The Next Step

by Bob Aberle

A logical progression in learning to fly Radio Control. Uses Ready-To-Fly parts.

PHOTOGRAPHY: BOB ABERLE

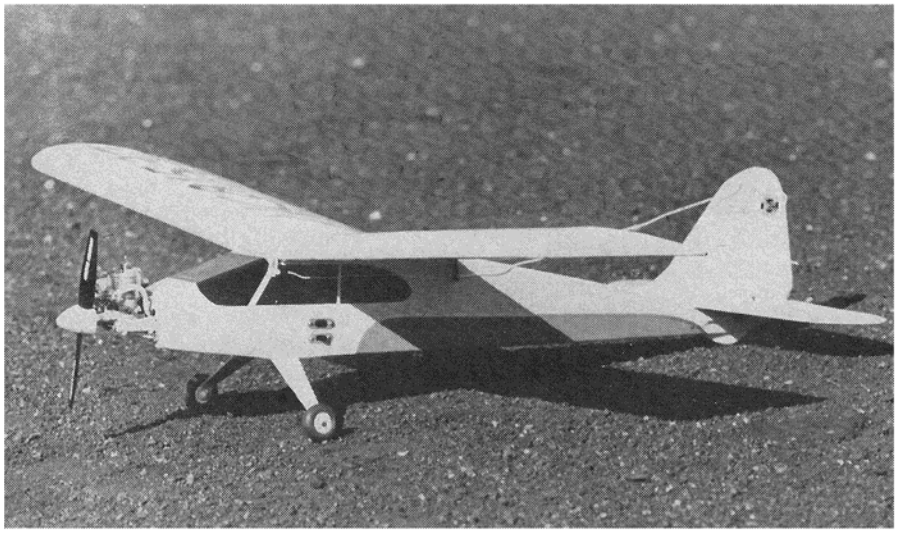
Looking at the lead photos of this article i'm sure you would conclude that this is just another simple little .09 powered R/C trainer. Well, in fact, it is. However, upon closer inspection of the photos and text, you would find that this particular model has a theme all of its own. My recent product review of an MRC chipmunk model (November 1980 FLYING MODELS) provided the actual idea for this design. Let's say you bought the little Chipmunk as an R/C trainer. It came ready-to-fly and included an installed Enya .09 engine. All you had to do was install a three channel radio system and head for the local flying field. But let's say you couldn't get help or made an error (with help) and parts of the Chipmunk were damaged beyond repair. What would you do next? Well you could buy replacement parts for the Chipmunk from MRC. An alternative (and one that isn't very costly) would be to build up a new trainer around the parts still available from the Chipmunk. Hence the "NEXT STEP" design.

Design Considerations

The *Next Step* has a very basic plan form. Since I couldn't know what parts of the Chipmunk might be available I decided to provide a complete aircraft design. Wing area was chosen at 275 square inches to be identical to the Chipmunk. The span was reduced to 36 inches so that basic balsa lengths could be used without waste. To get back to the same area the new wing chord (width) had to be increased somewhat. Fuselage length was roughly the same as the original Chipmunk. The big design difference was the location of the wing on the top of the fuselage. High wing designs are generally more forgiving for a beginner. For my new wing design I chose a modified Clark "Y" flat bottom airfoil at 13.5 percent thickness, the modification being that the curvature of the lower forward surface was eliminated in the interest of easier building for the beginner. The tail surfaces were intentionally oversized so that the *Next Step* could handle a variety of wing sizes, from several ready built models now available on the hobby market. All of the design variations discussed in this article centered around the use of the MRC/Enya .09 TV engine as the basic power plant. This was a very inexpensive and reliable engine. A perfect choice for a beginner project such as this.

