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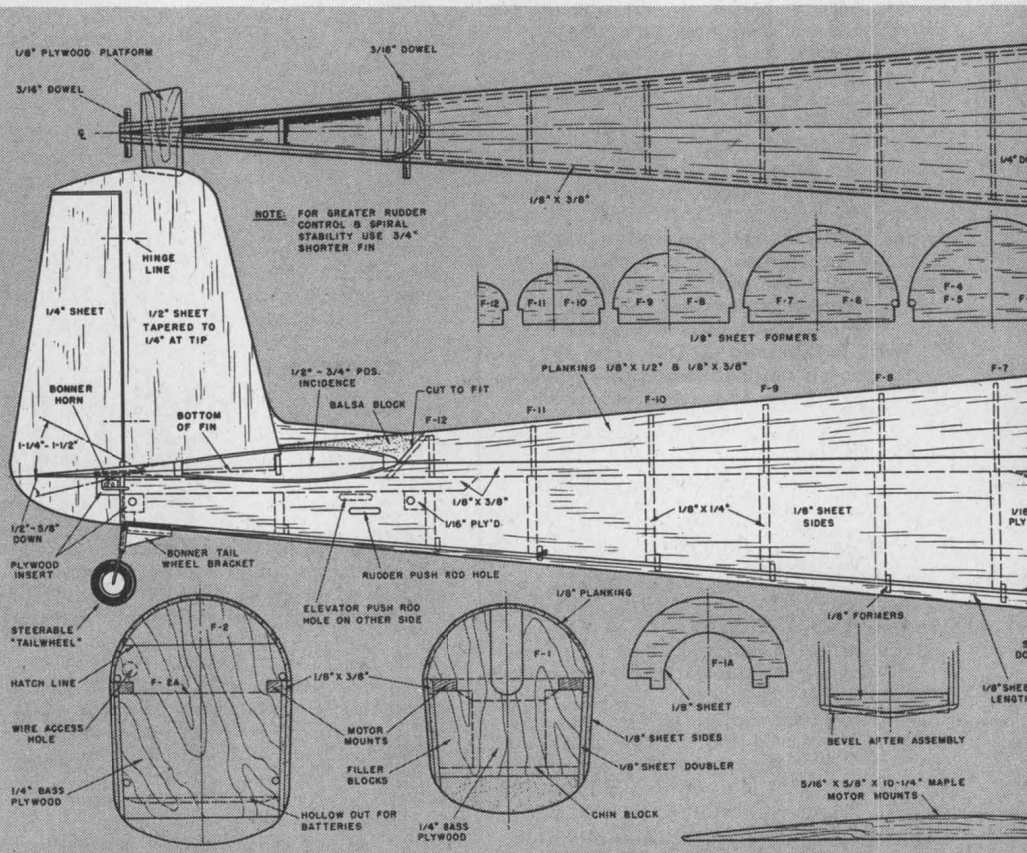
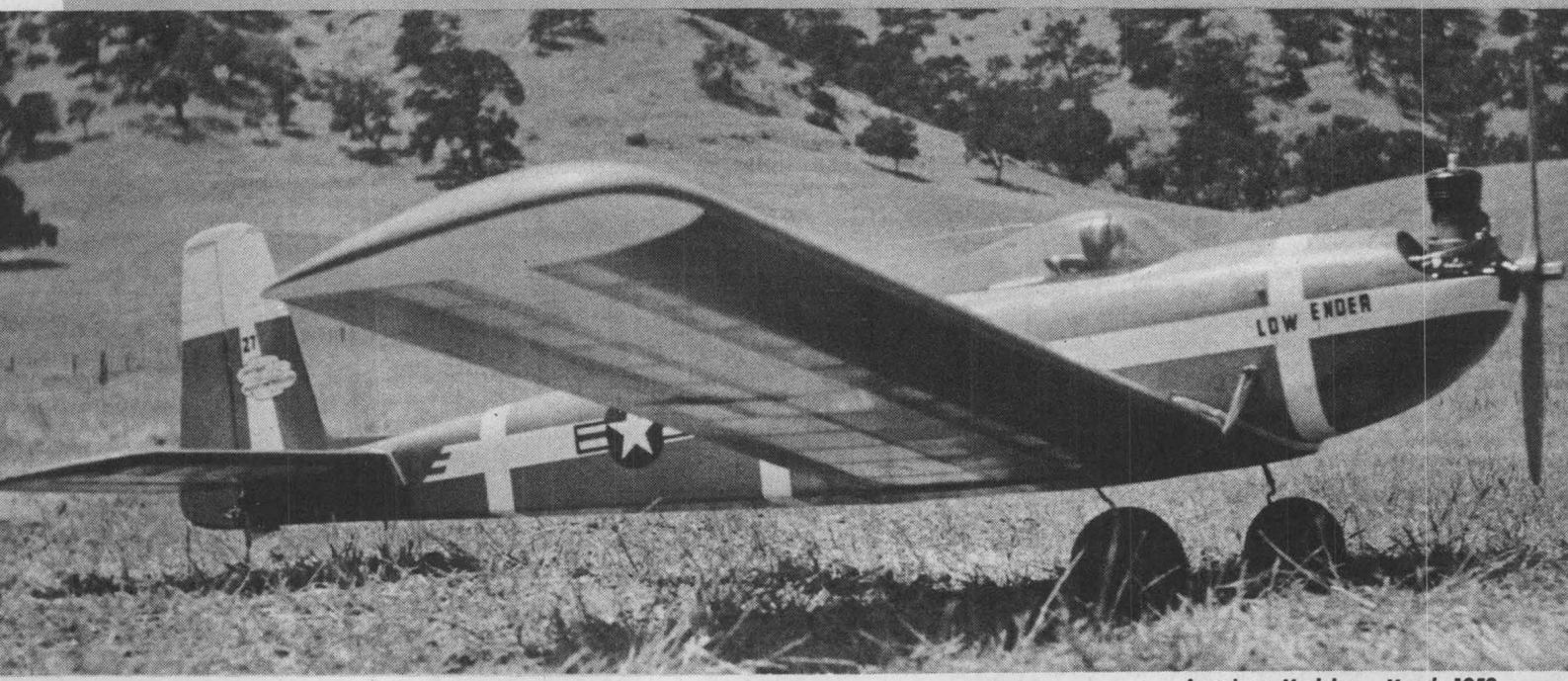
LOW ENDER

