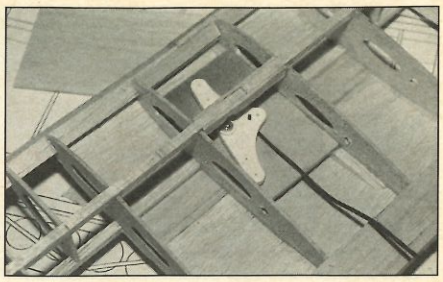
After both flaps are finished and sanded, set them aside and build the flap tip pieces as shown. Note that the outboard one is adjustable. Glue the inboard flap tip in place; be sure to keep it straight.

The method you choose to cover the wing and flaps will determine how and when you hinge them together. I like to use MonoKote-type hinges. Cover the wing and flaps with the covering of your choice. If you use a plastic iron-on film or fabric, select the base color now and add the trim later.

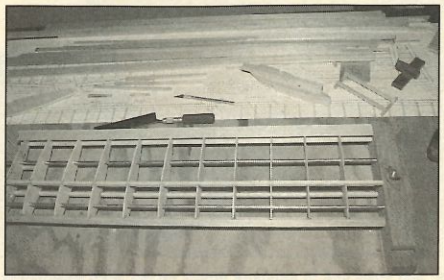




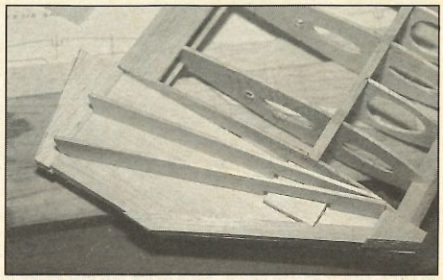
You can make the construction go quicker by cutting out as many of the parts as possible before starting the assembly. Author recommends using "See Temp." plastic template material for transfering patterns to balsa. (Write to See Temp., P.O. Box 105, Sussex, WI 53089, or call 800-423-1257 for details.)



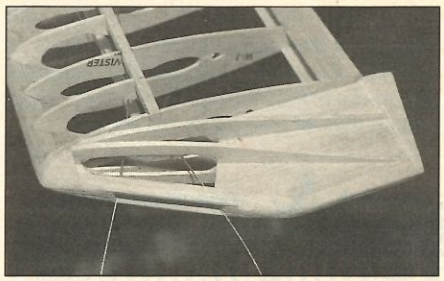
Sig bellcrank bolts to a 1/8 plywood plate. Note the doublers at the spar and leading edge butt joints; there are similar doublers on the inside of the top and bottom trailing edge sheeting also.



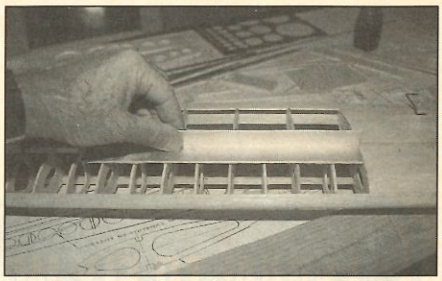
The prototype T.S.'s wing was built on a homemade wing jig. However you do it, it's imperative that the wing be built perfectly straight and with no warps whatsoever.



This view gives a good idea of the optional wingtip outline before it all gets carved and sanded to shape.



The finished left-hand wingtip. Note the slot for the adjustable leadouts—important feature for bringing the model into optimum trim.



Use a long sanding bar or block to even up all of the ribs.

TAIL SURFACES

These are likewise laminated together to make them more torsionally warp-resistant. Construction is similar to the flaps, but the ribs run straight instead of diagonally. Use light wood—weight in the tail is not good. After construction and sanding are finished, it's time to cover. Use the base color again and do the trimming after final assembly. Cover the rudder but not the fin at this time.

