



Joseph's Coat had nothing on the author's "Square Hare!" The moral of the story is: Save all your Monokote scraps and sooner or later you'll have a free covering job . . . if you can stand it! All major parts of model can be marked directly on wood with ruler and ball-point pen.

the SQUARE HARE

Back in the days when "Trainers" were *really* trainers, many an R/C flying field was overrun with "Rectangular Rabbits." If it could handle "Gallop Ghost", it's a cinch with modern propo. By BILL NORTHROP

In days of old
When R/Cers were bold,
'Cause proportional had not been
invented,
There were many bashes . . .
And terminal crashes . . .
But the pilots were most always
contented.

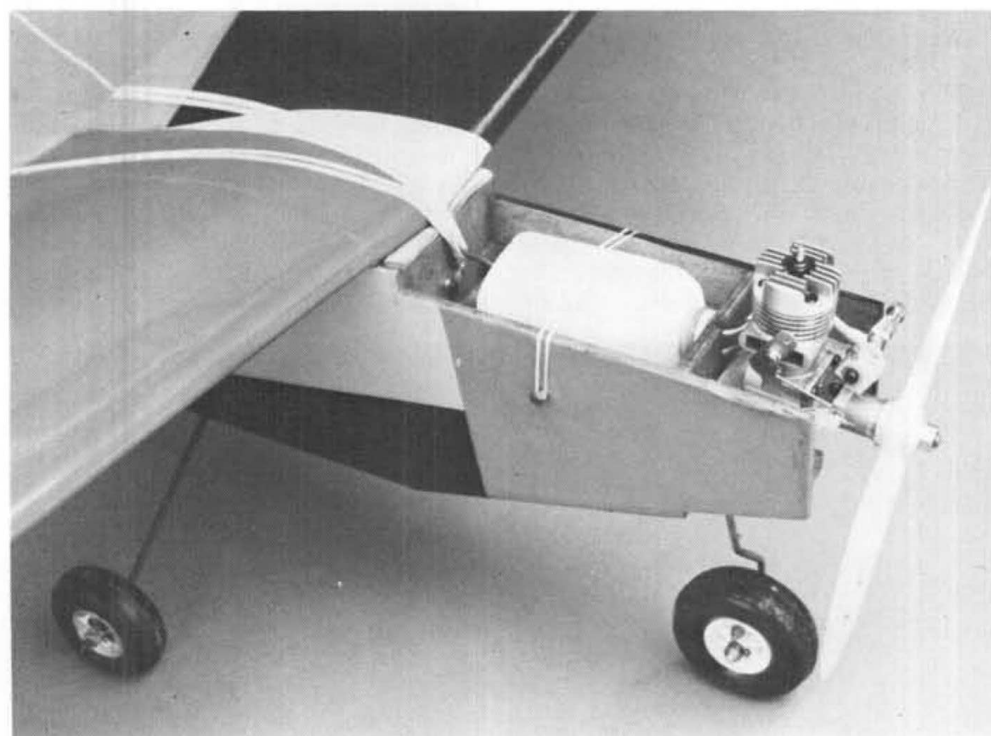
The "Square Hare" dates back to those days of old. It was designed and built in 1961, and published in the September 1962 issue of what was then

called American Modeler. In the same issue, there were ads for Space Control and Command Control; two analog proportional radio systems . . . The first and somewhat unreliable proportional rigs available to the hobbyist. Prior to those systems, there was Walt Good's TTPW (Two Tone Pulse Width . . . also referred to as "Too Tough to Piddle With"), pulse rudder, and "Gallop Ghost." Everything else was escapements and reed multi systems.

In that age, single channel was the dominant radio control system for the average modeler. Various actuating systems were individually developed by experimenters who attempted to get more than one control from a single channel. Actuated by the radio's relay, rubber band powered escapements were the most common and manufactured item in use. Actuated by a push-button on the transmitter, there were simple sequential escapements that gave you alternating right and left rudder, there were compound escapements that gave you selective right or left rudder, and there were escapements that would allow you to select right or left rudder and up or down elevator . . . but only one at a time. Talk to an old timer about the fascinating challenge of radio control flying in the "good old days."

Early pulse rudder systems employed magnetic actuators or electric motors. A pulse box of some type or another was connected to the transmitter, and used to send pulsing on-and-off signals to the receiver, which in turn caused the receiver's relay to pulse. By wiring the actuator through the relay contact points and a separate set of batteries, one could make the actuator pulse back and forth. Connected to the rudder by a torque rod and crank system, the actuator would cause the rudder to constantly wag back and forth.

