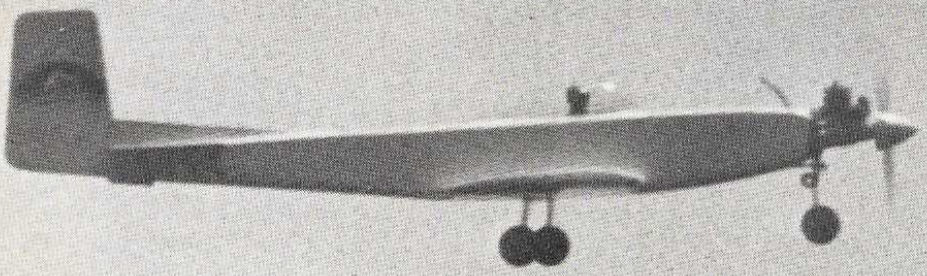
Build the Ace Three-Ten Trainer



PHOTOGRAPHY: BOB ABERLE

An intermediate low-wing R/C trainer designed around the new Ace 3-channel Commander system, World Engines OS Max .10SR. Some fine spirited performance, low fuel cost / **Bob Aberle**

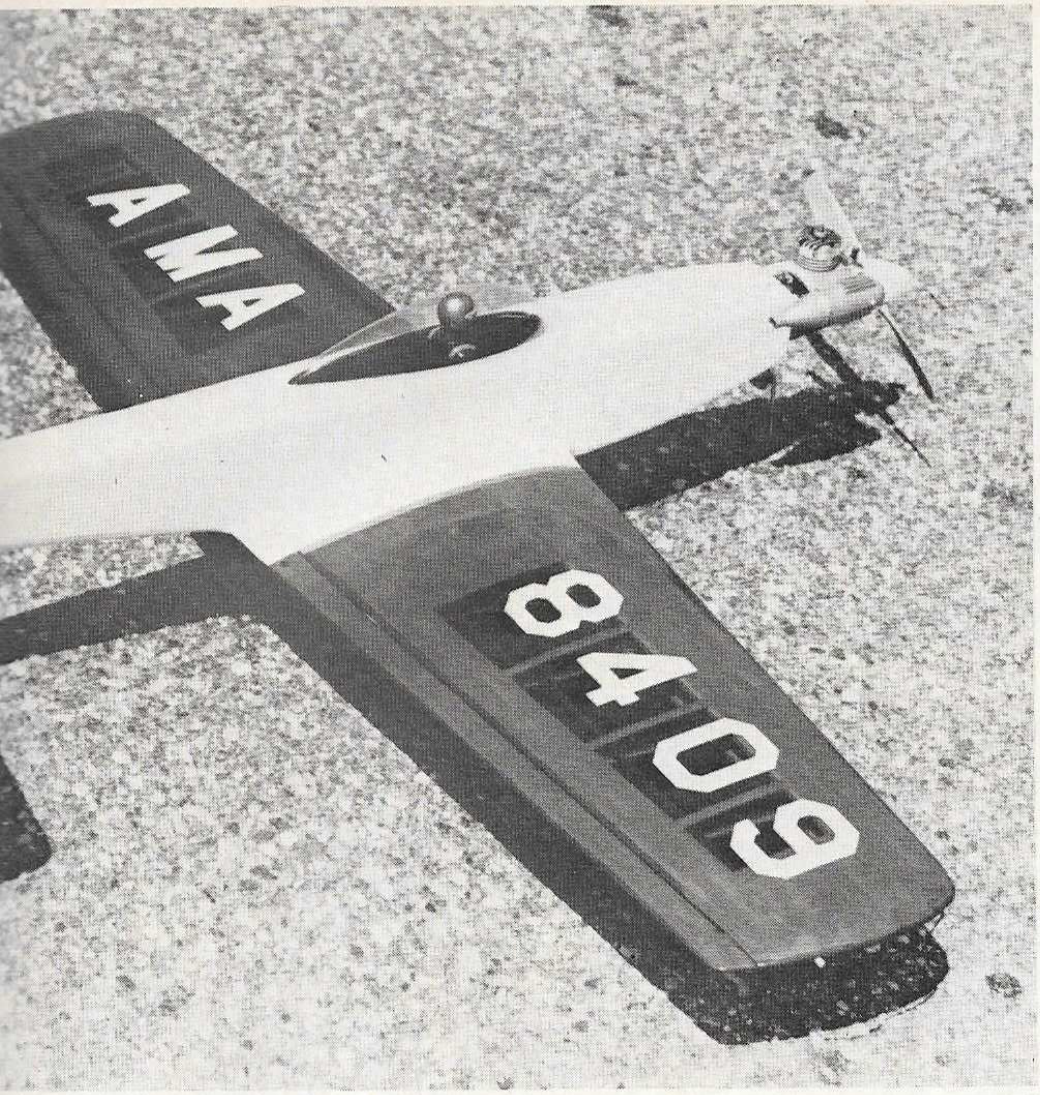
One of the most neglected engine sizes (for R/C use) over the years has been the .09 cu. in. displacement (small class A). Engines of this displacement have always been available. In the past ten year period O.S., Enya and Cox, to name a few, have marketed engines in this category. The O.S. and Enya both being available with reliable R/C type throttles and mufflers. Unfortunately, neither magazine designs nor model aircraft kits have ever explored the full potential of these little engines. Most .09 powered R/C models today are simply high wing, sport or trainer types, but never a high performance type capable of at least intermediate pattern maneuvers. I had just recently completed a new Ace three channel Digital Commander R/C System kit (see FLYING MODELS September 1977) and was looking for a suitable subject to flight test the equipment in. At the same time I had just received a brand new O.S. MAX .10SR (Schnuerle ported) engine. With the availability of both a lightweight radio and an engine I was able to come up with a new .10 powered design that is certainly not a basic trainer.