Designed by
DALE ROOT
Oakland, Calif.

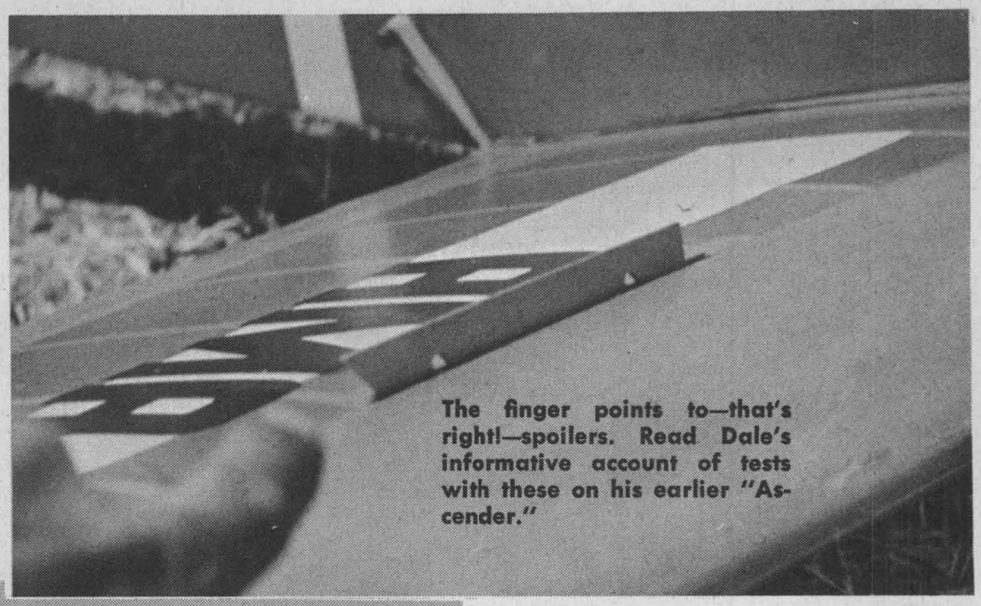




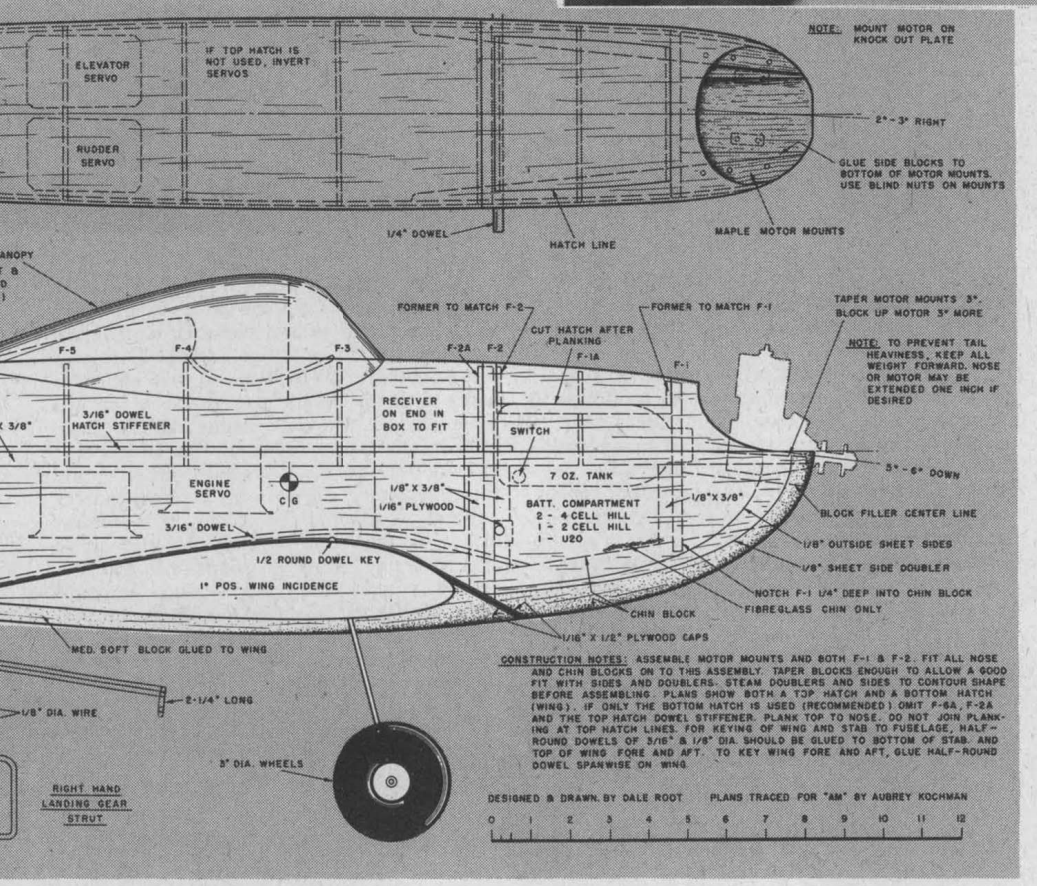
■ After watching the outbreak of low wing multi ships, and further back a couple of rudder-only low wings flying around, I decided to give this trend a whirl.

Low wing R/C ships have several things in their favor. The ground handling in a high wind is phenominal. They just seem to be riding in the "dead air" close to the runway, and never turn over in a cross wind. Take offs have the advantage of lifting slowly from the run without the tendency to zoom that cabin jobs always seem to have. Landings are the reverse, they get close to the ground and seem to have a cushioning action and "stick" on the runway when the wheels touch.

The first thought in a modeler's mind on low wings is, probably, the danger of loss of spiral stability. This factor of spiral stability is probably the biggest



The finger points to—that's right!—spoilers. Read Dale's informative account of tests with these on his earlier "Ascender."



reason that low wings haven't been popular in the past. I find that this problem is one more of fear than of fact when the proper dihedral and fin area are used. I've purposely flown the Low Ender many flights on rudder only and elevator, without use of ailerons, and can say it's almost as safe as a cabin wing or shoulder wing on turns and spirals. As fin area is increased the spiral stability decreases and tends to stay in turns more. However, as can be seen in the photos the fin had been increased to study this effect and also the effect on rolls and outside loops. Even with the enlarged fin, no real dangerous result was obtained and as I said only a greater tendency to stay in turns was noticeable.