FUSELAGE

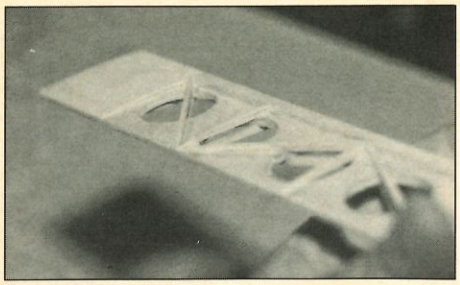
If you study the plans carefully you will see that I've departed from standard "stunt ship construction." The construction is more like that found in RC. I'm really following Rule #2: Build it only as strong as it has to be. Accordingly, the nose is built from sheet balsa with triangle stock filling in the corners. A plywood firewall is used with a radial-mounted engine. Aft of the wing, square balsa stock is used to frame out and support the tail surfaces.

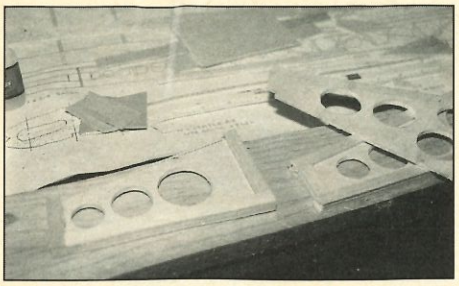
It's interesting that after several hard landings (crashes), not much damage has been done to the fuselage. The first incident required a nose rebuild after bouncing in at an acute angle. The wing needed to be recovered on the bottom where the knock-off gear punched into the wing. The aft fuselage and control surfaces were not damaged.

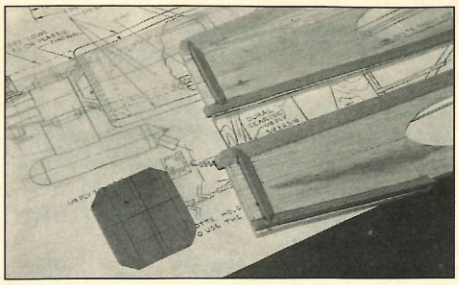
The second crash was straight into concrete. It was so hard that the engine was split in two, but again the repair only required a new nose. There was no damage to any other part of the plane. The gear popped off away from the plane, so it didn't poke into any part of the wing.

I believe that this type of construction exhibits a cushioning or shock absorbing characteristic that so far has saved the plane from any really extensive damage.

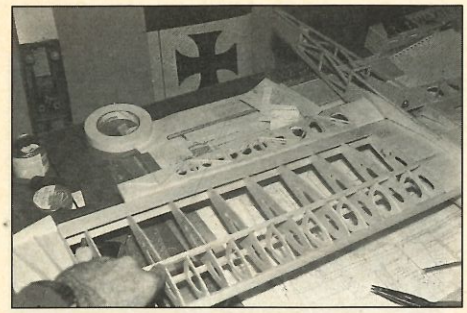
The fuselage looks a lot harder to build than it really is. Start with the nose pieces—use light wood. Prepare the nose pieces with datum lines and bulkhead location lines. Pin one of them in place, or use my favorite method, a very light coating of 3M "77" spray contact cement. Stick the longerons in place and trim them to length. Cut and place the cross pieces and diagonal braces over the