Design Details

First of all I chose aileron control because of the low wing (no dihedral) configuration. Since I wanted to initially limit myself to the three available channels in the Ace system, I settled on aileron, elevator and throttle control. Using a trike gear arrangement I was able to hook up a steerable nose gear working off the aileron servo. The rudder was fixed in position (not moveable). I always start my designs by establishing a total estimated weight using known factors such as, the weight of the engine, R/C equipment, wheels, landing gear and a guess on the structural weight. In this instance I felt that 30 ounces was a good target weight. I wanted the wing loading light, around 18 oz./sq. ft., so that an average flyer could land the model comfortably. From these first two assumptions I arrived at a wing area of 240 sq. in. Last consideration was a wingspan not to exceed 36" so that conventional size balsa lengths could be purchased with a minimum of waste. To keep the model real simple I permanently glued the wing to the fuselage, which eliminates the need for the hold-down bolts. Radio access is through a removeable top hatch cover which I have used successfully on many of my recent designs. Plenty of room is provided for the new Ace radio system. Likewise there is plenty of room for the addition of a fourth servo to control the rudder should you want to add this at a later time. Remember, the Ace three channel system can be easily expanded to more channels. The resulting design which I call the Ace Three-Ten (Ace *three* channel R/C and O.S. Max *.10* engine) certainly fills the gap between the tiny and sometimes tempermental ½A's and the gas guzzling, high performance .40 to .60 powered models. The O.S. Max .10SR requires only a 2 ounce fuel tank which still provides a respectable 6 minutes of flying time. That's a lot of flying per expensive gallon of fuel. And that fuel won't be getting any cheaper in the future. Maybe we modelers ought to seek a tax rebate or incentive for flying *smaller* R/C models (Ha!).

Construction

Begin, as always, with the wing. Prepare two 1/16" or 1/32" plywood wing rib templates, one for the root (center) rib and the other for the tip rib. The airfoil section selected for this model is the NACA 24012. Drill two .125" diameter holes into each of the plywood rib templates as shown on the plans. These holes will provide the basis for the wing jig system. Place a stack of 1/16" balsa blanks (a total of 7, one for each rib) between the two template ribs. Drill through the stack and then insert 4-40 hardware to hold it together. Cut the stack down to the templates and then sand. Separate and number the ribs in order. Repeat this process for the other wing half. Make duplicates of the plywood templates out of 1/16" balsa. These will become the number 1 and 9 ribs. Slide all the ribs on to two 1/8" diameter steel wires (at least 36" in length). These wires will form a wing jig of sorts. Space the ribs out on the wires which are in turn elevated slightly above the full size plans. Add the 3/16" × 3/4" balsa leading edge and the 1/8" × 1/2" trailing edge. Both of these pieces can easily be stripped out of sheet balsa stock. The two main spars are 1/8" × 3/16" *spruce*. Make sure you use spruce and not balsa for the spars. Since the



Bob holds still here for six seconds. Lunchtime at Grumman, but some guys would rather fly than eat. **Top:** The Hawaii R/C club gets a salute with a decal on Bob's fin. Graceful in line, well proportioned.