What really was astounding, was the complete lack of the spin characteristic. This was a worry on the first flights as the small fin would have given it a chance to show up in great style for spins. The first take off the Low Ender made had everybody getting out from under it for fear it would fall down. It had too much decalage (by 1½°), too little down thrust (by 3°), and was slightly tail heavy for this set up. It hung on the prop full bore and merely flew around in a power stall, steering with rudder only. In fact, as it proved out in subsequent flights, it was difficult to make it spin. The airfoil just didn't want to "pay off" in loss of lift. This was the biggest surprise of the whole project . . . "a low wing that didn't want to spin." And with 45° "up" elevator.

Since that time this airplane has under gone almost every conceivable C.G. change, fin area change and decalage setting that could be given it, to study various effects on flying the full stunt pattern. The settings on the plans have been the best found. At time of writing a new wing of only 13% foil and 72" span is being built. The prime reason is to increase speed, by a thinner foil and area. Maneuvers, to this writer, appear better when they are faster and cleaner, although not necessarily easier to fly. The ship should prove an even better flyer with the thinner foil (very similar to the "Ascender" foil) and same dihedral, or perhaps only 7° for increased rate of roll. The new foil is on the plans for those that wish to try it. Perhaps ½° more decalage should be used. Also a K & B 35 will handle the smaller faster wing, with more ease than the thicker section.

Both the K&B R/C 35 and the Spitfire 60 have been interchanged at times for no particular reason except to try them. Both work well and fly it well. Our field runway is rather rough and up hill so the added power of "60" gets it in the air a little easier before the ship runs out of runway. The K&B 35 handles it almost as well unless power sags from a hot dry day.

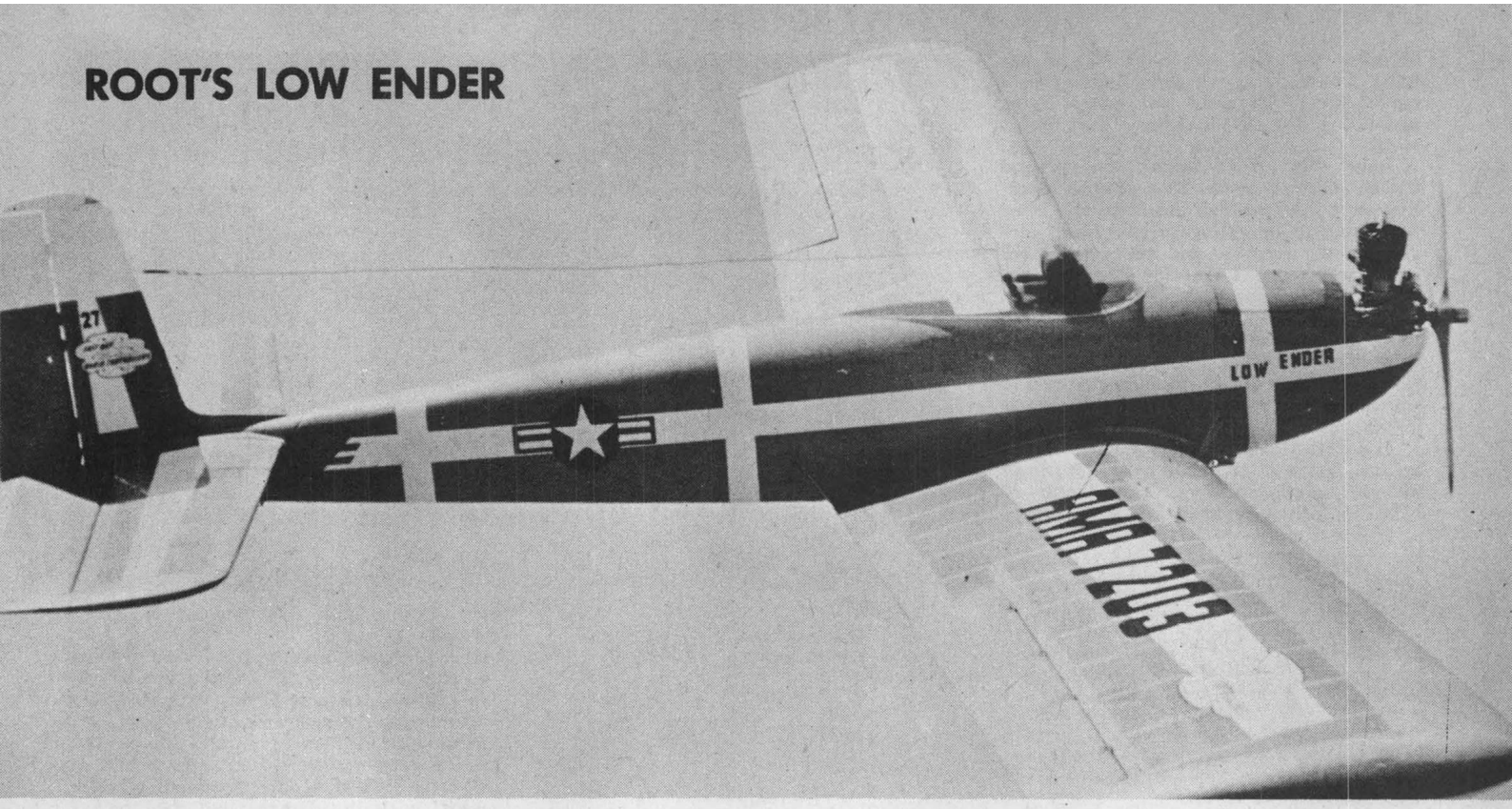
Outside loops and rolls just didn't appear right on first flights. On outsides it would stall violently as though the wing had lifted from the fuselage. (They can do that on "low wings," you know, on outsides.) In repeated flights, excessive added fin area, and dorsel area was tried. Fred Dunn, of Astro Hog design fame watched it react and helped glue balsa on the fin. None of this did any good at all. The real trouble it was found, was merely in using too much elevator travel. We had used 1" of down when ½" was all required. On rolls, only a small amount of down as it rolled over was the solution to good rolls. Eventually the C.G. was moved aft ⅜" to improve the outsides. Now, none of these things are a problem.

