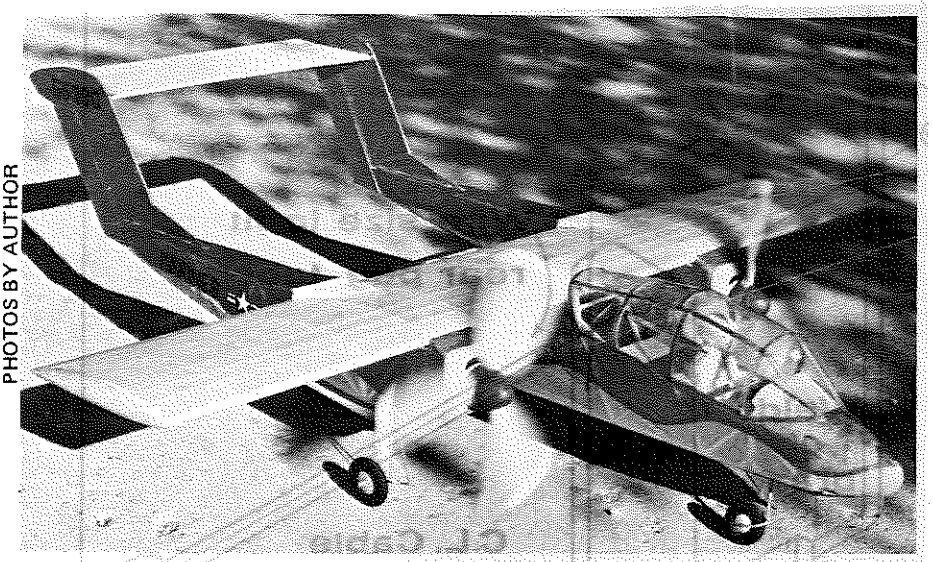

PHOTOS BY AUTHOR

OV-10A BRONCO

By TOM HOULE . . . Rubber scale twins are said to be difficult to fly, but the OV-10A is an exception. The model is exact scale, and while it's not an endurance flier, it is fast and smooth, looks great in the air.

• Twin-engine rubber-powered scale models have always fascinated me. I can still recall the Comet P-38 I built as a kid. No, it did not fly. After all that work, I decided to hang it up in a prominent place. In fact, I have researched the Comet P-38 since then and was surprised to find that it is a close copy of the P-38H. Even the fin serial number shown on the plan is correct. *U.S. ARMY AIR FORCE FIGHTERS, Part 2,* by William Green and Gordon Swanborough and published by ARCO Publishing, has excellent three-views and photos of the Comet kit. So, if you don't like the squarish lines of the OV-10A Bronco, build a much sleeker P-38H.

The real purpose of building the OV-10A was to fully explore the concept of a large size twin rubber-powered model. Are successful flights possible? Is trimming difficult? What about the power-to-weight ratio when using two motors? These questions and a host of others were dancing through my head as I cast about for a likely model.

Round-body twins were eliminated at the start. As were all twins with nacelles not long enough to contain sufficient motor lengths. I mean, this is scale, and you just don't see twin-engine aircraft with rubber extending aft of the nacelles! And I wanted something simple.

Walt Mooney had published a profile all-balsa version of the OV-10A in a back issue of *Model Airplane News.* After reviewing this article and building a Peanut version which flew fairly well, I decided to build a 36-inch version to see if increased wing area would improve performance.

I scaled up both the Peanut plan and the 36-inch span plan from *Jane's All The World's Aircraft, 1975-76 Edition.* There are other scale references available in various aircraft publications, and don't forget your local library for a history of this bird.

Russ Brown of the Cleveland Free Flight Society and Flying Aces Club (F.A.C.) was kind enough to send me copies of some out-of-print North American (now Rockwell International) OV-10A promotional material. This was invaluable as a source of detail, color schemes, and markings.

My plans are exact scale with the exception of stabilizer and wing airfoils, nose gear strut (extended 5/16 of an inch), and all three landing gear struts, which were simplified somewhat. You may be concerned about the lack of dihedral. I was too, but could not see putting any in. It would have destroyed the hulking appearance that I liked. As it turned out, with the long gear legs, shoulder wing, and virtually all weight down low, roll stability has not been a problem.