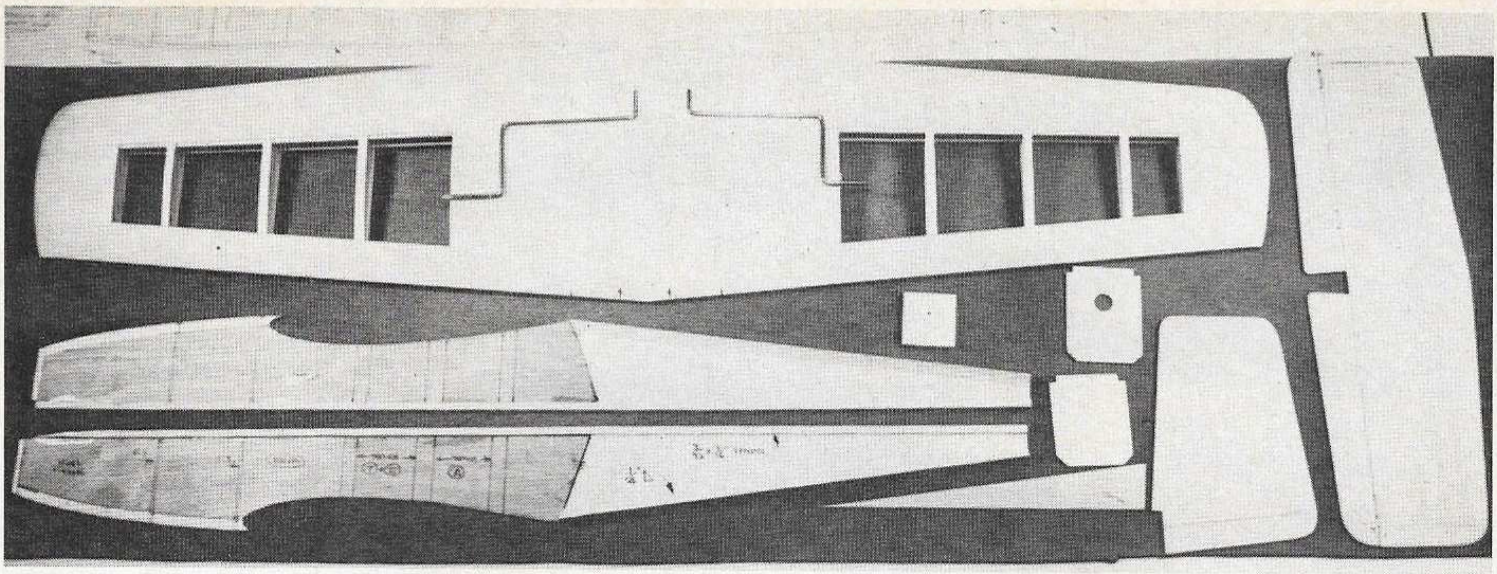
main landing gear struts mount in the wing, you must make four additional plywood sub-ribs (partial ribs) out of 1/32" plywood. Patterns for these ribs (numbers 2A and 4A) appear on the plans. The trunion blocks are made up from pieces of 1/4 × 1/2" and 1/8" × 3/16" spruce. Epoxy the trunion blocks to the plywood ribs. Note also, that a partial rear wing spar is used to support the plywood sub-ribs. This spar is also 1/8" × 3/16" spruce, but only extends as far as the trunion block on each side. It is a good idea to bend up both landing gear struts from 1/8" dia. wire at this time and check their fit in the blocks.

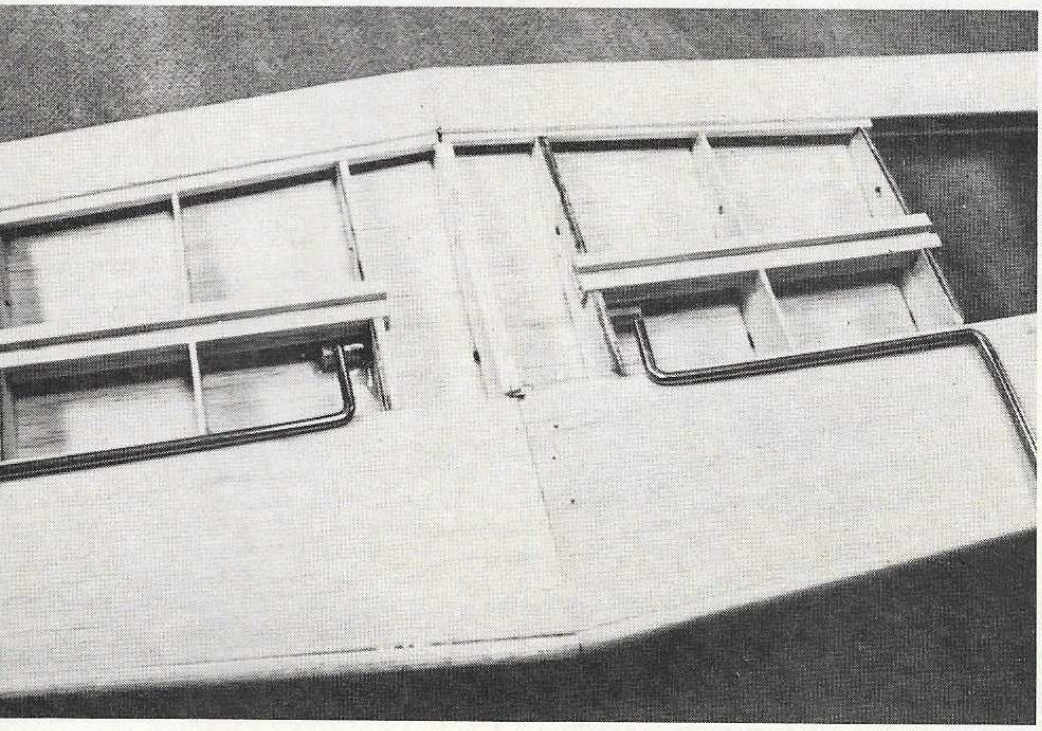
Complete the wing sheeting and trim both the leading edge and trailing edge stock to the final airfoil shape. Add the solid balsa wing tip blocks and carve to shape. Finish sand the entire wing structure with #150 and #220 sandpaper.

