



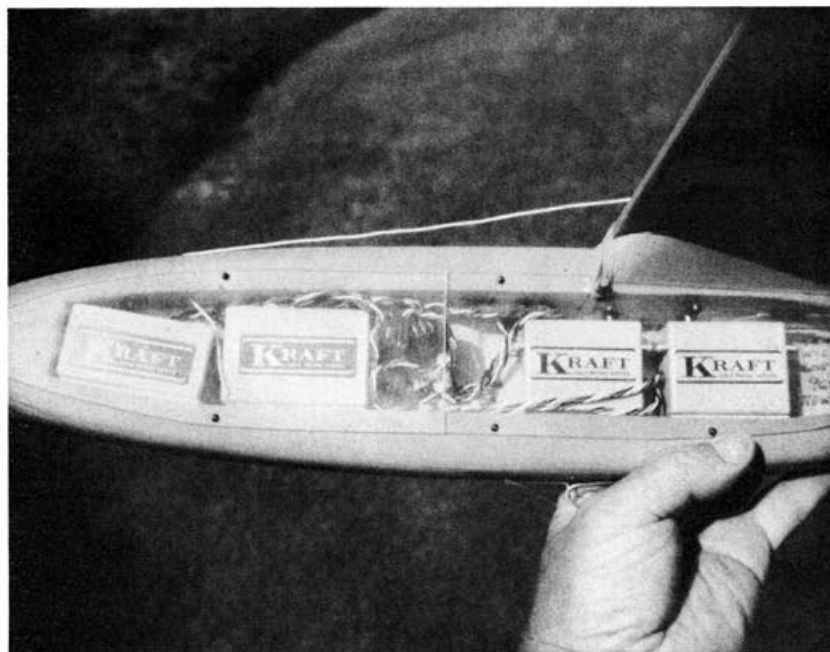
Ken Willard and unique Cliffmaster.

# CLIFFMASTER

By KEN WILLARD

A TOP SLOPE MACHINE, WITH UNIQUE PROFILE FUSELAGE, THE QUICK-BUILDING CLIFFMASTER IS ADAPTABLE TO THERMAL SOARING.

Equipment section of profile glider receives lots of comments.



The Cliffmaster is not so much a design as it is a design concept. The reason I say that is because, since the original prototype was built, there have been four variations constructed. And all four of the designs have at one time or another won an event in which they were entered.

The idea behind the Cliffmaster evolved from a desire to have a small, but fast, entrant in RCM's annual slope soaring pylon races at Sunset Beach. And, at the time the idea hit, there were only a few days before the races, so the construction had to be simple and fast. And it is.

The best thing about the design is its adaptability to various wings. In fact, I had planned to include the drawings for a thermal wing along with the racing wing, but time didn't permit. However, for those of you who want to experiment, you can draw up your own version. I would suggest a wing with 74" span, root chord 7", just like the racing wing, and taper to a 4" chord at the tip, with the leading edge to be kept straight and the trailing edge tapering forward. As for the section, a 9% thickness, with maximum camber at the 40% point, and a flat bottom, should do a reasonable job. That's what I plan to try, anyway. Keep it light, too.

But back to the racing version. The wing is ultra simple to build, although I did complicate it slightly for you by tapering the spar thickness from 3/8" at the root to 1/4" at the tip. The original wing did not have this taper, and thus the thickness ratio, which is ten percent at the root, increased to about 15% at the tip - and this slowed the model down.

There are better wing sections than the one I used - but I doubt if there are any that are faster to build. The bottom and top sheeting is 3/32" sheet, and when you pin the bottom sheet to a flat surface, add the trailing edge stock to the leading and trailing edge positions as shown, glue the spar in place, and then bend the top sheeting over the spar; the top sheeting takes a natural curve from leading edge to trailing edge and only needs a couple of aligning ribs between the root and the tip. The 1/8" x 3/32" strip just ahead of the trailing edge stock at the rear of the wing gives you a good gluing surface.

Admittedly, it's rather unusual to use trailing edge stock at the leading edge of a wing, but if you'll note that the width of the stock is 3/4" at the

*(continued on page 66)*

## THE CLIFFMASTER

(continued from page 16)

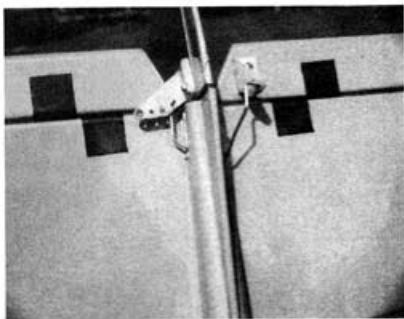
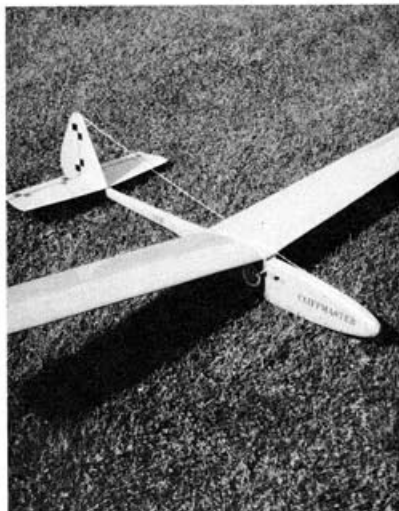
leading edge, and that used at the trailing edge is 1" wide, you can see how it fits the natural curve of the wing, with just a little sanding required.