In the air, provided the rudder was pulsing fast enough (and it usually was), the airplane merely flew straight ahead not reacting to the continual wiggling. When a turn was desired, the flyer



How's that for an accessible fuel tank? Enya .19 is more than adequate power for the "Boxy Bunny." Ground control is sufficient without the need to rig a steerable nose wheel.

pushed one of two buttons on the control box which gave either a full "on" or full "off" signal to the receiver, resulting in a fully locked right or left rudder. By skillfully playing the buttons, a variety of maneuvers could be accomplished.

The next step was to have a pulse box in which the pulses could be varied from 50% "on" and 50% "off" to 60-40, or 65-35, or 70-30, and so on. This was fairly easily accomplished by many experimenters (you didn't have to be an electronics genius, just a mechanically inclined modeler) and resulted in a stick controlled rudder that could give you a *proportional* amount of turn instead of "all or nothing."

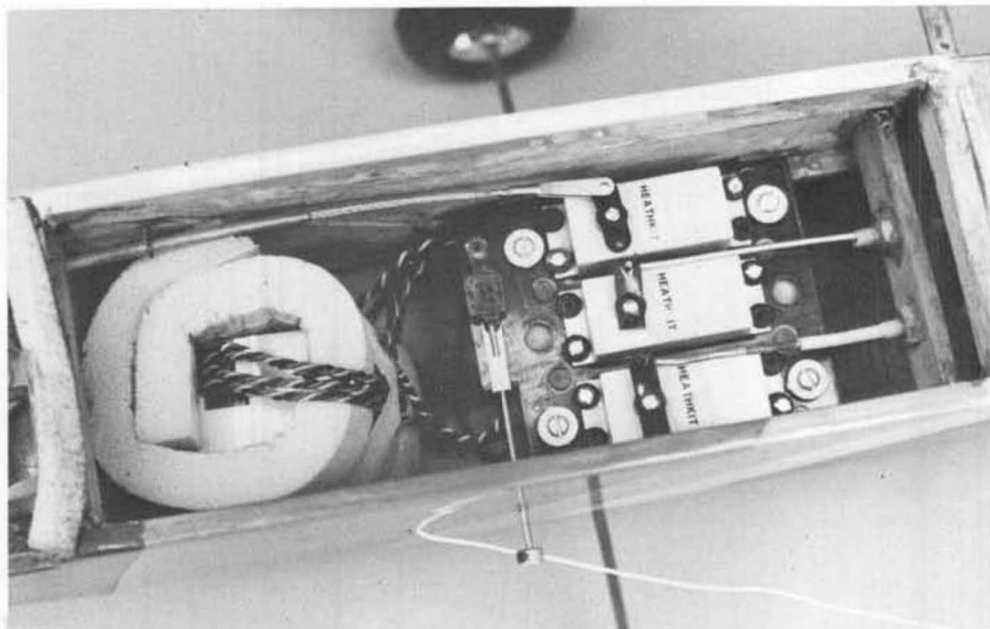
Then came "Gallop Ghost." This term referred to single channel pulsing systems as described above, except that now, the *speed* of the pulse could be varied as well as the time on or off. As a result, elevator control, though slightly interacting with the rudder, could be had. A characteristic of this system, which would require diagrams and photos to describe (even when you saw one in action, it was hard to believe!) was that in "up" elevator the system was pulsing at its slowest rate. Consequently the plane *did* react to the deflecting surfaces, resulting in a galloping flight path. Nevertheless, it was cheap proportional.

We hope you'll pardon the above brief portion of R/C history, but the Square Hare was developed for pulse rudder and/or Gallop Ghost, and as such, fits well into the requirements for a beginner using today's reliable 3-channel systems. Designed to withstand the rigors of experimentation and the less reliable radios of an earlier era, it will now help the beginner through his indoctrination into the great hobby of R/C flying.

The "Rectangular Rabbit" was designed around common stock sizes of balsa and plywood. In fact, except for occasional reference, and tracing of a few parts, it can be built without the plans. The first duplicate of the "Boxy Bunny" was built by a modeler who jotted down a few basic measurements on a piece of paper during a Saturday afternoon flying session. He came back the following weekend with the completed model, his first R/C ship!