Before putting the wing aside it is advisable to set up the ailerons and their linkage. You could use standard 3/32" dia. wire aileron torque rods since the ailerons are certainly large enough (3/16" × 3/4" T.E. stock). I still felt I could tolerate a smaller size so I bent up my own from 1/16" dia. wire and used 1/16" I.D. brass tubing as the bearings. The plans show the correct size and location. You must epoxy both brass bearing tubes to the wing trailing edge. After this dries add the fixed portion of the aileron (center-section). Cut out the ailerons and make all the necessary slots for the hinges. Insert the ailerons to check on the fit. Remove the ailerons and put the wing aside for awhile.

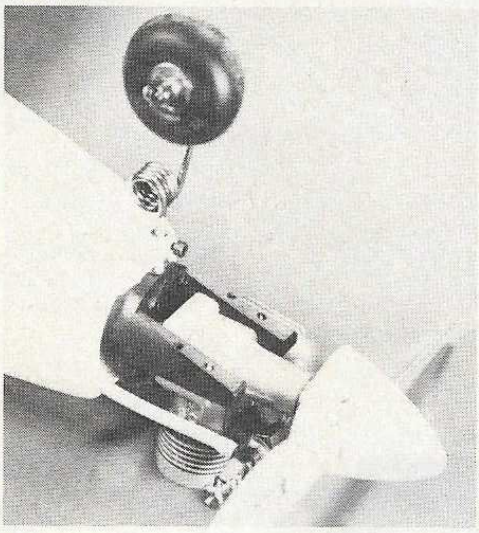
Next item is the fuselage. Cut two sides out of 3/32" × 4" × 36" medium balsa. Also two 1/64" or 1/32" plywood doublers. Cement these doublers in place using Hobbypoxy Formula II. I chose to build a small amount of curvature into the sides from the wing leading edge forward to the firewall. This was accomplished by raising the front edge of the fuselage side off the building board by approximately 3/16" until the epoxy cement dried. You can also add at this time the top 3/32" × 3/16" spruce stringers and the bottom 1/4" triangular shaped stock. While this is all drying cut out the firewall and the two formers. Don't forget a hole in former F-3 for the passage of the battery cable. You will also have to trim away part of former F-2 so that the 2 ounce Sullivan fuel tank can be installed into the forward compartment. Drill and mount the Kraft-Hayes KM-15 radial engine mount to the firewall with 4-40 hardware and blind mounting nuts. Epoxy the nuts to the rear of the firewall. Drill the mount for the O.S. Max .10SR at this time using a #37 drill as the starter hole for the #4 sheet metal screws.

Assemble the fuselage upside down on your building board. Insert the two formers and firewall in position and spot glue with Zap or Hot-Stuff. Draw the sides together at the rear and also Zap in place. Follow this with a liberal application of 5-minute epoxy. Now the hatch cover assembly must be prepared. Make a preliminary rail or crutch out of 3/32" × 3/16" spruce so that they run along the inside of the fuselage stringers. Epoxy the cross pieces as shown on the plans. Now add the 3/16" sheet balsa top, with suitable cuts for the hatch cover (removable portion). Sand the corners to a neat, round contour. Add the support pieces for the hold-down screws. Two 8-32 Tatone nylon screws will be required. One in the rear and one just in





Gear legs are visible here on the completed wing framework. Formers, doublers, siding and the tail gives you an insight into it all. **Left** and **below:** 3/32" gear wire inserts into recesses in hardwood blocks in conventional manner. O.S. Max .10 mill, installed on a sturdy Kraft KM-15 radial mount.



front of the canopy. The front end of the hatch cover is held in place with the extended spruce rail pieces. Don't do anymore work on the fuselage at this time.