The only way you'll find out if you like twins is to build one. So let's get started. It looks like a lot of work, but it all goes together quite rapidly. That's why I selected the OV-10A. It has rectangular fuselages, rectangular center pod, and a straight wing planform. What could be easier? Yeah, I know. A single motor project!

CONSTRUCTION

Starting with the wings, which I always build first, cut out the ribs. As we progress through the building notes, I will point out areas where you can save weight. I suggest using 1/20 sheet in lieu of 1/16 for the ribs. As built and tissued, the wings are quite strong. The 1/20 sheet would reduce weight appreciably with little effect on strength.

Select your 1/8 square main spars looking for two matched, straight, and firm grain sticks. Likewise select the 1/20 or 1/16 sheet for the ribs. Pin down the bottom 1/8 square spar over the plans. Cover the plans first with clear plastic food wrap or waxed paper.

I used Titebond glue throughout. The cyanoacrylate glues might work but with Titebond you don't need perfect joints to ensure strength. The trailing edge is notched for additional strength and pinned in place. Now install all ribs.

Note that seven of the ribs are undercut by 1/32 of an inch to enable flush fitting of the 1/32 sheet skins at the fuselages and center pod. Support these ribs with 1/32 sheet scrap when they are glued to the bottom spar and trailing edge.

Install the leading edge, top spars, and add the top 1/32 sheet all while the wing is still pinned to the plan. When all joints are cured, remove from the plan and add the bottom 1/32 sheet fill. This sheet ensures a good joint with the fuselages and the foam fuselage and pod fairings. Either foam or soft balsa tips can be used. I used very soft balsa. Shape the tips per the plan and front views. Sand the entire structure and set aside for the moment.

At this point I built the two vertical and one horizontal stabilizer assemblies. I hinged both, since I really had no idea what kind of control inputs I would need to maintain flight. Besides, it looks nice and very little extra weight is added.

The control surfaces should be hinged to the fixed surfaces with soft wire. If you use copper, it may fracture after several adjustments. I used stainless steel safety wire, but any zinc-coated steel wire should work. The control surfaces are scale. Don't worry about their size. They are large but definitely not sensitive.

Mark the location of the horizontal stabilizer on the vertical stabilizer mount. It is important that the horizontal stabilizer incidence be as shown. That way you will not have to bend the elevator up or down. Somehow I managed to get the horizontal stabilizer incidence about right when still on the drawing board. That doesn't happen too often, folks!

In order to save some additional weight you could use 3/32 squares and 1/16x3/32 strip to build the vertical stabs. However, since they do support the horizontal stabilizer I opted for the 1/8 thickness and a slight weight penalty. Sand after all joints are thoroughly dry and set aside for tissue covering later.

Since the center cockpit pod is the most difficult to build of the two fuselage configurations, I built it first. Again, you could use 3/32 squares and 1/16x 3/32 uprights, diagonals, and cross-pieces if you like. Just be sure you add a few 3/32 sheet gussets to brace the 1/32 plywood nose gear mount.

You can build the nose gear strut as elaborately as you wish. I used plain wire and duplicated only the basic assembly. The forward and aft blocks are foam obtained from the craft section of the local hobby shop. Cut the blocks to match both the side and plan views. Then gently shape to rough final form with a very sharp hobby knife or single-

edge razor blade. A dull blade will gouge rather than shave. The idea is to slice thin pieces off the block. Final sand to a smooth contour with 320 sandpaper.

The blocks should be glued to the fuselage structure before final shaping and sanding. The effect is quite nice once the blocks are in place. Note that the front block goes up and over the front of the pod and becomes the instrument panel and upper nose cowl. A lightweight Bristol or card instrument glare hood should be glued over the foam.

Building the primary structure is super simple. Build the two sides on the plan, remove, and assemble upright with the two sides pinned over the plan view. Use a balsa wheel for the nose gear, either commercially available (Old Timer Models of Milwaukee has them) or "roll your own" from several cross-grain laminations. In either case, be sure to bush the wheel with a 3/32 O.D. brass tube to ensure smo-o-o-o-th ROG takeoffs.

The nose strut was extended 5/16 of an inch to raise the leading edge to an acceptable angle of attack when resting on the ground. Otherwise, I doubt if it would ROG. If the scale strut length is used, you'll have to make such a gross wing incidence deviation that it would definitely be unsightly. Anyway, the lengthened strut is not really apparent. Do it and enjoy an ROG or two.