It's a bit much to brag about one's design, but we have talked to a multitude of modelers over the years since the Hare was first published, and it's surprising how many had cut their R/C teeth on one. The most recent Rectangular Rabbit reminiscing took place at the Seattle WRAMS trade show when we met a Canadian modeler who told of his "Hare" raising experiences some years ago.

The ship is extremely rugged, yet light (an even 3 pounds, ready to fly), is inherently stable, and can be flown at moderate speeds throughout the modeler's early flight training. For this peri-



The author's Square Hare has been the test bed for many different R/C systems. Here it carries the Heathkit GDA-1057 receiver and 3 sub-miniature servos. Internal switch stays clean.

od, it is also advisable to move the balance point about 3/8 of an inch ahead of the mark shown and use minimum control surface movement. Once the flier has gained confidence, move the balance point back, increase control sensitivity, open up the throttle, and watch out! Wanna do a 2-1/2 turn snap roll followed by a spin... in either direction? Get some altitude, pull the nose up, then slap the stick into either back corner of the box.

Engine size can vary from .15's to .29's. For the beginner, a throttled back .19 is more than adequate. Our Enya 19 R/C gives a good range of power. A .29 gets you into the "bomb" category, but then, some R/Cers prefer to "aim" their aircraft rather than fly them.

Since Square Hare may appeal to the completely raw beginner in modeling, as well as to the newcomer to R/C, we'll try to be fairly detailed in build-

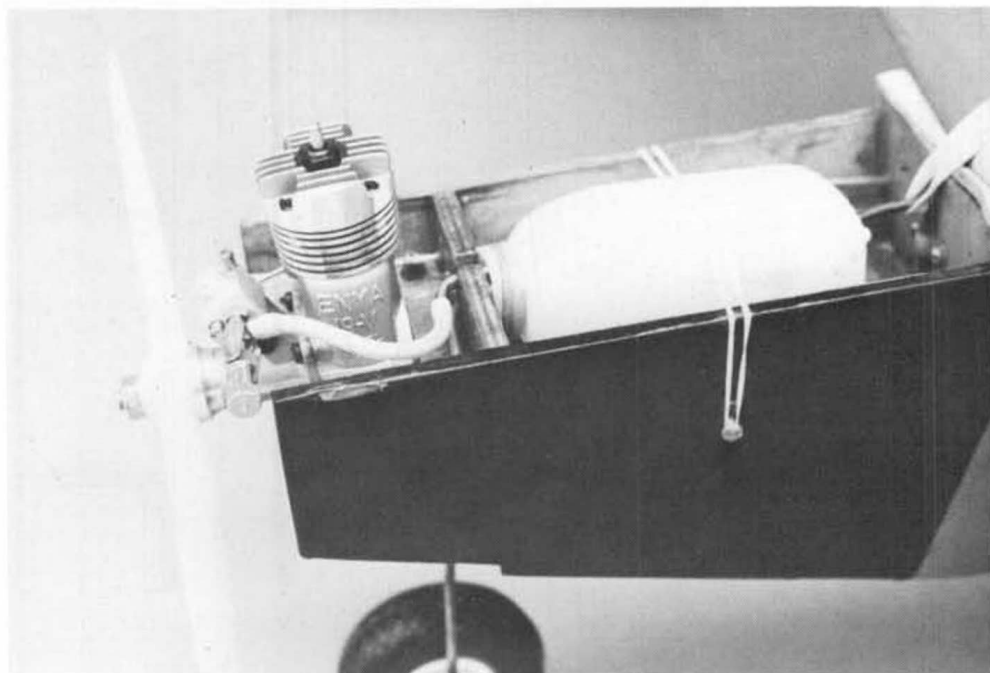
ing instructions. The full size plans show actual shapes and sizes of parts, however, being true to its name, the major parts for "Boxy Bunny" can be marked out directly on the wood itself, with no need for cutting up the plans, or making meticulous tracings. Get yourself a ruler, a small carpenter's square or drafting triangle, a soft pencil or ball point pen, and you're in business.

Read the instructions through before beginning actual construction.

FUSELAGE

Select two straight, fairly firm 1/8 x 4 x 36 inch sheets of balsa for the sides. Usually, if you pull two sheets right next to each other from the dealer's rack, they will be from the same log and have the same texture and bending strength. This will help in keeping things square(!) when bending the sides toward each other at the tail post.

Now, using the carpenter's square,



Engine mounts on removable plate, making it easy to service and make thrust adjustments.

ruler, and your favorite marking device, carefully lay out two *opposite* body sizes. Draw in bulkhead positions, verticals, doublers, and motor mount beams. Cut the sides to shape and match the sides back-to-back, checking all markings for accuracy. (Remember that old saying "An ounce of prevention is worth a pound of cure." ... An we *do* want to keep it light, don't we?)