Design Alternatives

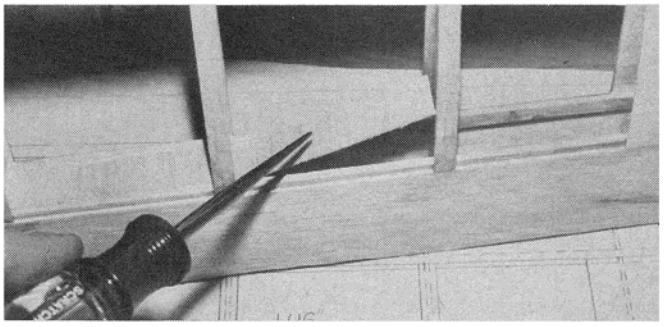
Assuming you have an .09 engine already, you might want to build the complete *Next Step* design. If it's still useable, mount the MRC Chipmunk wing. If not here are some options: First build my wing. It works fine. I have also successfully flown the *Next Step* fuselage and tail assembly with an MRC Eagle wing which has a 48 inch span and 375 sq. in. of area. Performance with this big wing is much like a powered glider. If you want that type performance, you can easily duplicate the effect of the Eagle wing by building my wing design to a full 48 inch span instead of the 36 inch version shown on the plans. Another wing tried is the Carl Goldberg Models Ranger-42 with a span of 42 inches and 240 sq. in. of area. This smaller wing makes the *Next Step* a hot performer which I don't recommend for the beginner. In any of these wing alternatives you will have to adjust the wing saddle to make the particular wing fit the fuselage properly. I use some foam tape or balsa shims to make some of the semi-symmetrical (round bottom) airfoils fit the fuselage properly. You may also adjust the location of the rear wing, rubber hold down dowel depending on the width of the wing you select. One more variable—the radio system! I use my usual Kraft lightweight airborne system with three KPS-18 servos which is a little on the expensive side for a beginner. To prove a final point I added a four ounce weight on the center of gravity (C.G.) of the model to roughly simulate the weight of a relatively heavy three channel R/C system. The extra weight was tried with all design variations just described. Quite honestly it has no effect at all. So that's it. An .09 R/C trainer with a lot of choices. Can a beginner "scratch" build (build from plans)? In this case I believe yes. The materials employed are relatively inexpensive and easy to find at most local hobby shops. If you succeed, you will have acquired a great deal of confidence at a very early entry point into the hobby, something you can't obtain when buying ready built models or when building kits. How about it?



Construction Sequence

Before actually cutting any wood I generally make up a set of templates or patterns. I use an extra copy of the plans because they are available to me as the designer. You can

Our cover girl, Patti Aberle, is holding Dad's favorite transmitter, the Ace Silver-Seven (**top**). The Next Step has Aeronca Champ looks (**left**).



Bob stresses that 1/16" vertical grain balsa webbing must be added between every rib station at the main spar and at the beginning of the trailing edge sheeting (**above**). Bob is shown here ironing Top Flite's Super Monokote onto a wing panel (**left**). It's the light way to go.

easily trace the various parts from the full size plans directly on to vellum (translucent) drafting paper. Next step is to rubber cement these tracings to the backs of manilla folders or simply lightweight card stock material. Let the cement dry overnight and then cut the templates to the outlines. It is then easy to mark the various parts directly to the balsa or plywood material using a ball point pen. The templates can be saved in a file folder for use later on, should repairs be necessary, or in case you want to build a duplicate model.

Wing (built up version)

I always start with the wing. If you decide to use the MRC Chipmunk wing or some other type foam wing then skip this section. First make up a set of wing ribs. You will need 14 ribs from 1/16 inch balsa and two tip ribs from ¼ inch balsa. I make up two 1/32 inch plywood rib templates (from the cardboard templates just mentioned). In this design all the ribs are the same size. Make up a stack of balsa blanks (over sized pieces) and place them between the two rib templates. Bolt the stack together with long 4-40 screws. Using a long X-Acto #26 carving blade knife, carve down to the plywood template surface, on both sides. Sand the entire sandwich. Mark the spar cut out locations and then separate the stack. Remember that the ¼ inch thick ribs are intended for the wing tips.

Construct the wing on a flat building board. In this case I use an old piece of Homosote model train board because it is easy to push pins in to. Cover the plans with wax paper so that the excess cement doesn't cause the wood to stick to the plans. Strip out the bottom leading edge and trailing edge sheeting from 1/16 X 3 X 36 inch soft balsa. Use a steel straight edge to cut these sheets accurately. Add the lower cap strips (1/16 X ¼) inch balsa- cut from scrap pieces) and the lower center and tip sheeting. Next the bottom ⅛ X ¼ inch *spruce* spars are pinned in place. *Do not use balsa for these spars!* Install all the ribs for one half of the wing. Add the ¼ X ¾ inch balsa leading edge and the top spar.