Make up canopy formers A-C and the two lengthwise canopy support rails. These are molded from four strips of 1/32x1/8 around corrugated cardboard or 1/8 balsa forms. Let them dry overnight or bake for an hour in a 250° oven.

The canopy structure is what sets off the OV-10A, so take your time and do it right. Once the canopy frames are complete it is time to make a solid balsa canopy mold. You cannot flat-form this canopy because, except for the windshield, it is one continuous compound curve. The front and plan views show this.

I built a complete balsa dummy canopy from the windshield aft using 1/8 sheet as a base and 1/8 sheet bulkheads glued to it in the same locations as the molded canopy frames. Once these bulkheads are glued to the 1/8 sheet base at the correct angles, you can fill in the areas between the bulkheads with 1/2-inch thick blocks. To duplicate the molded canopy frames, place the molded frames on a sheet of 1/8 balsa and trace the outer profile onto the sheet. The balsa bulkheads must match the molded frames.

With the 1/2-inch balsa filler in place, you can now carve and shape the balsa to match the side, front, and plan view profiles. I made three cardboard templates to check my progress as I carved and shaped.

The idea is to produce a solid balsa replica of the canopy. Use the bulkheads as checkpoints. Carve the 1/2-inch balsa down to them but do not go any further. If you have low spots, fill them with plastic wood or some such thing. Sand smooth and apply a couple of coats of varnish. Sand some more. You *do* want a perfect canopy, don't you?

Fit your balsa canopy to the center pod and make sure that it flows into the fuselage at all points. Satisfied? Okay. We are ready to either vacuum form or hot water mold the canopy. That's right, troops. I said hot water mold a canopy.

Since I do not have vacuum form capability, I used the hot water molding process. Dave Gibson, a modeling mentor of mine from Canton, suggested I try this. He has had some experience with it and passed it on, so I am passing it on to you too.

The canopy, due to its compound curves and pinched-in width at the bottom, cannot be molded in one piece. Since there is a horizontal canopy rail on each side, it seemed logical to mold two side panels and one top panel. They are installed with an overlap at the horizontal canopy rail on each side.

A 1/2-inch sheet balsa box was built that stood three inches high and was just large enough to slip over the balsa canopy mold.

Obtain some .015 butyrate plastic from your local hobby shop. I believe Sig also sells a similar material. Both vinyl and butyrate will work with the hot water process. Acetate will not work, as it will not soften enough. I tried a .0075 thickness too, but it was not stiff enough when molded. Anything from .015 up will work.

Stretch the plastic across the open box tightly, wrap it over the sides and hold in place with rubber bands and pins. Get the plastic as tight as possible. Slit the corners so the plastic wraps around the corners.

Set a shallow pan on a burner with about 3/4 of an inch of water in the pan. Have the mold and the balsa box plus plastic ready to go nearby. When the water boils, immerse the balsa box, with the plastic down, in the water. Wait two to three seconds and pull out the box while snatching the mold with the other.

With no hesitation, place the box and plastic onto the side or top of the mold and push hard. You must mold the plastic while it is still hot and pliable. It may take two tries to get it right. Be sure you have extra plastic sheets. You could also try placing the balsa mold in the water and plunging the box over the mold while underwater. That way, you have an ongoing supply of heat. In any case, once you are satisfied that the draw is deep enough, get the plastic out of the water. The butyrate I used had a tendency to mottle and turn milky if left in the water too long.

There you have it; a simple, low cost way to obtain a compound curve. I haven't tried it with a one-piece canopy, but if it were molded underwater, I do not see why it would not work.

Vacuum forming should be done in the usual way. Make two side and and one top panel just as in the case of the hot water process. Trim the three molded sheets and fit to the canopy frames. I found cyanoacrylate glue to be perfect here as a neat, quick means of attachment. Do not worry about the overlap at the horizontal canopy rail. It will be covered up with strips of tissue which simulate the canopy frame.

Since the entire cockpit is gray, I painted the interior of the canopy frames and exposed balsa with flat gray. I also carved a styrofoam pilot. I did not add an observer, as this bird is used only for ferry flights. Hence, the sponsons were also omitted.