Using a fuselage side as a pattern, cut two nose doublers from 1/16 ply, and glue in place, using contact cement or epoxy. If you decide to use white glue, be sure to moisten the opposite sides of the mating pieces to equalize curling. Unless you've got X-ray eyes, you'll want to re-mark the location of Bulkheads A and B, and the motor mount beams.

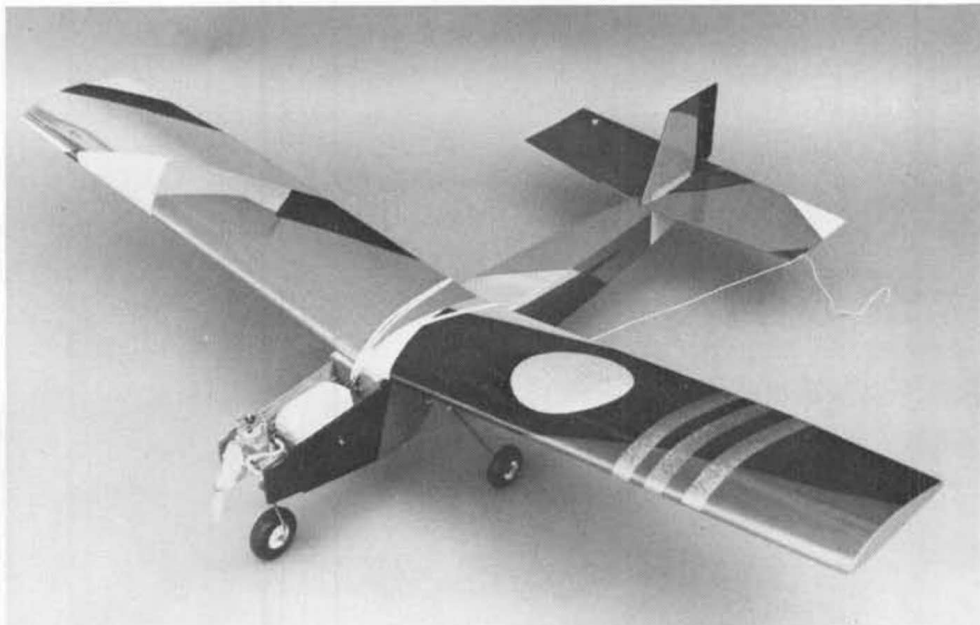
Now it's time to glue in the maple motor bearers, vertical stiffeners, stabilizer mounting doublers, dowel gussets, and 1/8 x 1/2 tail post stiffeners. Titebond or Wilhold will do for these.

The next step is of primary importance in getting a properly aligned fuselage. Make up the 1/8 inch sheet balsa tank floor which fits under the motor mount beams. All four corners must be exactly 90 degrees. Now assemble and glue the two sides, the tank floor, and bulkheads A, B, C-1, and C-2. Grab a couple of pencils, lay them on the fuselage sides, even with Bulkhead A, and wind rubber bands across top and bottom so they clamp the fuselage tightly together at this point. (Told you to read through the instructions first. Did you have those pencils, or Kraft-Hayes clamps in a handy position?). Repeat clamping at locations B and C. Check for squareness (This thing isn't called a "Rectangular Rabbit" for nothin'!), by making sure the ends line up when pulled together at the tail. If they don't, now is the time to give the fuselage a "calculated twist" to bring it into alignment.

Add the 3/32 plywood end plate 'D' which keys into the notches formed by the sides and the 1/8 x 1/2 verticals at the tail. As a last step before setting the fuselage aside to dry, insert the 1/8 x 1/4 cross pieces at the first station behind 'C.' This pulls the aft section of the fuselage into its final shape. No more cross pieces are needed. The cross-grain planking will stiffen the fuselage, when added.

Speaking of cross-grain planking, when the above assembly is dry, you can plank the bottom, starting at the rear and working forward. When you get to the 1/8 ply main landing gear floor, now is the hour to tackle the bending of the 1/8 inch diameter music wire main gear.