At this point I cut out the three 3/32 inch plywood wing braces (WB-1, 2 and 3) and epoxied them to the wing panel under construction. Finish off the wing half by adding the top leading and trailing edge sheeting; top and center sheeting; and cap strips. Lift this wing half off the building board and proceed to build the other panel in the same manner. As you build this second panel you may also join up the first panel at the center section (epoxy the other halves of the plywood wing braces). Make sure the dihedral ("V" angle) angle of the wing is as shown on the plans.

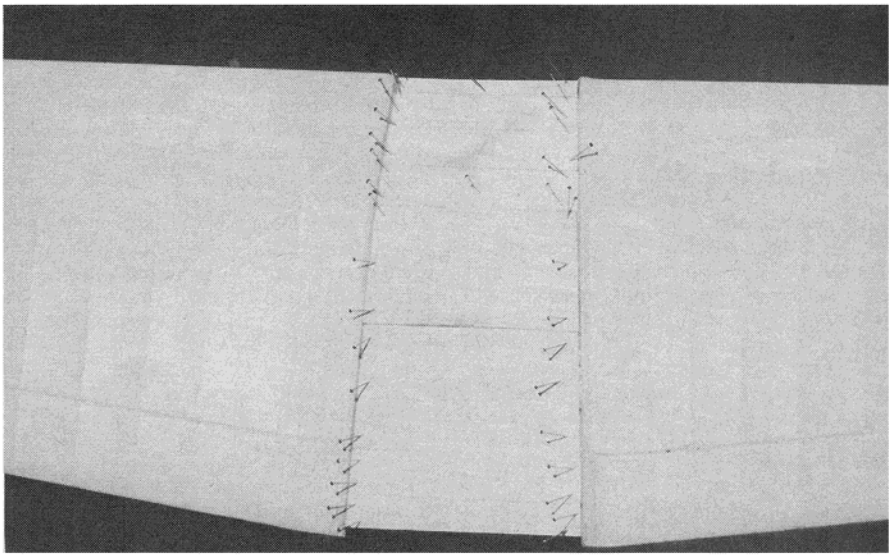
The finishing touch to the wing is to add 1/16 balsa with the grain running vertically between each rib station at the main spar and at the beginning of the trailing edge sheeting. This takes a little extra time but adds tremendously to the overall strength of the wing. Finally install a piece of 1/16 inch diameter wire at the trailing edge, center section, to prevent the wing rubber bands from penetrating the balsa wood.

MRC Chipmunk Wing

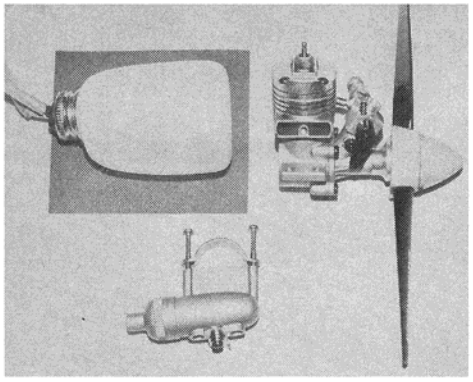
All you have to do here is sheet the center section of the Chipmunk wing with 1/16 inch soft balsa. Run the grain span wise and use epoxy cement. Don't use regular modeling type cements, such as Ambroid, since they will melt the foam material. This sheeting covers the aileron servo opening that is molded into the Chipmunk wing, when used in its intended low wing configuration. Also remove the landing gear struts since they can not be used in this application (high wing location).

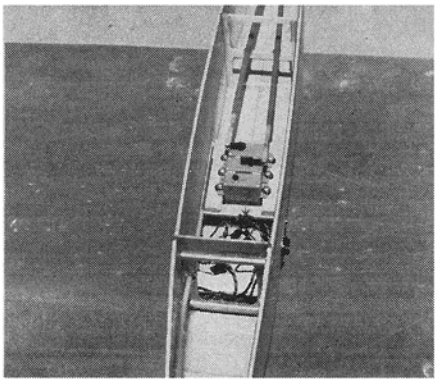
Fuselage

Using your templates transfer the fuselage side outline to the balsa sheet. Select two pieces of medium weight 3/32 X 3 X 36 inch balsa for the sides. Use some of the left over material at the tail area to splice in further forward where the sides are larger than three inches in width. I tack glue both sheets together and then cut both sides at the same time to make sure they end up identical. Cut out the 1/64 inch plywood doublers and cement them to the balsa sides with Hobbypoxy Formula II. Careful here—make one right and one left fuselage side. Add the rear spruce stab support and let both sides dry overnight. Cut out all the identified plywood formers. A small coping saw or better still a Dremel Jig Saw comes in handy for cutting plywood parts. You will need to purchase small sheets of 3/32, ⅛ and 3/16 inch thick plywood for the various formers. Keep



The MRC Chipmunk wing center section is shown sheeted with 1/16" balsa. Prime the balsa and then paint with Pactra's Formula-U paint.