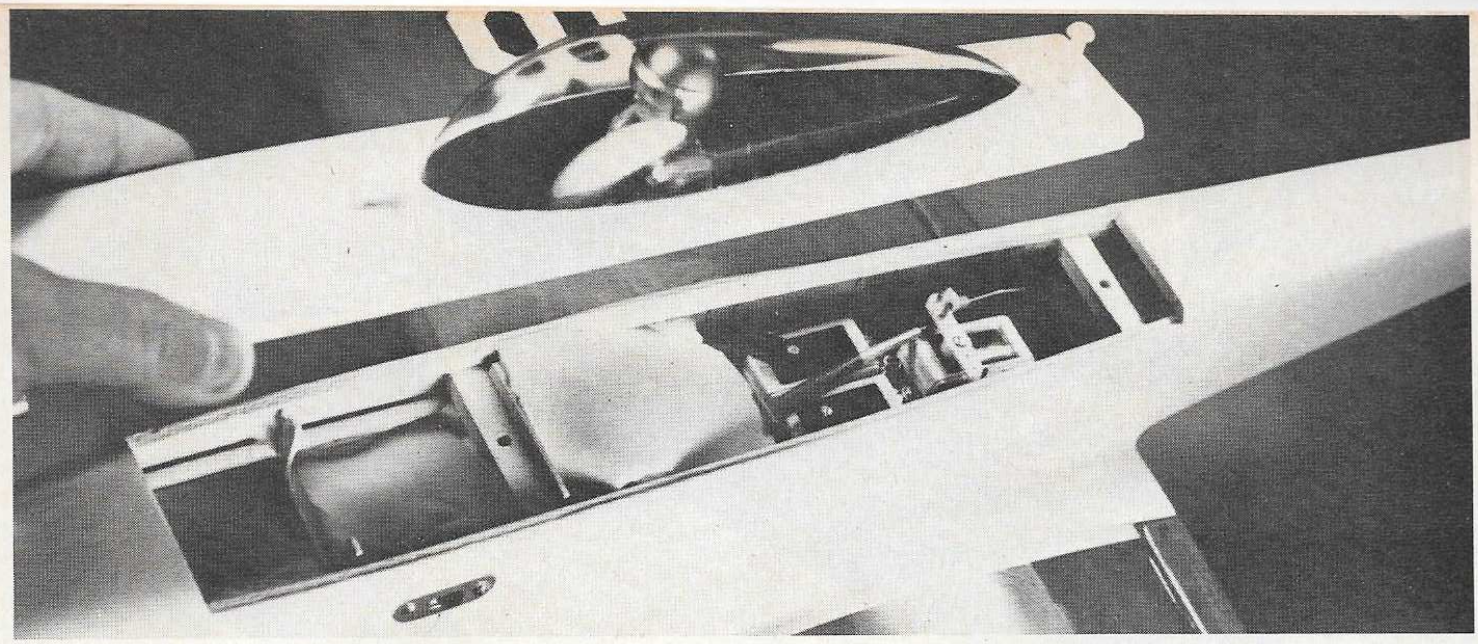
Construct the stab, elevator and vertical fin from 1/8" soft balsa. Observe the grain at the stab tips. This prevents warping to a degree. Note also the 1/8" plywood insert in the lower portion of the fixed vertical fin. Don't omit this very important piece. Mount the elevator control horn and pre-fit the small Klett hinges. Bend up a small length of 1/16" diameter wire to join the two elevators. Finish sand all the tail pieces at this time.

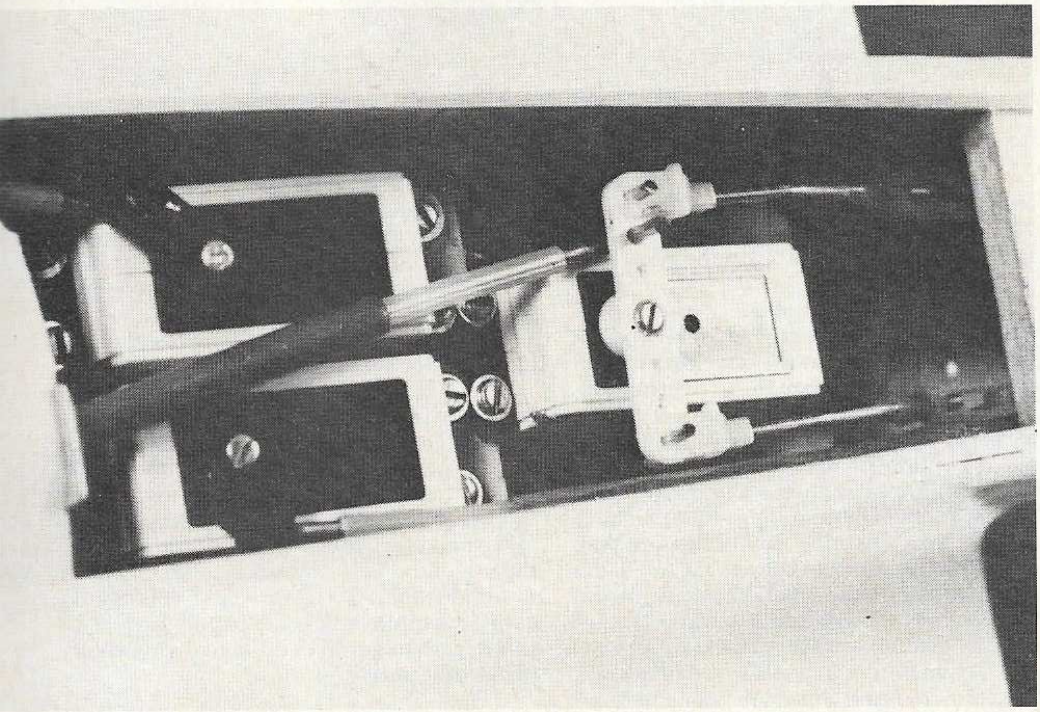
Final assembly involves first mounting the wing to the fuselage. Use 5-minute epoxy cement for this. Next step is to attach the horizontal tail at the rear of the fuselage. Use some Zap to hold it in place until you can get some 5-minute epoxy on the joint. Then add the vertical tail. Align by sight and also spot in place with Zap followed by 5-minute epoxy. Add the spruce servo rails as shown on the plans. The throttle and elevator servos mount forward, side by side, the aileron servo mounts aft, on the fuselage centerline (top view) and is actually a little higher than the front two servos. By raising the aileron servo you will be able to pass the Gold N'Rod control tube forward to the steerable nose gear. Don't forget this point. Run another Gold N'Rod tube out to the rear of the fuselage for the elevator connection. Once this is done you can sheet over the bottom, rear portion, of the fuselage with 3/32" balsa. Sand the lower corners into a neat round shape. Connect up the ailerons using Goldberg 1/16" diameter aileron pushrods. Use the outboard holes on the Ace (D&R) servo output arm to get the most possible throw. This is necessary because of the height of the aileron servo with respect to the pivot point of the aileron hinge line. Finally connect up the engine throttle with the remaining servo using a short length of Gold N'Rod. I generally install the receiver and connect up all the servos to see if all the controls work properly at this point in the construction.