One other difference in characteristic of the low wing was its response to a trim setting on a trimmable elevator. The elevator on the low wing, as opposed to the elevator on the shoulder wing, was a great deal more critical. This is especially noticeable in the landing set up. It has been flown both trimmable and neutral return. The neutral return setting for neutral elevator is sensitive to ½ turn of a Bonner Servo or about 1/16" at the elevator trailing edge. This is perhaps due to the low decalage setting too. However, when adjusted properly, flying is much easier and stunting without a ballooning tendency, is very satisfying.

Low Ender responds very well to rudder for turns. It isn't necessary to use "aileron" and "up" elevator for turns. The ship could be built and flown without ailerons should the builder not have the equipment to control them.

Ordinarily a low wing ship has a strange turn characteristic. With ailerons

ROOT'S LOW ENDER



it rolls up a wing and *then* turns with wing lift or when elevator is applied. With rudder only, the tail usually slides around in a skid and *then* it banks into the turn. Flying directly over head this could be readily observed. However, this ship does make good turns on only rudder, and there is a slight hesitation between "kicking" the rudder and the bank. The resulting bank is not excessive or dangerous. Of course a pylon turn with aileron, to roll it up on its side, and "up" elevator to crank it around, is the quickest turn. Some ships at the '58 Nats had rudder and aileron working together on one stick control. This should be an ideal set up for low wings, or most any ship for that mater, although I haven't flown the method.