These are some of the parts that Bob obtained with the MRC Chipmunk ready built plane (**above left**). Bob likes to pre-fit the entire radio system in place before the fuselage is finished (**above right**).

the excess material. You will always be able to use it on other projects. Note that the firewall (F-1) has a hole in the center for passage of the fuel lines. Former (F-2) also has a clearance hole for the passage of the fuel tank (which must be inserted through the R/C compartment). Make sure the tank of your choice clears this hole *at this time*. If you are not using the I.M. Products 2¾ ounce tank that is supplied with the MRC/ Chipmunk, you might try a Sullivan round (R-4) tank (4 ounces capacity). You may also be able to use a Tatone three ounce "Stick-A-Tube" tank. The 2¾ ounce tank will run the Enya .09 for approximately six to seven minutes (two ounces is a little too small and four ounces is a little too much fuel capacity).

Assemble the two sides (doublers facing the inside) with former (F-2) in place along with the ⅛ X 3/16 inch spruce longerons (by the wing trailing edge location). While this is drying bolt the engine mount to the firewall (F-1) using 4-40 socket head screws and "T" nuts. Epoxy these nuts to the firewall so they won't work loose later on. If you are not using the MRC radial engine mount you may select the Kraft KM-09 mount as a substitute. Install the firewall at this time and also draw the sides together at the rear. Use a clothspin or modelers clamp at the rear position while the epoxy cement dries. I generally place the forward fuselage very carefully in a large bench vise, applying just enough pressure to hold the sides against the firewall. Again use five minute epoxy cement at these joints. When this dries add the plywood formers (F-3), (F-4) and (F-5) which will provide the anchor point for the landing gear. Also add the 3/32 inch balsa bottom sheeting, both fore and aft of former (F-4). Do not install the top sheeting at this time with the exception of the small piece that fits under the vertical fin at the rear. Add a ¼ X ⅛ inch spruce wing saddle or support on both sides of the fuselage in the area of the wing mount. Insert the two 5/32 inch diameter wood dowels (wing hold down) in place and epoxy. Put the fuselage aside for the moment.

Tail Surfaces

Select a price of soft ⅛ X 3 X 36 inch balsa. I like the Sig contest balsa for this particular application. From the single sheet you will be able to cut out the complete fin, dorsal, rudder, stab and elevators. Pre-sand all the tail surfaces. Install the ⅛ inch plywood inserts on the elevator and rudder, to which the nylon control horns will be mounted later. Join the elevator halves with 1/16 inch diameter wire. Cut all the slots for the hinges and actually install the hinges briefly to make sure they fit and operate freely. I employed the Klett brand small hinges on this model (four on the elevators and three on the rudder).

Initial Assembly

Temporarily mount the wing to the fuselage using a few rubber bands. Pin both the stab and vertical fin in place. Align both of these surfaces with respect to the wing. Using five minute epoxy, cement both tail surfaces to the fuselage. Remove the wing for the next step.