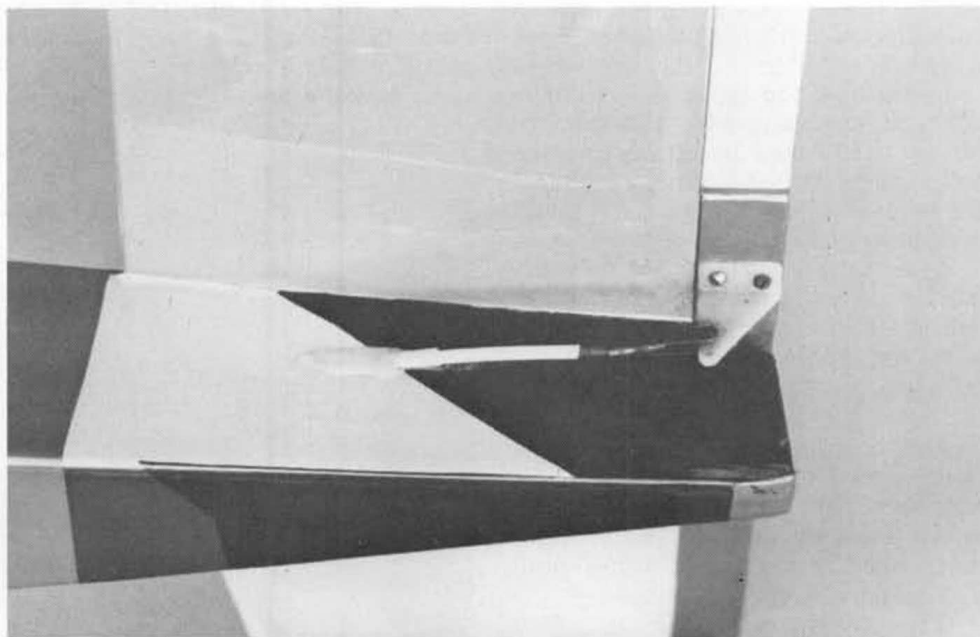
Don't flinch ... A sturdy workshop vise, a pair of vise-grip pliers, a well positioned tongue between gritted teeth, and you'll have that landing gear in no time. The secret is to start from the



The all-sheet wing is extremely rugged and warp-proof. It is built from the top down, and has built-in washout to prevent tip stalling. There is no spar, but a large leading edge and diag. ribs.




All-sheet tail surfaces glue directly onto fuselage. Run control tubing before final assembly. Considering usual nose-heaviness before trimming, 3/16 rather than 1/8 sheet could be used for tail.



This particular Hare had been completely assembled before controls were installed, so epoxy on outer control tube had to be put on outside.

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Field Box
kit included

Vital Statistics:

MATERIAL: 200 lb. test B flute corrugated cardboard with No. 1 white finish both sides. SPAN: 64" LENGTH: 31 1/2" ASPECT RATIO: 12.4 WING AREA: 330 sq. in.	AIRFOIL: Under cambered STAB AREA: 76 sq. in. STAB AIRFOIL: Flat WEIGHT: 15 oz. w/o gear, 21-28 oz. flying weight. SURFACE LOADING, TYPICAL: 8 oz. per sq. ft. DIHEDRAL: 9°
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Hare . . .

middle and work toward the ends.

While you're in the wire-bending mood, you might as well sculpture a nose gear too. Nowadays, however, there are several ready-mades that can be modified to do the job. You don't need a steerable rig. When taxiing, hold some up elevator and the direction you want. As the "Rabbit" hops along, the nose gear will bounce, and each time it's off the ground, the rudder will take effect. It'll work on anything but a glass-smooth surface, and who has *that* kind of a flying field!?

Install push-rods or tube-in-tube control connectors before planking top or aft fuselage. As described earlier, the original "Hare" was designed in the days of escapements, pulse rudder, and Galloping Ghost. Multi, which was only in reed configuration at the time, was way too big for a ship this size. Undoubtedly, today's radio will be a 3-channel installation similar to the Heathkit GDA-1057 rig shown.

Complete fuselage by adding inner and outer wing opening doublers, filler B-1, and the 1/8 inch music wire forward wing rubber hook.

TAIL SURFACES

These are the extreme in simplicity. Mark out directly on the wood, using the square and ruler. The stabilizer stiffeners probably wouldn't be needed if you're going to Monokote. The original "Hare" was finished natural, with 3 coats of sanding sealer and several of clear, followed by some color for trim.

In this case, the stiffeners were essential. The 1/4 inch triangle fillets are also quite important for keeping the fin attached to the fuselage . . . real convenient for stability.