Add the forward balsa sheeting under the fuel tank compartment. I also made small fillets around the wing/fuselage and the stab/fuselage joints using Sig Epoxolite. This adds alot to both appearance and strength. Also added was a Williams Bros. 1" scale pilot's head. This was placed underneath a Sig 7" bubble canopy which was slightly cut down to fit properly on the removable hatch cover. The inside of the canopy area was covered with black regular MonoKote. Bolt that pilots head down carefully so it doesn't get loose and bounce around. Last construction step involved the application of lightweight (3/4 ounce) fibreglass cloth to the forward fuselage area, especially under the fuel tank and battery pack. This cloth was applied with Hobbypoxy Formula II cement.

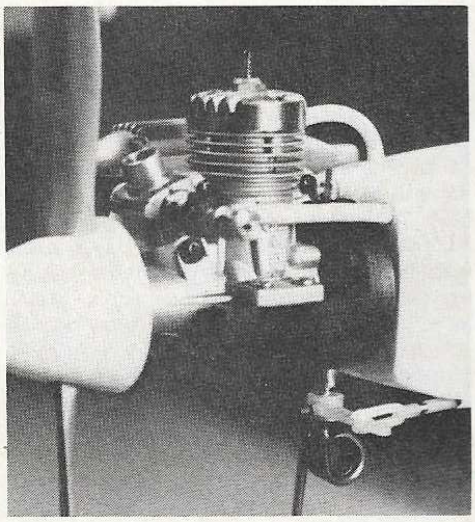
Finishing

The fuselage and vertical fin received three coats of K&B primer (brushed). Sand between each coat with #320 paper (dry). The wing was masked off approximately 1" out from the fuselage. Likewise the horizontal stabilizer was completely masked off. Cover the canopy with masking tape, then spray the primed structure with two coats of either K&B Superpoxy or Hobbypoxy white (I used the latter for this particular model). The wing and stab were covered with transparent red Solarfilm. Final trim included gold Bridi 1/4" wide tape between the junction of the epoxy paint and the Solarfilm. My





Easily accessible, all the radio brainwork is at your fingertips when you need it. The little Ace system fits with room to spare. **Left:** Nose wheel is steerable, pivets in the Kraft mount. **Beneath:** Engine and elevator serves side by side, aileron servo centered in the fuselage. It works nicely.



AMA license numbers were cut out of a sheet of white, regular (sticky) MonoKote.

Final Assembly

On my prototype I chose 1-1/2″ diameter main wheels and a 1-1/4″ diameter nose wheel. Both types of wheels are of the Perfect brand which work quite well and are relatively inexpensive. You will have to drill out the axle holes somewhat. At the time I could not purchase commercially a 3/32″ diameter, coiled spring nose type landing gear. John Tenke, a fellow modeler, was able to bend one for me on his special bending jig. I have since learned that J.G. Model Co., 909 West 3rd Street, Monterello, California 90640 is now offering 3/32″ diameter pre-formed landing gears. You might write to them for details and prices. The nose gear bearing was simply made by drilling through the Kraft radial engine mount. A Goldberg (SA-180) 1/8″ diameter nylon steering arm was used on the 3/32″ wire without much difficulty.

Install all the control surfaces at this time. Use 5-minute epoxy sparingly for this. Avoid getting the epoxy cement on the hinge pins. If you do accidentally, put a small drop of Three-in-One oil on the hinge pin before the cement sets. Don't forget the 1/16″ diameter wire elevator coupler. I did this, one side at a time, without any problems. Bolt on the elevator control horn and connect up the clevis.