Preliminary Radio Installation

This is always the best time to install your radio system. If you wait until the model is painted and finished you can easily end up with "unsolvable" problems. Plan your R/C equipment layout so that it is located as far forward (close to the wing leading edge) as possible. I made up my own servo tray out of plywood and scrap pieces of spruce. You can easily use a molded plastic tray if one happens to be available for your particular servos. Place the throttle servo forward and the rudder/ elevator servos behind it. Don't forget to make provisions for your power (on/off) switch and possibly a charging jack. Always mount these on the opposite fuselage side from your engine exhaust/muffler. Residual fuel and exhaust can easily ruin switches and jacks. Since the top fuselage sheeting in not in place you will find it very easy at this time to install the Sullivan brand Gold N' Rods (red-flexible type). These rods connect the servo output to the flight control surfaces (rudder and elevator) at the rear of the fuselage. One small diameter nylon rod actually moves inside a larger rod to transmit the control motion. Install the nylon control horns on their respective surfaces and temporarily "hinge them up". Don't cement the hinges in place until after the model has been painted. Run another Gold N' Rod forward, through former (F-2) and around the fuel tank, then through firewall (F-1) up to the engine throttle lever. Sometimes I run a soft brass cable inside the Gold N' Rod (outer jacket) since it is a little more flexible. Now temporarily connect up your receiver and battery pack. Operate the controls and make sure everything works correctly (left is left, right is right, etc.) without any unnecessary binding which could easily drain your battery down prematurely. Remove all the servos and radio equipment until after the final finishing.

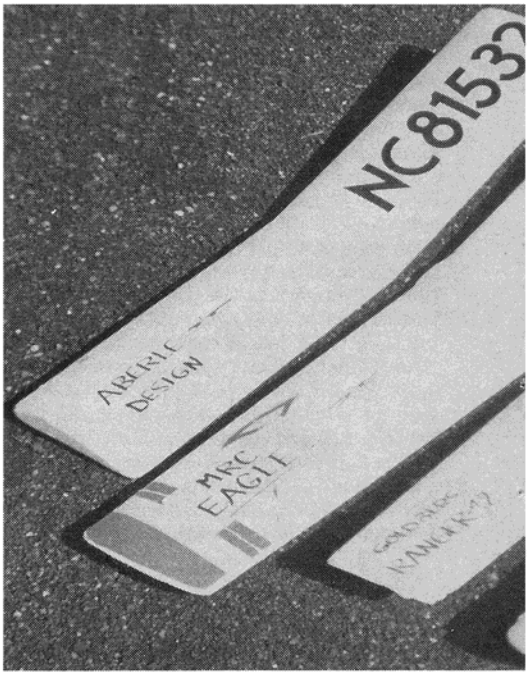
Final Fuselage Assembly

Add the top 3/32 inch balsa sheeting both fore and aft of the wing (cross grained is OK). Install the small dorsal back by the vertical fin. Depending on your choice of a wing you may have to adjust the location of the rear wing dowel and possibly some of the top sheeting directly behind the trailing edge. Drill the mounting holes in the Hallco landing gear. Drill the same holes through the formers (F-4) and (F-5) on the bottom of the fuselage. The gear will be installed after painting. Sand the entire model in preparation for covering and finishing. I suggest you use no. 150 paper lightly. Then go to number 220 and finally number 320 (black) paper (all dry at this time).

Covering and Finishing

I generally employ iron-on covering for the wings and epoxy paints for the fuselage and tail surfaces. You can't beat epoxy paints for durability. The entire fuselage and tail surfaces are given two brushed coats of Hobbypoxy Undercoater White (H-19) primer. Allow 24 hours drying time between each coat of primer or paint. Sand between both primer coats with number 320 paper (used very wet). After the second sanding let the water dry and then wipe off the surfaces with a tack rag (available from Hobbypoxy). I then brush on two coats of Hobbypoxy Cub Yellow (H-49). After masking off with black electrical tape, I apply a brushed coat of International Orange (H-56) on the lower rear portion of the fuselage. This tends to simulate an old Aeronca Champ color scheme. The parting line between the two paint colors is covered with ⅛ inch wide automotive type silver striping tape. Windows are simulated using black Monokote trim sheet material. Final touch involved a brush coat of Hobbypoxy Clear (H-08) over everything (including the Monokote windows).

The built-up wing is covered with opaque yellow Top Flite Super Monokote which roughly matches the shade of the Hobbypoxy Cub Yellow. Follow the instructions supplied with each roll of Monokote. This takes a little technique. Keep trying—don't give up after doing only one model. After awhile you will



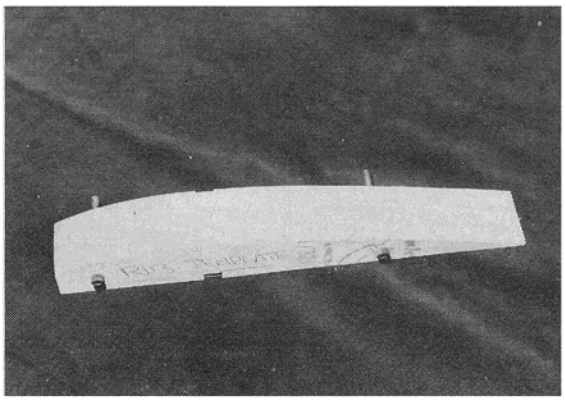
really appreciate this iron-covering (and it doesn't smell either!). Final touch involves adding some stick on decals, to the wing, simulating a full scale aircraft license number.

