



# WACO Biplane

By KEN WILLARD . . . Finally! Here's a fun little biplane designed for the G-Mark .030 that will fly and look realistic in the air or on the ground. Grab some sheet balsa and your micro radio gear!

• About twenty five years and thirty pounds ago, I designed a small, all-balsa and plywood Waco custom cabin biplane for the Cox Tee Dee .020 engine, an Otation super-regen receiver, and Babcock escapement. The design was published in the now defunct *American Modeler* magazine, and was popular with small airplane enthusiasts. After a couple of years of flying, the model was "retired" to hang in my garage.

A couple of years or so ago (the pounds had stabilized by then), I took the Waco down, cleaned it up, and installed a new radio and engine combination. The radio was Cannon's Super-Micro, and the engine was the G-Mark .030. It was the perfect combination; the throttle feature on the G-Mark made it possible to taxi out, take off, climb out, throttle back and cruise . . . even do touch-and-goes! It was a reborn hit.

I took some photos of it with me when I went to the Toledo show in April 1983, and showed them to Bill Northrop, originator of the phrase, "Real airplanes have round engines and two wings."

"How about an updated construction article?"

"I'll do it."

Time passed, other designs came along. Then I went to Toledo in April 1984. Bill gave me that icy stare.

"I'm working on it," I lied.

"When'll I get it?" Bill demanded.

"Before the end of May."

"What year?"

He had me trapped.

"This year," I promised.

So here it is. When you see it, if it's late

in the fall, don't blame me. I did what I promised . . . delivered it in May, 1984. Yeah, I shoulda done it sooner, but there's a side benefit now. In addition to Cannon, you can also install the new, lightweight equipment from World, Airtronics, Circus, or Ace. The choice is yours. There's room for any one of them. The plans show a schematic installation for three servos, a small receiver, and a small battery pack. The servos are installed merely by sticking them to the sides of the fuselage with mounting tape, and the receiver and battery pack are loosely packed in foam rubber and stuffed up front behind the firewall.

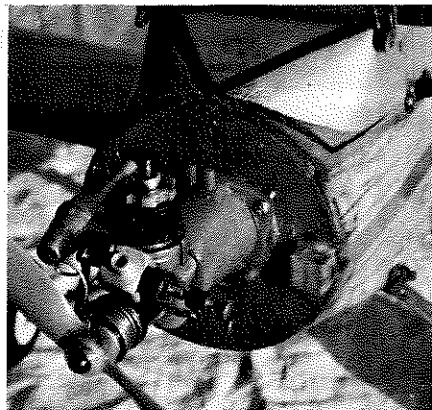
With the exception of the radio mounting, the basic construction is unchanged from that which was described twenty one years ago. This is the way it read:

**WINGS.** The top and bottom wings are made in three pieces — the right and left panels and the center sections. The panels are butt-joined and glued to the center sections, with the inboard ribs of the panels slanted at the proper angle to provide the right dihedral. Some sanding may also be required to make the angle accurate. Then a 1/2" strip of nylon, or Celastic if you prefer, is glued over the joint on the top and bottom to give it the necessary amount of strength. To make the panels there are a couple of tricks. Let's take a top panel in sequence.

1. Lay the bottom sheet of 1/16", sanded to 1/20", on a flat surface.
2. Put a piece of 3/16" sq. stick *under* the bottom surface, longitudinally, at the tip rib location. Pin the bottom sheet to the table.
3. Trim the bottom of the leading



Slightly different cola bottle cowl. Cutouts allow access to fuel lines and glowhead. The windshield block is held in place under wing.



G-Mark engine mount is an offset backplate shim that has been slanted and tapered to give down and right thrust.

edge to fit the curve from the tip rib to the next inboard rib. Glue in place.

4. Glue and pin ribs in place. Also glue the brace for the center section rib in place.

5. Glue forward edge of the top sheet to the leading edge. Leading edge can be shaped from a piece of 1/4" x 5/16" balsa, as shown in the side view, or if this is too tedious, use a piece of 1/4" square and run the top sheet forward an additional 1/8".

6. When dry, remove pins holding ribs in place and glue top surface to ribs and to the bottom surface at the trailing edge. Leave tip unglued. Hold top down to ribs with rubber bands stretched from plans at leading edge to pins at corresponding points at trailing edge.

7. When dry, remove from table, block up center rib 2-1/4", press tip down so top surface touches bottom surface all around tip curve. Glue and pin in place until dry.

8. Sand smooth, fit center rib to center section rib at the proper angle for dihedral, and assemble wing.

The bottom wing is made the same way, except that the tip slopes up from the outboard rib. To glue the tip of the bottom surface to the top sheet, block up the center rib 1-1/4".

**TAIL SURFACES:** Cut out the stab, fin, elevators and rudder from 3/32" sheet, sand, and after they are doped the hinges can be installed. Reason for waiting until this point to install hinges is to keep them from becoming stiff from soaking up the dope. The whole tail assembly is glued to the top of the fuselage at the stab. Note that the elevators with the 1/8" joining dowel must be installed before the rudder is attached to the fin.

**FUSELAGE:** This is a pretty standard box construction, with the two sides built up and then joined with conventional cross braces. Only a couple of points need explanation. Note the section A-A where the side brace has a slight curve to give the proper contour to the sheet side as it rounds into the forward firewall curve. You'll have to wet the sides and mold them to fit the firewall, glue and let dry. Then you can cut the shaped piece of 1/8" sheet on which the windshield block rests and glue it in place. Also the block at the bottom, which is carved to fit the firewall and fair into the bottom where the landing gear brace is glued.