WING

When you have finished this wing, you'll be amazed at how light, strong, and totally warp resistant it will be for the length of its life. Also, the built-in wash-out will stay there for the duration. By the same token, if you build it crooked, it's going to stay that way, so "don' duit!"

Another screwy thing about the wing . . . you built it from the top down, instead of from the bottom up . . . honest. You gotta do it that way, or it won't go together correctly. Please . . . Do it *my* way.

Start by butt gluing 3/32 and 1/16 sheets together to form upper and lower surfaces. To get good joints, trim the gluing edges with a metal straight edge. Hold two butted surfaces together on a flat board and tape them together in about six places. Pick them up, fold them back, and apply a cellulose model cement, such as Duco or Testor's, to one of the edges. Now open the fold, lay the joined surfaces on the board, taped side down, squeeze out the excess glue, wipe off, and repeat the taping process. Now you can stand the 8 inch wide plank in a corner and start on the next pair!

Glue the pre-tapered leading and trailing edges to the **UNDERSIDE** of the TOP surfaces. Be sure the surfaces have been tapered at the outer 8 inches of the trailing edge. Make a LEFT and a

RIGHT panel. If you forget, and make two 'lefts' or two 'rights,' you might as well go back and start another fuselage!

Make two aluminum rib templates; one for straight and one for diagonal ribs. Cut 5 straight ribs from 1/4 inch stock, and 12 diagonal ribs from 3/16 stock. And one last step before actual assembly starts . . . give the underside of the top surfaces two coats of dope.

When you're ready to begin, go to the bathroom, take the phone off the hook, and lock yourself in your shop. Once you start this job, you can't stop in the middle.

With a slightly damp sponge (not very wet), wipe the top surface of one top panel. It will curve. Now fit, glue into place, and pin, *from the top* all ribs for this panel. Leave out center rib. Shorten tip ribs to fit, but DO NOT trim the bottom of them to fair into the trailing edge . . . yet! Pin the whole structure down on a flat board (if you're hard up for a building surface, you can pin the structure to the back side of closet or cellar flush panel door!) Repeat with other panel. Unlock the shop door, put the phone back on the hook, and take care of any other pressing matter.

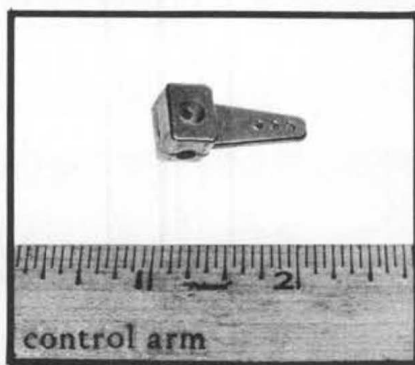
In case you hadn't noticed, the purpose of not tapering the tip ribs is to keep the upper surface of the wing completely true. Later, when the bottom of these ribs are tapered, and the bottom sheeting is added, you'll have that all-important, tip stall-killing wash-out built into the wing tips . . . See? This also explains why you *can't* build the wing from the bottom up.

When the wings have cured for about 12 hours, remove them (from the door?) and try an experimental twist. Even before the bottom sheet is added, you'll see that they already have warp resistance. Block each wing tip up 3 inches and sand in the dihedral bevel (same as you'd do for a hand launch glider), then firmly glue the two panels together. Next, add the 1/8 inch plywood dihedral gussets, and the center 1/4 inch rib, which has been shortened an 1/8th inch at each end. Finally, trim those tip ribs down to fair into the trailing edge and then plank the bottom with the previously prepared 1/16 sheets.

After final shaping, sanding, filling, etc., wrap a 3 inch band of celastic or fiberglass cloth and resin around the center section. The only way you'll break that wing is to take it down to the Post Office . . .

The original "Wectangular Wabbit," as stated earlier, was finished natural, and being all sheet balsa constructed, if you like to look at natural wood grain, this is the showcase for it. A trim color for accent really sets it off.

The present "Bunny" got its . . . ahem . . . color scheme(?) as a result of our search for a particular roll of Monokote. In the process, we came across a box of scraps. What happened after that is ob-



control arm

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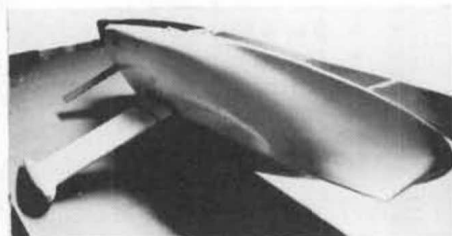


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