Final Assembly

In this order perform the following tasks: install the 1¼ inch diameter wheels to the Hallco landing gear: install the landing gear to the fuselage using 4-40 screws and "T" nuts (keep the screws as short as possible—a long screw might accidentally cause damage to the receiver or battery pack in the event of a crash); attach the engine mount to the firewall using 4-40 hardware; bolt the Enya .09 to the engine mount (again 4-40 hardware); install the fuel tank by inserting it from the R/C compartment through the hole in former (F-2); let the tank fill and vent lines pass out through the hole in the center of the firewall (F-1); install the inner Gold N' Rods running back to the rudder and elevator; install the rudder and elevator using Klett small hinges (epoxy carefully in place without getting excess cement on the hinge line); install the control horns and connect up the rods to the horns using mini nylon clevises; install the three servos in the tray or beam mount (your choice); install the switch harness and charging jack (if applicable to your radio system); install the receiver and battery pack wrapped in foam rubber for protection against vibration and crash damage; plug in all the servos and operate the system; run the radio antenna out the side of the fuselage, out to the top of the vertical fin; adjust all the controls neutral and finally install the throttle control rod and adjust it so that the servo is not stalled or overloaded at either extreme of control (high or low throttle).

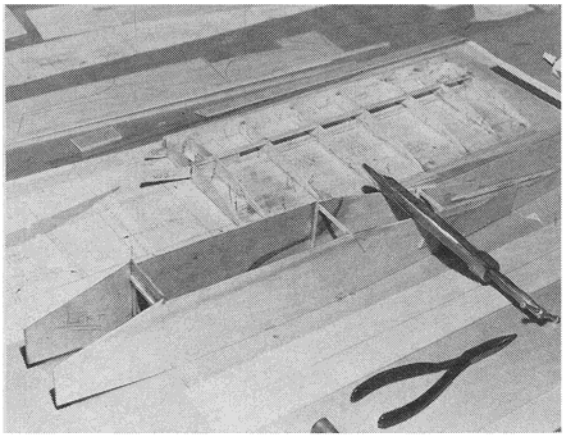
Check Out and Flying

You must make sure the model balances as

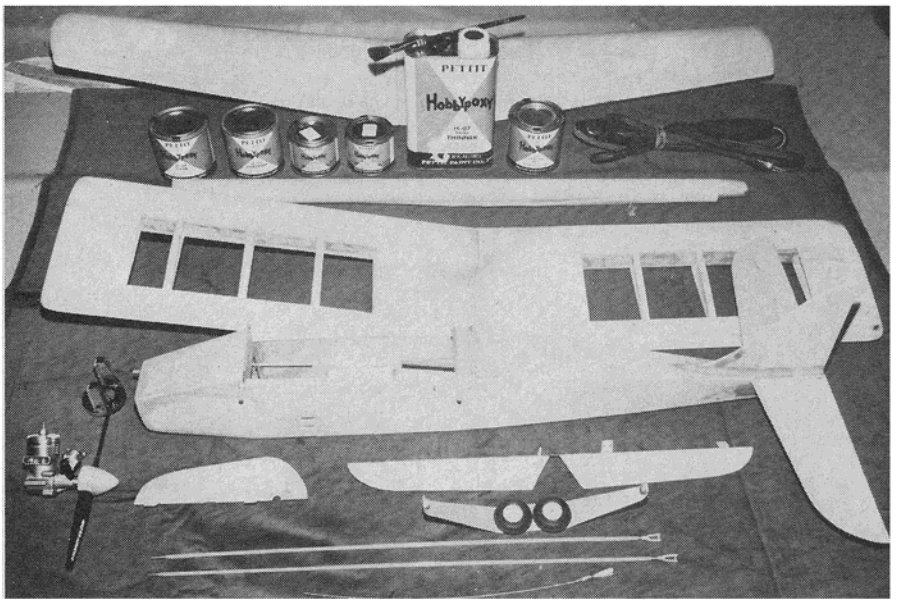


The ribs are made in a stack with plywood templates at either end of the stack and two 4-40 screws holding everything together for carving. Cut the spar slots while the ribs are still bolted together. It's easy.