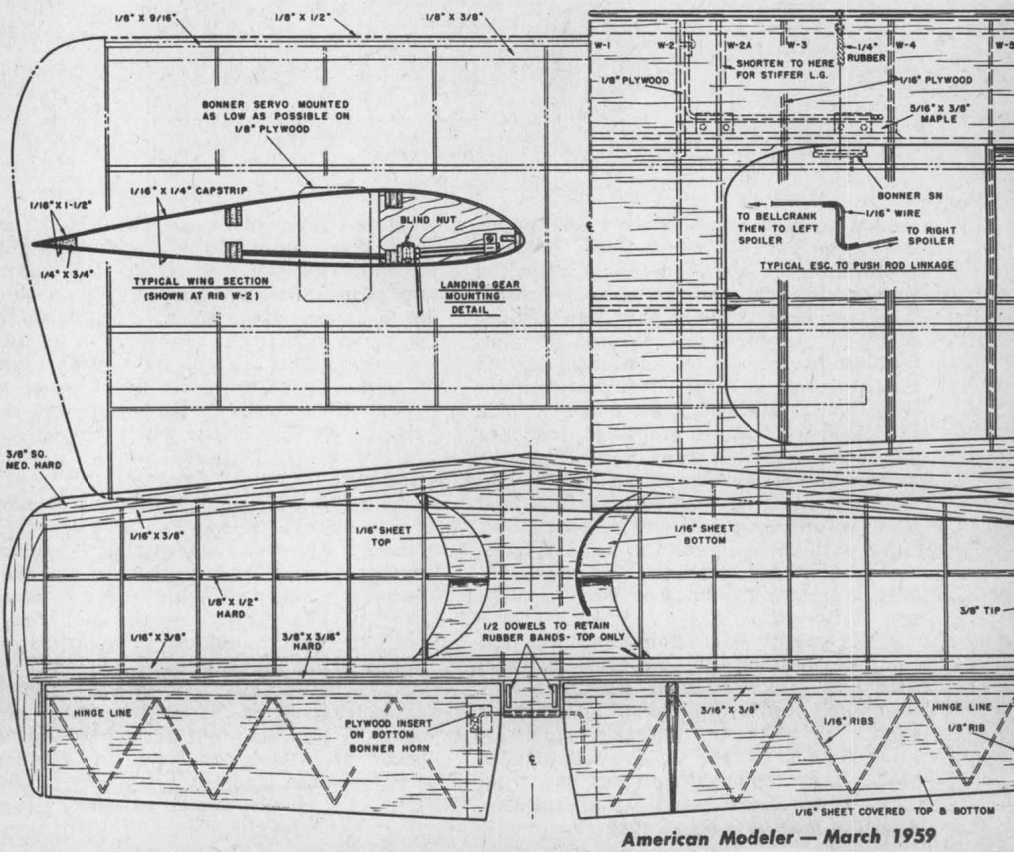
Our flying field has about 5° grade on the runway. Landing down hill with a floating airplane sometimes results in more altitude at the end of the runway than the beginning of it. Very exasperating! This is where and why the use of either flaps or spoilers for the ship were decided upon. Flaps or spoilers give a better rate of descent. The difference between the two being that flaps when taken off (pulled up) make the ship drop, spoilers make the ship rise when taken off.

It was decided to use spoilers for this model because of the safety and advantage of a jump in altitude should the spoilers need to be retracted back into the wing for any reason.

These spoilers are 5" long and extend only ½" high. The reaction when extended is phenominal. It's like losing all of the wing area on the spoiler location plus 30° either side of it. The rate of sink increases greatly of course, and more power is applied to keep the forward speed up to reach the runway. If used on windy days there won't be enough forward speed to reach the runway unless ¼ to ½ throttle is applied. Actually it's easier to hit a spot with spoilers than without because of the greater vertical descent.

Soaring gliders use spoilers for landing as a regular routine. If they are under-shooting, they retract the spoilers, gain altitude, and can extend the landing several hundred feet. The model works the same way.

For every gain there is a price to pay. The price with spoilers on a model is that some up elevator is a "must." Not much is needed, but enough to bring the nose back to level again and hold it there. When spoilers are applied, the nose drops ten degrees or so. With trimmable elevators this wasn't given a second thought as a touch of "up" was automatically applied. Incidentally, a higher rate of sink is obtained by applying more up elevator; the rate of descent can thus be controlled, too. The ship doesn't balloon with spoilers, as it would without them, when up elevator is applied. With a neutral return elevator a problem is presented to get "up" trim. This was solved by Jerry Nelson on his shoulder wing with spoilers. Jerry made a switch-over circuit for the elevators. He used micro switches on the spoiler linkage to switch over to an inverted contact plate in the Bonner Servo which relocated his neutral position. The plate is a mirror image of the one already in the servo and directly inverted over it. Another set of wiper arms are added. Perhaps some one else will find an even simpler solution for this on neutral return. Of course, trimmable and dual proportional presents no problem.



Before the plane was built, the probable effect of spoilers on a model was only a theory as they had never been used in this area at least on an R/C model. To determine their effect the "Ascender" was selected as a test job. A piece ¼ square by 5" was glued and pinned to each wing panel at the 1/3 chord point, just inboard of the ailerons. We realized, of course, that once the ship was in the air it was at the mercy of the effect, if any, of these fixed spoiler strips. The "Ascender" normally took off in less than 100' with a high rate of climb. The 35 engine was revved to full rpm at the top of our 200' runway and the ship released. It bore down the runway and passed the 100' point still on the ground. It finally tore into the air near the end of the runway and lifted rather heavily into the air, but going fast. After circling the field, and finding anything less than ½ throttle would let the ship settle, it was landed very prettily in a very short landing approach. Being very pleased and drunk with success over the experiment, another piece of ¼ square by 5" was fixed to the top of the first pieces. This made the spoiler ½" high and should give the desired effect. The "Ascender" was again put at the top of the runway and released at full revs. It went by the 100' point like a wingless bomb. It hit the end of the runway going full bore and still not light enough to lift off. After tearing through weeds and clods of dirt for another 50', it broke into the air. By this time it was necessary to climb over or around an oak tree. But time and distance had run out and through the oak tree it went, with only 20' of altitude, and sounding like a truck full of garbage cans being dumped.