The 1/16" x 1/4" spruce sticks glued to the top of the sides, with notches for the rubber bands that hold the top wing in place, can be cut from Popsicle sticks.

With these two sticks jutting forward, the windshield is carved from a block of soft balsa which fits between the sticks, under the leading edge of the wing, and forward to the firewall, where a piece of tapered balsa is fitted, as shown, so the block can be removed without having to take off the top wing.

Note the offset for the engine mounting blocks. This takes care of the down-thrust and right thrust and results in the center of the propeller aligning with

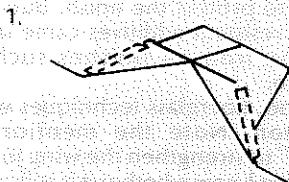
the center of the cowl.

As for the cowl, there are several alternatives. If you are fortunate enough to find one of the 3" aluminum cowls that used to be available, it'll be nice, although it will get dented in hard landings.

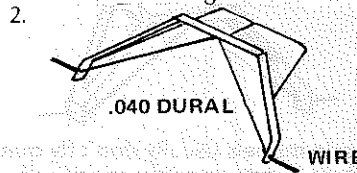
The best bet is to take an RC Cola plastic bottle — you know the type — and cut out the bottom. Tailor it to the right shape and fit it to the firewall like a bottle cap, hold in place with a couple of small screws. This cowl will survive all sorts of banging about. Make cutouts for the needle valve and the fuel tank intakes. Also, unless you want to rig up some wiring scheme to attach your booster battery, a hole will be required to get at the glow plug. I'm assuming, of course, that you'll be flying with the cowl on. You can fly the model without it, but it doesn't look nearly as well.

**WING STRUTS:** These are cut from 1/32" plywood. After you've finished the wings and fuselage, put them together, fit the struts in place, then glue small strut braces to the wing surfaces, located so that the struts are under slight pressure and have to be snapped in. Then you can fly the model with the struts mounted, and, in case of a hard landing, they'll snap out without damage.

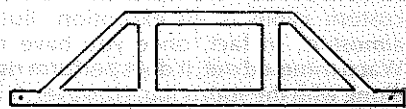
**LANDING GEAR:** Here again there are several ways to make a semiscale gear. The whole structure can be made up from 1/16" wire:



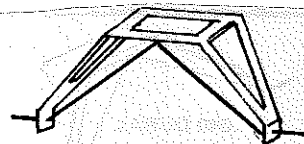
Then add balsa fairing to the main strut.



Or cut the whole pattern from dural,



and run the axle wire up to front top center.



Scale models usually don't fly quite as well as sports models specifically designed for R/C. This is even more likely to be true for scale biplanes. The Waco custom cabin is no exception. But it almost is. In fact, once you have the Waco trimmed out, it does perform right along with the sports job. However, it is a

little more touchy during the trimming-out stages.

Most important in the trim is to be sure the model isn't tail-heavy — and this may mean you'll have to add ballast at the firewall, because the nose is rather short. It's better to start off nose-heavy, if anything, to avoid the common stall and crash of the tail-heavy job. If it's nose-heavy, it will fly faster and may be hard to keep up with on the controls, but that's better than trying to keep turning it out of a stall.

Since the rudder and elevators are fairly large, they are very effective. Keep the travel down to ten degrees or less until you're familiar with the response rate. Also, a 1/16" droop in the elevator can make the difference between a stalling flight or a steady one.

Because of the large fin and rudder areas, the Waco, when trimmed, will hold a turn in either direction until opposite rudder is applied. Also, if the alignment is off, the turn in that direction will gradually build up into a spiral dive. Opposite rudder will pull it out, but you should re-trim your rudder before the next flight.

Hand launching is easy, due to the stagger of the lower wing. You hold the model by the rear landing gear struts and launch straight ahead and level.

Take-offs are fine, if you have a runway. Just be sure your wheels are straight and there is no binding.

#### UPDATE NOTES ON THE WACO

Most of you are totally unfamiliar with super-regen receivers and escapements, as mentioned in the original article. Too bad; you'd have a lot more appreciation for the modern day lightweight equipment. With an escapement, when you operated the controls, they went right to full throw; you couldn't "ease in a bit of up elevator." It was all or nothing. But you learned how to "blip" the controls — short blips for gentle action, longer blips for more violent maneuvers. It was, as they say, a "sporty course."

Also, twenty five years ago, we used nitrate dope, and then added a "fuel-proofer" to protect the finish. Butyrate with fuel resistant additives came later, as did the iron-on finishes such as Monokote.

Then too, fiberglass techniques were uncommon. Note the mention of "Celastic" to strengthen the wing joints. I don't even know whether it is still available, but, nylon tape is, so you could still use that, or a strip of fiberglass tape.

One last observation. With the G-Mark .030, the performance is very realistic. You have to "fly it on the wings." It will not take off and climb straight up. If that's what you want, install an .049. But I don't recommend it. The full-scale Waco "E" was a fine performer. Don't spoil your model by making it a hotrock. The model's realistic appearance and performance is what makes it such a crowd pleaser... even when dwarfed by some of today's giant scale jobs.

Kids love it. At least this kid does! •