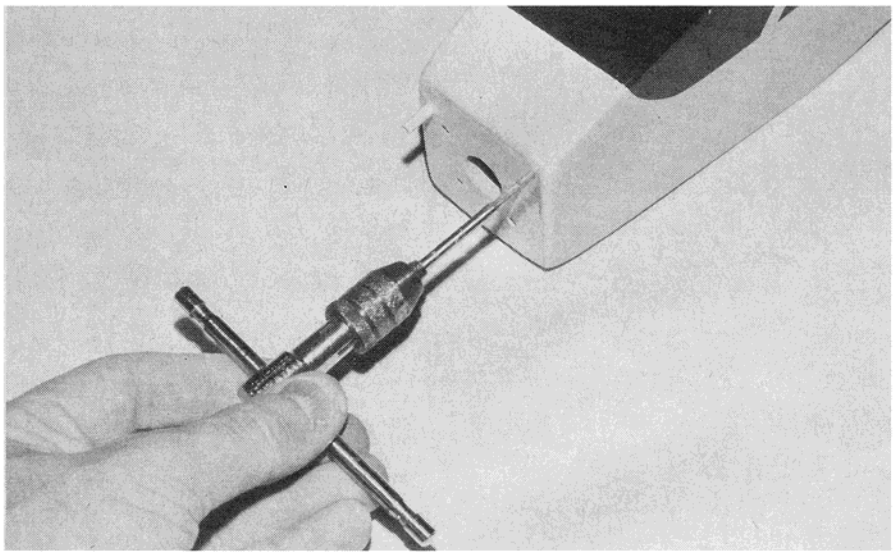
1/64 plywood doublers are laminated to the fuse. sides using Hobbypoxy Formula II glue. Be sure to make one left and one right fuselage side. Note template.

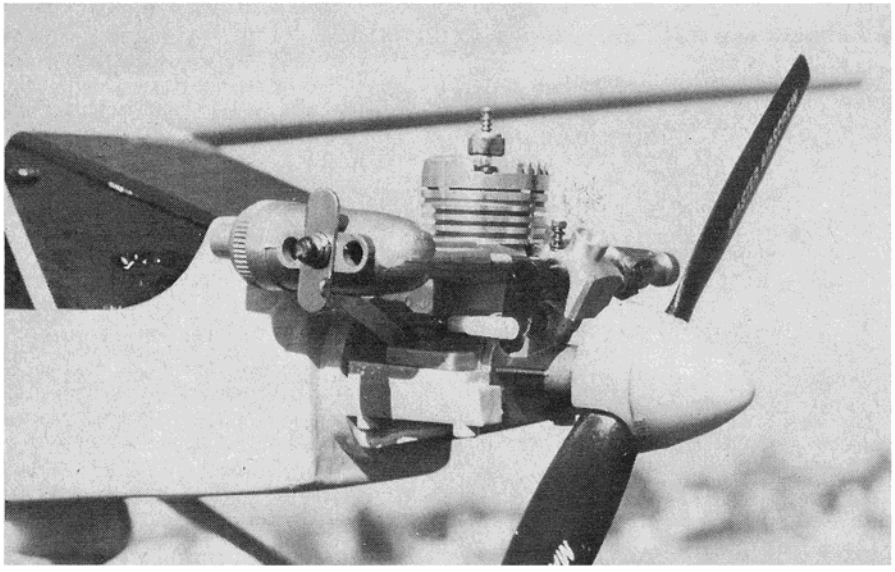


Here we see the fuselage and wing under construction. A "C"-Clamp holds the aft fuselage together. On the wing Bob has added the dihedral braces. Note pins.