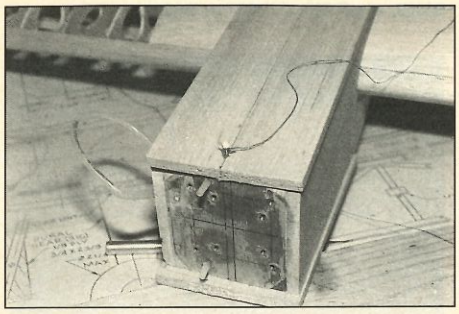


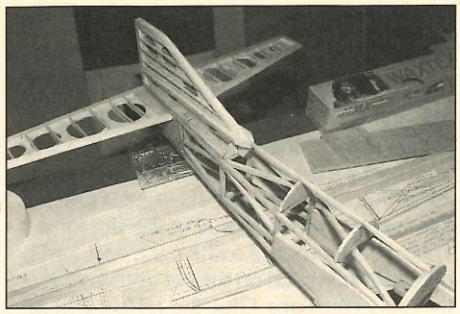




■ LEFT: Wing flaps are made of a 1/8-inch balsa core, full of lightening holes, with 1/16 balsa strips on both sides. ■ CENTER: Tail surfaces are built up like the wing flaps—a lightened 1/8 balsa core, but with 1/8 balsa strips top and bottom. ■ RIGHT: Forward fuselage sides are 1/4-inch balsa with 3/8-inch triangular stock in the corners and also directly behind the 1/4-inch plywood firewall. The right fuselage side is 3/32-inch shorter than the left, to provide the necessary right thrust. Mark the engine mounting bolt pattern on the firewall, drill the holes and install blind nuts before epoxying the firewall in place.







■ LEFT: Use a thread tied to a pin in the tail end of the fuselage and stretched to opposite points on the wing exactly the same distance from the fuselage centerline to get the wing perfectly square with the framed-up fuselage before gluing the two together as a solid unit. ■ CENTER: The same trammeling technique, with the thread anchored to a pin in the nose, is used to get the stab perfectly aligned on the fuselage. ■ RIGHT: With the tail surfaces glued permanently in place, the upper fuselage turtledeck structure can be added.

plans. If you are using the contact cement method these pieces will stay right where you put them.

Once you are satisfied with the fit, glue it all together with thin CA. Now, pick it up, turn it over, and place another piece of wax paper over the first built-up side. Build the second side right over the first. This will insure that they are as close to identical as possible. Once the sides are dry, carefully remove them from the building surface. Make certain that all glue joints are sound.

Glue the triangle stock to the inside top and bottom nose section. Install the backing for the firewall. (Did you notice that the engine offset is built in?) Turn the fuselage sides upside down, locate and install bulkhead F1 using CA glue. Prepare the firewall by drilling all holes and seating the blind nuts. Epoxy the firewall in place in the fuselage; put some epoxy around the blind nuts as well. Let everything set until the epoxy is completely cured.

Next, glue in the tank mounts, then install the tank with all tubing. Place a bit of foam between the back of the firewall and the front of the tank. This done, you can now add the top and bottom balsa nose blocks.

Place the flap control rod into the rear of the wing cut-out and slip the wing into the fuselage. Check that the wing is level tip to tip and that the fore/aft centerline lines up with the datum line. Once you're satisfied that everything is absolutely square, lightly glue the front part of the wing to the fuselage, up to the spars only. Connect the flap pushrod to the flap control rod as shown. Hook up the elevator pushrod and run the end through the aft fuselage opening. Place the assembled wing and fuselage over the top view. Carefully bring the tail pieces together, making sure that the fuselage stays lined up with the centerline. Keep the fuselage straight!

Cut, fit and glue the top and bottom cross and diagonal bracing in place. Use epoxy to permanently glue the wing in place. See how stiff the aft fuselage is?

Glue the vertical and horizontal stabilizers in place. If you have access to one, use a Robart incidence meter to check alignment. Otherwise measure, measure, and measure some more.

Install the turtledeck formers and all fuselage stringers. Glue the tail wheel mount in

place. Add fillers behind the canopy area.

Prepare the plywood landing gear mount by drilling and tapping the four holes (#25 drill, 10-24 tap). Flow thin CA into the tapped holes. After the glue has set, run the tap through them again. Add the triangle stock supports to the inside fuselage sides, mount the gear to the plywood plate with two 10-24 nylon bolts, and epoxy the mount in place. After the epoxy has cured, remove the gear and rough-sand the fuselage to shape. Finish up with 220 grit.

Install all of the various parts, again checking all fits and alignments as you go. Check the weight and balance and adjust accordingly. Cut the canopy from a 14-inch Sig bubble canopy, but don't install it yet. If you are going to install cockpit detail and/or a pilot, now's the time to do it.

You can fillet the wing joint now, using your favorite method. Mine is lightweight spackling compound. I dry it completely with a heat gun so there's no moisture left to cause problems later. Sand the fillets and check the fuselage once again.

Cover the fuselage with your choice of covering—I like iron-ons. I start with the bottom first, working from back to front so that all laps are to the rear.