Install the canopy and windshield now so that the tissue covering can be brought up to and over the edges of the plastic. It makes for a neater, more prototypical installation.

Put the whole works aside and proceed to the two fuselages. Again, these are standard construction. Build four identical sides over the plans, remove, and erect while pinned over the plan view. It takes a bit of doing to pull in the sides at the front. A couple of rubber bands will be appreciated. Be sure to install the 1/32 plywood rear peg support prior to assembling the fuselage sides. It is a lot easier to do it on a flat side.

Bend and install both main gear legs and like the nose wheel, either use a commercial balsa wheel or laminate your own. Bush as per the nose wheel.

The nose block assemblies are also standard. Be sure to use some type of ball bearing. I used the JASCO .062 size available from Old Timer Models. Also, .062 music wire was used for the front hook and winding eye. A conventional free wheeler was also installed on each prop hub. Note that the two free wheelers are opposite from each other. Prop spinners are removable.

The three-blade props are scale and I highly recommend the version shown on the plans as being very efficient. The blades are 1/32 plywood, and after water soaking, are formed on a 4-inch diameter bottle at a 15° angle from vertical. Make three left-hand and three right-hand blades. Three should slant to the left and three should slant to the right. Let them sit for three to four days or bake at 250° F. for an hour or two.

The hubs are straightforward and very strong. Bush each hub and nose block with 3/32 O.D. brass tube. Make sure the bushings are true, otherwise your props will wobble. Glue the ply blades to the hubs, ensuring that you have exactly 120° of separation between adjacent blades.

Build a conventional right-hand prop and an unconventional left-hand prop. The conventional prop goes on the left side. The unconventional prop goes on the right side. See the front view for direction of rotation.

If you are still with me, you should be ready to start covering. Since there is always an unsanded bump somewhere, give the whole structure one more shot with the sanding block, assemble the entire airframe to ensure that everything fits (including the horizontal stabilizer), bask in the glow of your building genius for a moment . . . then take it all apart.

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That's right. This plane can be covered the easy way: in pieces. Even the vertical stabilizers are covered before attachment. What could be easier? At this point you must decide if you want the all-gray Air Force version or the forest green, white, and gray Marine scheme. I chose the Marine decor, as I thought it a bit more exciting than all gray.

As designated by the North American literature, the Marine wings are all white top and bottom. The horizontal and vertical stabilizers are both forest green. The three fuselages are green upper and gray lower surfaces, separated by a wavy line.

I obtained the wavy line demarcation by laying a length of green tissue over a corresponding length of gray. I then cut a wavy line with a sharp razor blade through both pieces. This works especially well if you do the cutting on a layer of newspaper. Then overlap the two 1/16 of an inch and glue together with diluted white glue. The overlap is not too apparent. Make up six such pieces for the two fuselages and the center pod. Or, you could airbrush the green over gray.

Water shrink the tissue and apply one thinned coat of dope before final assembly. You can also apply all markings and insignia before final assembly. It's a lot easier to do it now.

When the fuselages are glued to the wings, make sure they are true. Do not offset the thrust lines using the fuselages. Glue in the horizontal stabilizer, making sure that it is correctly positioned as shown on the plans.

There you have it. One completely assembled North American OV-10A. But before you fly, put on another coat of dope. Two coats should be sufficient. Any more adds weight and doesn't really help.

Make up two motors about 22 inches long; each motor should be six strands of 3/16 flat rubber. I used F.A.I. brand. Braid the motors to shorten them and install. Attach at rear with 3/16 aluminum tube pegs. Also, be sure you slip pieces of plastic tubing over the front prop hooks. They may save you from a blown motor due to a minute nick in the prop hook.

Wind the motors just enough to hold the nose blocks in place. Pin the props so they cannot rotate and balance the model at the point shown on the plans. Do not attempt to fly unless the center of gravity is at or slightly in front of this point. Add weight as necessary. Mine required nose weight.

I just happen to have 75 acres of waist-high grass right next door to me, which really facilitates hand gliding to check for turn, warps, C.G. location, etc. If you do not have access to some kind of tall grass, I hesitate to recommend test glides.

You might try 100 turns on each side and ROG the model for its maiden voyage. Set the rudders and the elevator at neutral before the first glides or launch. Use up elevator to correct for a fast nose-down glide. If you need more than 1/16 inch of up elevator to flatten the glide, remove some of the nose weight and omit the up elevator.