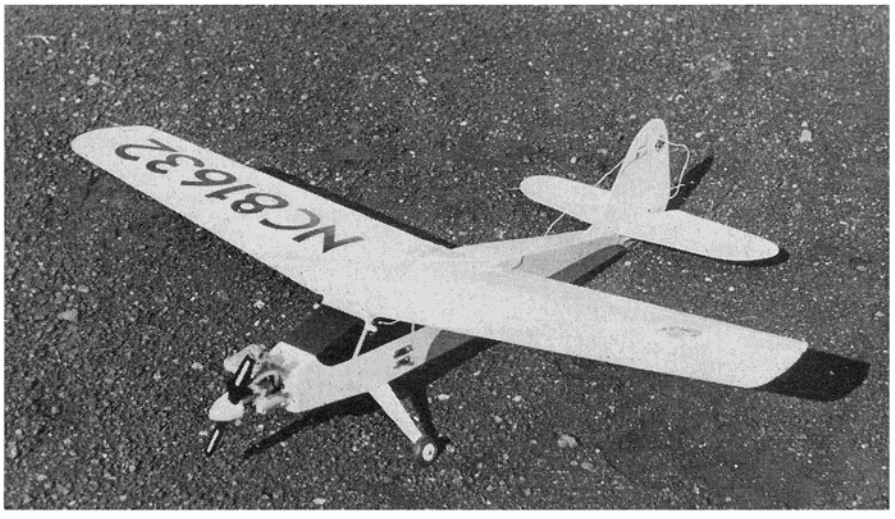


The completed model structure is shown here along with the Hobbypoxy brand finishing paints used on the fuse and tail (above). These are the four types of wing tried on the Next Step (left). Results in text.





Finishing paints tend to plug-up the "T" nuts; it's a good idea to run a tap through the holes to clear the threads (**top**). A close-up of the engine and mount shows the muffler baffle open for priming (**center**). The tank vent can be seen directly below the muffler. The engine is an Enya .09 from an MRC Chipmunk. Shown here is the Next Step with the MRC Chipmunk wing (**below**). Other wings can be used too.



shown on the plans (approximately two inches back from the wing leading edge). The prototype model balanced perfectly with all the different wings mentioned earlier. If it doesn't balance, add lead fishing weights fore or aft to make it balance *before attempting to fly*. Pre-set your control surface movement as follows: rudder-5/8 inch either side of neutral and elevator-5/16 inch either side of neutral. I used a Master Airscrew black fibreglas 7-4 prop and 15 percent nitro fuel. I made sure the MRC/Enya .09 was well broken in before attempting to fly (some can be quite stubborn when new!). Final weight of the basic model with the built up wing was 27 ounces. With the MRC Chipmunk wing it was 28 ounces and about an identical weight with the MRC Eagle wing (even though it has almost 100 sq. in. more of area). At the 27 oz. weight the wing loading would be 14.2 oz./sq. ft. with the built up wing. As stated before, the additional four ounces of weight to simulate a "heavy" radio system, didn't harm the performance of the model.

All the flying to date has been by hand launching. Without a steerable tail wheel or skid, ground maneuvering at slow speeds can be very difficult. Have someone launch your model so that you will have your hand right on the transmitter control stick to give an immediate command (especially helpful in higher wind conditions!). The *Next Step* is basically a very forgiving performer. As a basic trainer the large 48 inch (375 sq. in.) MRC Eagle wing is about the best, provided you fly in winds less than 15 m.p.h. Best all around wing appears to be the MRC Chipmunk. It stalls gently and has a good comfortable sink rate on landing approaches. The built up (my own design) wing provides somewhat more of a "hot" performance. Much like you can expect from a "clipped" wing full scale aircraft. As you progress with this design you might find this wing more challenging. Remember you can simply add wing span to this basic design to obtain more area. A 42 inch span version (same width) has approx. 320 square inches. A 48 inch version would have 375 sq. in. (or the same as the MRC Eagle wing). The building experience you get is also very important if you hope to progress further in the hobby. The Ranger 42 wing turned out to be just a little too small to be considered as a basic trainer (for this specific application). The Ranger-42, as a total model is, of course, an excellent model for the beginner (just had to say that Carl!)

Conclusion

Try experimenting with different wings. Possibly a local modeler might have an old wing lying around that he could pass on to you. If so, build up the *Next Step* fuselage and tail, adapt the wing and go flying. In general you will find this design a very excellent basic trainer.

Is there a step beyond the *Next Step?* Of course, you might try a flat (no dihedral) wing with ailerons next. After that you could progress to a low wing configuration. If you readers would like a logical progression of designs in this same power class please write to us at FLYING MODELS and let us know. We want to react to your requests as best we can.