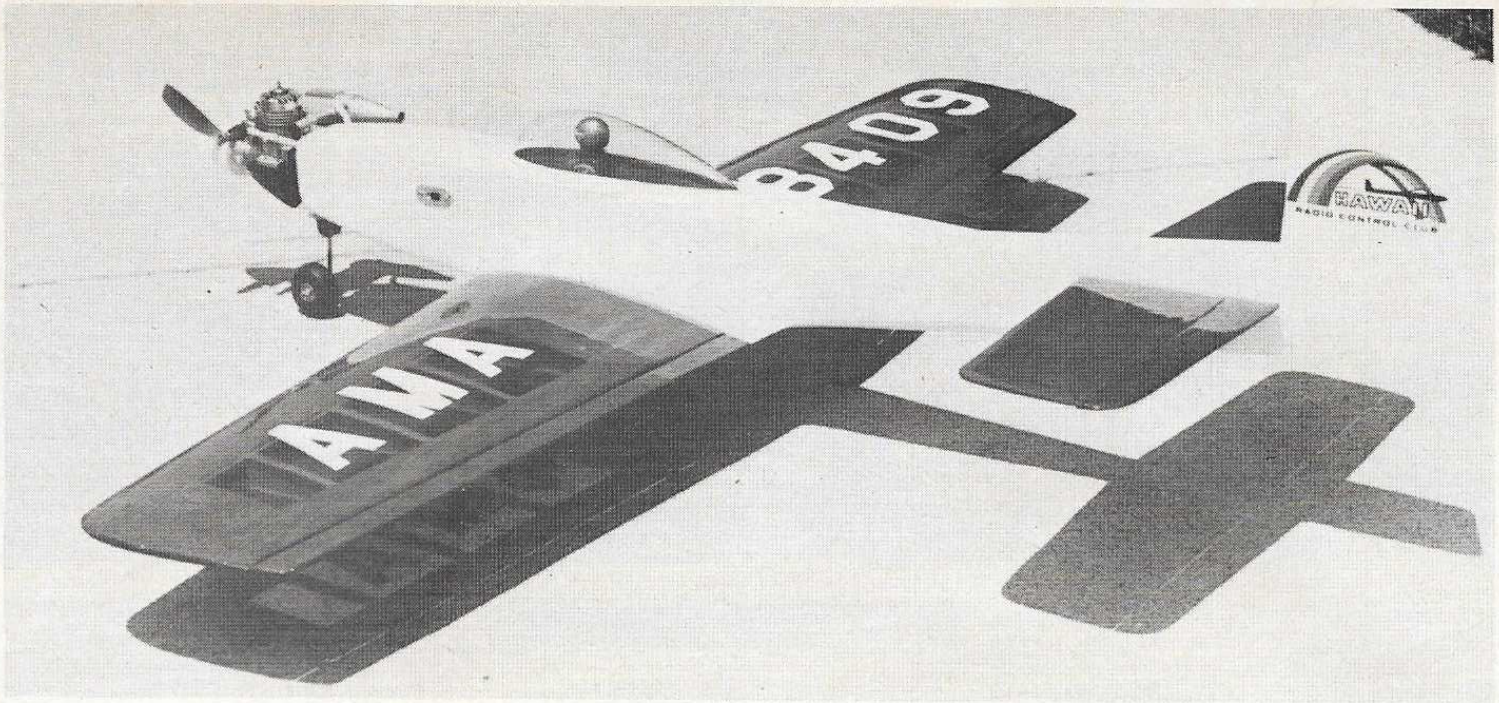
Install the radio equipment as mentioned before. The receiver and battery packs must be wrapped in soft foam rubber. I had to use a slightly different battery pack in this model since the long pack (2.75″ length) supplied by Ace with their three channel system wouldn't quite fit. A square type configuration, using the same 400 mah cells, proved better for this particular application. Ace sells injection molded cases for this size as well. The radio antenna was run out through the center of the wing, using the wing jig wire holes. Any excess at the wing tip is passed back through the rear wire holes. I've never had any trouble using an internal antenna system. It also eliminates drag and places less strain on the antenna wire itself.

Balancing

Make sure that the model balances exactly as shown on the plans or if anything slightly further forward. Don't fly it in a tail heavy condition, so add weight if necessary to make it balance properly. All balancing should be performed without fuel in the tank. In my case I was forced to add approximately 1 ounce of weight in the tail to correct a nose heavy condition. This unusual condition occurred because of the heavy weight of the new O.S. Max .10SR engine and muffler (something close to 6-1/2 ounces). Final weight of my prototype model was 32 ounces which was very close to my original estimate. Final wing loading was therefore 19.2 oz./sq. ft.

Flying

Although I normally fly a new engine right out of the box I did, in this case, follow the O.S. instructions which call for a 20 minute break-in period. As it turned out, keeping it running at all during the break-in period was quite difficult. In many instances the engine would seize after only a few seconds of running. I was only using a mild 5% nitro content fuel at that. Because I was anxious for that first flight I discontinued the break-in session. This was almost a big mistake. During my first flying session the engine seized up once in the air and for the



most part sagged quite badly with a resulting loss in power. I was forced to remove the muffler for a short while to prevent the engine from further overheating. Propeller selection turned out to be another problem. With the help of our local expert, Mr. George M. Myers, a 7-6 Top Flite nylon prop, cut down to 6-1/2" diameter seemed about the best. With that prop the engine tached at 12,500 rpm using 15% nitro fuel. O.S. indicates that up to 40% nitro content fuel can be used after the engine is fully broken in. I have not had the opportunity to try this as yet. At any rate the old standby 8-3 or 7-4 props don't seem to be the correct answer for this new Schnuerle ported engine.