You may think the dihedral appears to be excessive, but it isn't. Since you will be making rudder only turns, this amount of dihedral works out best with the vertical fin and rudder area, and you can make very tight pylon turns with a minimum of skidding and subsequent loss of speed. Also, the dihedral works out to be about 7 degrees in each panel, and old time free flighters will recognize that as a fairly standard amount.

For added strength at the center section, a one inch wide strip of celastic is used along with the plywood dihedral braces. The celastic fairs into the fuselage and does not detract from the appearance.

So much for the wing. Now we come to the "unusual" fuselage. Just before building the Cliffmaster, I built a profile fuselage glider, using 1/4" hard balsa, and attaching the radio units to the side with double stick tape. It worked all right, but the appearance left something to be desired, and the 1/4" boom was always breaking on hard landings - which are fairly standard occurrences in slope soaring.

Then came the idea of using a one inch wide block of balsa, with a cutout to house the receiver, battery pack,



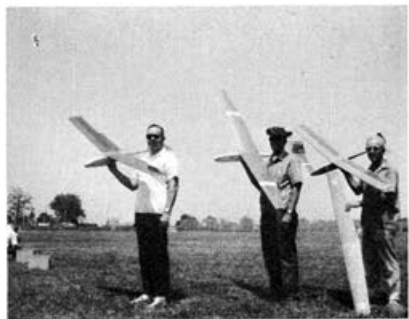
Rudder & elevator control horns. Note extra hole to increase rudder throw.

and servos. The Kraft units are all less than one inch wide, so they could be internally mounted, and then have side plates to cover them. Originally I had planned to run the pushrods along the outside of the fuselage back to the tail, then Jim Nelson, a neighbor and modeling enthusiast, suggested the hollowed out 'race' to accommodate the pushrods, and it worked out fine. The only problem I had was fitting the connections to the two servos, the problem being that the take off from the servos had to be on the same side. This was solved by mounting one servo flush to one side, and the other flush to the opposite side. It's a close fit, but works.

The switch is mounted to one of the side plates as shown. The other side plate doesn't have anything mounted on it and is removable for the purpose of battery charging. I also made it out of clear plastic rather than plywood - for two reasons. One, it displays the equipment and makes a great conversation piece. The other is for a more practical purpose - you can make a visual inspection of the equipment after a hard landing without having to remove the cover.

Back at the tail, a slot is cut in the tail boom to insert the ventral fin, which is made of 1/8" plywood for

Watson, Andris, & Willard with four versions of the 'Cliffmaster'.



strength. The top of the plywood piece is fitted flush with the top of the boom, and this makes a very strong assembly.

The wing cradle is made from two strips of 3/4" triangular stock. Note that they are glued to the sides about 1/8" up from the top of the fuselage, and then cut away at an angle so that the center of the wing will lie snugly in place. I also have shown a slight cutout at the center of the fuselage which I had to make to allow for the slight additional thickness created by the elastic reinforcement of the center section of the wing.

Round the corners of the fuselage (except at the wing cradle and at the tail where the stab is glued on), add the wing dowels, sand smooth, and you're ready to apply the finish.

Tail surfaces are cut from 1/8" sheet stock, and the fin is reinforced at the base with 1/4" triangular strips.

Finish is a matter of choice. I chose MonoKote because it goes on so fast, and gives a professional appearing job in a minimum of time.

I also used MonoKote for the hinges on the rudder and elevator. They stand up to all normal use, and in the event of a landing which puts a strain on the hinge, they let go without ripping up the wood, and are easily replaced. Incidentally, the hinges are made from the old style 'wet' MonoKote, which is available now for trimming purposes.

The Cliffmaster is very easy to fly. It responds quickly to elevator, so keep the travel down by using the end position of the control horn. It needs a lot of rudder action, so use the inner hole for connecting the pushrod.

For those of you who have equipment that is wider than 1" there is the alternative of using wider stock - or two pieces of 3/4" stock glued together - or you can make a 'Pregnant Cliffmaster' like Marshall Watson did - added two half inch doublers up at the equipment section, cut out to match the main block. He did it so he could put two servos side by side; he wanted an additional servo to operate flaps which he added to the wing.

Ballasting for various wind conditions is done by taping flat fishing weights right to the sides of the wing cradle. This keeps the weights close to the CG, thus increasing the sink rate and the forward speed at the same time.

The C.G. location doesn't seem to be critical. I've shown the range through which I've flown the prototype, and the location where I seem to get the best results. Try all of them and find the one which suits you best - in fact, you'll probably use various locations, just like I do, depending on the wind conditions.

I think you'll like the Cliffmaster. It's a real crowd pleaser. At first glance, everyone looks at it and wonders "Where's the equipment buried?" Then, if you have one side plate transparent, you turn it and show them - and darned if they aren't off to build one of their own!

So tell them where to get the plans, will you? And let me know how yours turns out.

**Marshall Watson's 'Pregnant Cliffmaster' going up on tow. Note flaps - very effective for spot landings.**