However, it proved the point of spoilers being effective. Although these were too large for only the 5 sq. ft. of the "Ascender" wing, they are just the right size for the 6½ sq. ft. of the Low Ender. For those who wish to go to the extra effort of installing spoilers they should prove useful and an advantage for hitting the spot, or runway. In Low Ender a Bonner SN escapement with ¼" rubber was used to actuate them. This was energized by the simultaneous action of fast engine relay and a micro switch on the right aileron push rod. These two simultaneous controls are not used as such, ordinarily.

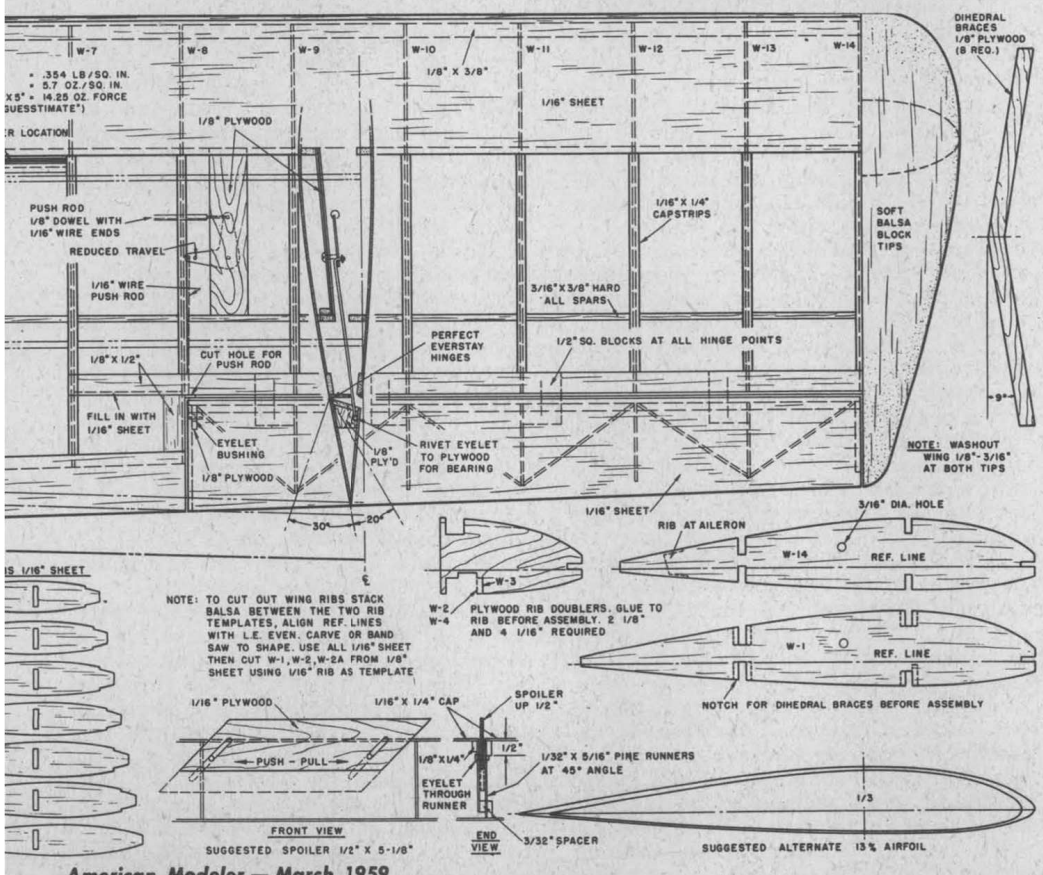
In flying the Low Ender, no special knack is required for its handling characteristics. It handles much the same as any other type ship. The response to control is good and immediate. The controls respond very well at near stall speeds. Turns can be executed by rudder, to start the turn and bank, a little up elevator, and then proper aileron is used to keep it in the turn at a constant bank.

The rate of roll is not as fast as one would suspect. It rolls easily and just slow enough to look good and to give time to apply a touch of "down" as it goes around.