The big first flight question was how well the model would steer on the ground using the aileron servo? To my surprise this worked out quite well. The model tracks straight and can be steered easily for the first 75 feet or so. During this time you can hold a little down elevator to keep the nose gear on the ground. Once you decide you have enough takeoff speed, rotate with some up elevator quickly, to get the model in the air. Remember, as soon as the nose gear lifts off the runway you no longer have steering control. Once in the air the Ace Three-Ten performs like any ordinary pattern plane with the exception of maneuvers that require rudder control. Landings I found to be quite gentle. You will have to adjust the O.S. throttle for a very low idle. Anything more than dead low idle tends to keep the plane in the air. Because of the small diameter of the wheels you will have to use some type of smooth take-off surface (blacktop or concrete). I doubt if you could get it off a grass strip. Final control surface movements were as follows: elevator +/– 1/4" and aileron +/– 3/16". Keep the nose gear steering to a reasonable minimum. Something like 10 degrees either side of neutral should be more than enough. By the way I did have to reverse the servo direction on both my aileron and elevator servos.

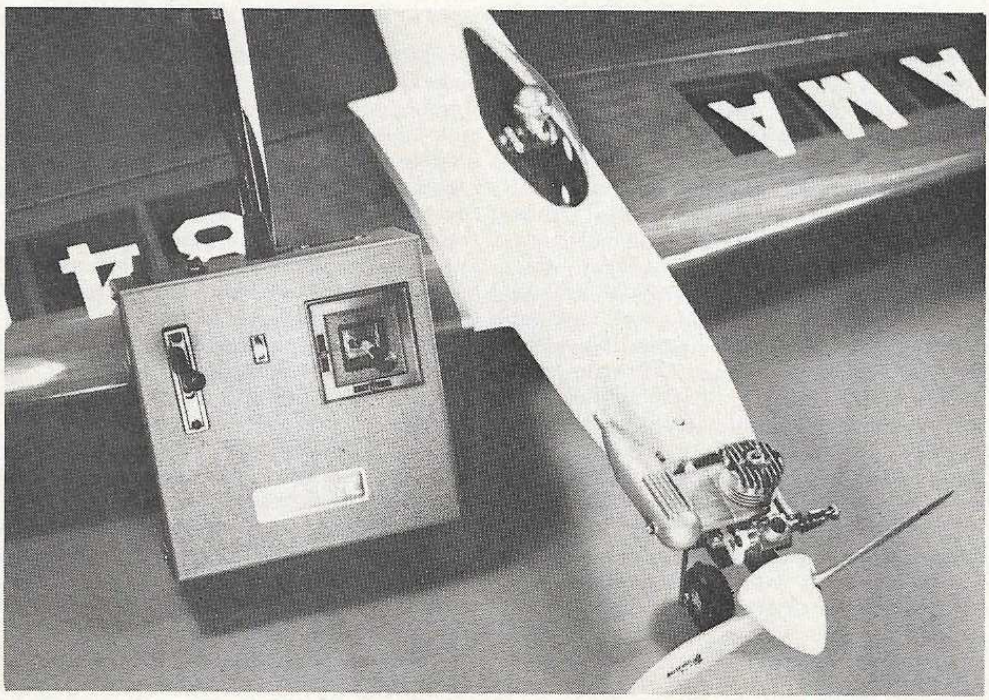
The Ace three channel R/C system performed without a glitch. As expected the new servo amplifiers provided extremely fast response with excellent resolution. Range was never a problem even with the internal antenna. Power consumption of the receiver battery pack was very low thanks to the use of the new, low drain, CMOS I.C.'s in the decoder. To save weight you could easily substitute a 175 mah battery pack and still expect to get over an hour flying time (with three servos in use).

Final Comments

You may at some later time want to add a fourth channel to control the rudder. To do this you could place the aileron and rudder servos side by side. The steerable nose gear linkage would then be connected to the rudder servo. By doing this you would only add approximately 1-1/2 ounces to the model. The full four channel control would make this model a good advanced pattern trainer. Remember, too, that the cost of material for building a model this size is relatively low as compared to a big .60 job. I doubt if my balsa wood cost me more than $10.00.

What about that Hawaii Radio Control Club decal on the vertical tail? These new decals were passed on to me by my good friend, Ben King. Ben is the Editor of his club's newsletter, The Hawaiian Flypaper. On our recent trip to Oahu, Ben gave us probably the best day long tour we ever had. Modelers are truly great, all over the world.

Since I usually run out of ideas for color schemes why not send me several of your clubs decals. I would be glad to display them on my future designs as I did in this case. Send them to me % Carstens Publications, P.O. Box 700, Newton, New Jersey 07860. Let me know also what type of new designs you would like in the future.



Small in size, but not in spirit. An economical ship to fly, capable of real aerobatic performance. **At top:** Well matched. Ace's system, a performer of a powerplant and a design inspired by the potential.