If the elevator settings produce large pitch changes, you need to move the C.G. forward in 1/4-inch increments until the sensitivity is reduced to a manageable level.

You should make all pitch adjustments with the props pinned and the rubber tensioned. This ensures the C.G. will stay put while you are trimming.

Put in 100 turns on each side, making sure that the motors are lubed, stretch wound, and that you have wound the two motors in the correct directions. Remember, they are counterrotating!

My Sig winder had the chuck and winding hook threaded onto the winder shaft. It is not pinned or brazed. Since I have used this winder for several years with no problems, I was totally unprepared when I wound the right-hand motor. Since it is wound "backwards," at 75 turns or so the rubber had enough torque to unscrew the chuck from the winder. The chuck and rubber tried to bury themselves at the back of the right fuselage! Unbelievably, no damage was done. I have since switched to a winder which has the chuck pinned! Either that, or locate a left-handed winder. Let me know if you do.

One hundred turns on each side should be enough to see what the model is going to do. It will probably turn to right or left and might roll in to that side. To prevent this, add a 1/16 shim to the inside of each nose block. The left motor should have left thrust, and the right motor should have right thrust. This adjustment offsets a weak motor and prevents the stronger motor from drastically turning the plane to the weak side. Make this adjustment before your first powered flights. And make it equal on both sides.

My model did not require any downthrust at all. It flies to the left, to the right, or straight ahead with both motors canted outward 1/16 inch at the nose block. Rudder is used (about 1/8 inch of offset each side) to control the turns.

Because of the huge vertical stabilizers and no dihedral, it can and will drop the inside wing in a turn and roll in. This is managed by putting a 1/32x1x6-inch down aileron on the bottom of the inside wing. It should be about 3/16-inch down at the trailing edge.

Of course, you could also build scale ailerons into the wing. These would indeed be functional. Or you could severely wash-in the inside wing. I didn't do this because it flies so well to either side or straight ahead that I wanted to keep all options open. Functional ailerons would be best. I highly recommend them.

The model is very stable in flight. Perhaps this is due to the gyroscopic effect of the two props and zero torque. With both fans turning it is an impressive sight. The two low-pitch 9-inch diameter props provide plenty of thrust. It will almost fly right out of your hand. Do not use thrustline adjustments to control the turn. The side thrust adjustments are incredibly sensitive. You will get right or left turns you never heard of if you start fiddling with variable mixes of turns, strands, and side thrust.

Keep the number of strands, motor length, number of turns, and side thrust equal. Use the rudders for turns. They are very mild; 1/8 inch of rudder offset will produce a nice, gentle turn. But don't forget to keep that inside wing up.

Work your way up to 350 turns on both sides with the six-strand motors. I am sure you will be amazed as I was at the inherent stability of this model. It is one rubber model where the more power you add, the more stable it seems to be. The climb is rock solid; gusts do not upset it. I attribute this to the low center of gravity, high wing, 9-inch 3-blade props, and counterrotation, which cancels torque.

It is truly strange not to have to work with or against torque. How many models have you built that would fly to either side or straight ahead just by bending the rudders? Believe me, it is weird.

A word about winding and launching: it takes two people and at least four hands to wind one motor, hold it and the other rear peg while the second motor is wound. Then the helper must hold one prop while the builder holds the other prop and launches. The aft foam block on the center pod makes an excellent hand hold for launching. I count to three; on three we both release our props while I gently toss the model straight out. It will climb right from the launch. If not, add a touch of up elevator. If it still will not climb, remove nose weight in gradual increments. The elevator should be kept close to neutral and down elevator should never be required. If so, add nose weight fast because you are into stall country.

Once you are comfortable and thoroughly familiar with six strands and 350 turns on each side, add two more strands (another loop) of 3/16 rubber to each side and stand back, because now you've got a Bronco on your hands.

And try some ROG's, too. Mine gets off in five to eight feet with full power. I find the sight of a rotating twin to be absolutely fascinating. My model as it sits is certainly not an endurance model. It weighs over seven ounces without the rubber installed. With 234 square inches of wing area, wing loading is pretty high. But the objective was accomplished. I set out to build and fly a big rubber twin. I think you will enjoy it as much as I have. Twins *are* twice as much fun! •