Loops, inside or outside, are done easily without any tendency to fall off or wander on heading. The ship is not a real fast airplane and gives the flyer enough time to correct the flight if a mistake is made. In all the flying with changes and revisions to the aircraft in adjustments for some six months it never suffered a crack up. It has no mean tendencies to worry about even when out of adjustment.

The structure is as light as can be

Author-designer Dale Root with his Low Ender, successor to earlier Ascender which appeared as A.M. project.



practical for the strength necessary. It would weaken the ship if a hatch were used on the top for servo and radio access. The access opening, automatically obtained when the wing is off, is through the bottom fuselage opening and gives more than ample working room. It is helpful to build a simple cradle to set the rounded forward nose section into. A piece of 2" balsa plank, with a half round cut out of 5" diameter glued to a base plate of 1x4x12" makes a handy cradle. This is used at the field as well as on the workbench to work on the ship and to hold the inverted fuselage in a steady position.

A careful selection of clear grained wood and only hard enough for the strength required will be about the only saving of weight you can achieve building an R/C ship. Low Ender is large enough to absorb excess weight and still fly well, but better performance is had by a lighter wing loading, of course.

Construction procedure is not out of the ordinary and the plans should be self explanatory. The curved and tapered nose section was made for strength, appearance and streamlining reasons. Lay out ⅛" x ½" longeron and glue in place. Leave the doubler off at this time. Assemble the complete nose, including motor mount section, firewall and bulk-

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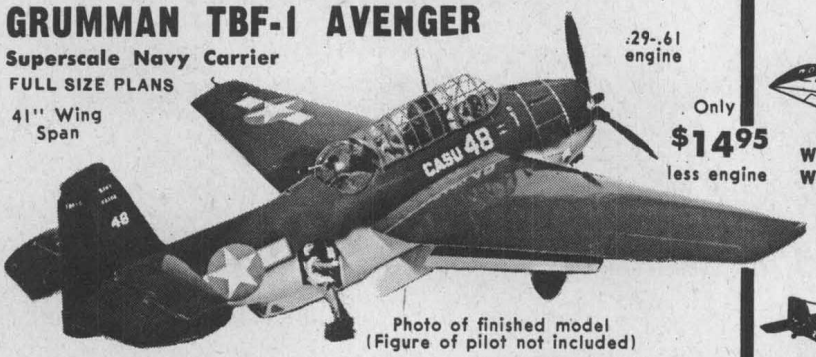

Photo of finished model (Figure of pilot not included)

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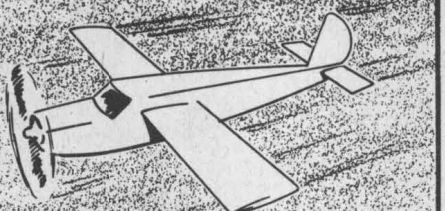

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Low Ender

head, bottom block and nose blocks. Do not round the blocks off but fair them into the general contour of the firewall and second bulkhead. The rounding off of the nose section is done after the doublers and sides are glued to this assembly. To this nose section assembly, glue the doublers and then the sides directly over this. Contact cement may work real well for this, although Wilhold vinyl glue was used originally and then rubber bands wrapped around for holding it down. It would also be wise to steam the doublers and sides to a contour before assembly.

Although this all seems like a lot of unnecessary labor, the result of a "clean" looking front end and a stronger airplane make it well worth while. The rest of the fuselage construction is pretty common and should be no problem.

If the thinner wing airfoil is used, the aileron servo could project out the bottom of the wing any amount required. The top of the wing should be left in the clear so it can easily slide off the fuselage in case of digging in a wing tip. A cover over the servo on the bottom of the wing can be shaped from a soft balsa block to resemble an oil radiator or scoop and would give a pleasant appearance to the ship. The gears protect the center section of the wing at this point so it should be damage free for rough landings.

Adjust the engine thrust settings for flying so that power on and off give no drastic change in longitudinal heading. Adjust the ship first for a good power off glide and then change thrust so only a slight climb is had at full power. Remove all tendencies to turn by trimming rudder and aileron surfaces and removing warps. Then all stunt maneuvers will be easier and more precise with little or no correction to keep the ship straight in loops, cuban eights, etc.

After the first three or four flights you should have the ship trimmed out for some real enjoyable flying. You'll wonder why you hadn't flown low wings long before this.