OK, the worst is done. Install the canopy with RC56 glue. Install the flaps, rudder and elevator. Trim the ship with that killer color scheme you've figured out. (I find it helps to use a color wheel for complementary layouts.) Use your imagination and have fun; just avoid the temptation to go overboard, as you can add too much weight. I really like the graphics that Vinylwrite made for me. Spray on a coat of clear polyurethane to seal the finish.

FLYING

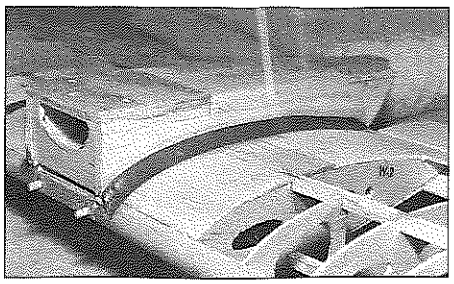
Check the weight and balance. Make sure they really are where they should be. Place enough weight in the tip weight box to cause the outboard wing to drop slowly when balanced on the plane's fore/aft centerline. Make sure that all fittings are secure and adjust the handle for neutral.

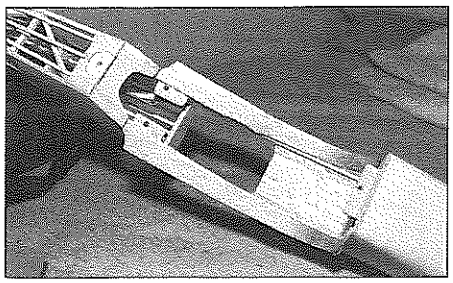
Take it out and fly. Some flight trimming may be necessary. The best instructions I've ever seen on trimming were written by Paul Walker for an article in *Stunt News*, the PAMPA newsletter. (PAMPA stands for Precision Aerobatics Model Pilot Association.) This is an excellent organization that you should seriously consider joining. You can get a copy of Paul's article from PAMPA for a nominal fee. The information in it will really help you now and in the future.

CONCLUSION

I hope you enjoy building and flying this plane. It's not at the cutting edge of CL Stunt design; rather, it's a straightforward, basic ship with the potential to help those of us on the lower rungs work our way up through the beginner/advanced classes. It is designed for the low-time pilot/builder and is set up more like an RC plane than the typical CL stunter.

Since I began using a stock K&B .28 Sportster, with its backplate radial mount, I've found that I don't have to beef up the nose like I would otherwise. Without the engine beams there is more latitude for tank mounting. I use a 4-ounce plastic RC tank on muffler pressure. With this combination and a 10x5 Rev-Up or APC prop at 10,000-11,500 rpm (depending on the prop), I get a smooth, almost tuned pipe-like run. The most common remarks I get after a flight are, "What engine are you running?" and "It's so quiet!"





The author's latest Twister Sister was built with a removable wing so he could transport it in a subcompact car. This isn't detailed on the plan, but these photos should get the idea across, for those who may want to engineer a similar system.

The radial cowl really adds to the appearance of this airplane. It can easily be made from a 1-liter soda bottle; throw the heavy base away and use the bottom of the clear plastic bottle. Paint the inside with matching paint and mount it with standoffs.

Since I started this project, about a year and a half have passed, so I think some updating may be helpful. The original prototype with the standard wing has been re-engined with an O.S. .40 FP to better cope with conditions here at high altitude. The plane handles it quite well. The plane shown in the building sequences has had wingtips added to the longer wing, giving it about 70 more square inches to further lower the wing loading.

If you're really observant you may notice that the plane in the photos is a bit beefier under the wing. I built it with a removable wing because there is no other way I can get it into my Geo Metro. I also found that I could save 4 ounces by going to a wing-mounted landing gear. The plane in the photos has the capability of using either the fuselage-mounted aluminum gear or wing-mounted wire gear.

The Twister Sister has a lot going for it and can be a very capable flier. Several features are designed into it that, with practice, should see you scoring better and moving up the competition ladder. Good Luck! ***MB***