WHING DING II

Dottie Curl poses with the WD II at Rancho Bernardo Playground in Southern California.

A Stand-Off Scale model of the ultra-light home built biplane. The original full size has a span of 17 feet against our model's span of 42 inches. Powered by a Tee Dee .049.

By Paul Denson

Robert W. Hovey's thoughts of building the 'Ultra Light' were brought on by the advent of the McCulloch 101A. This jewel of an engine inspired the WD-II design. The WD-I had a single wheel like a glider, but didn't work out too well. After analysis and design changes, the WD-II was contructed in a four month period and the first flight was made at Mojave, California, in February 1971.

Roll control is done with wing warping, however, the WD-II is so stable, some people turn with rudder only. If, after construction of the model, you desire to build the full size version, plans are available for $15.00 and an information packet for $2.00 from Aircraft Specialties, P.O. Box 1074H, Canyon Country, California 91351.

The original WD-II is advertised as an Ultra Light Biplane, ultra simple, ultra low cost, and ultra fun. The plane weighs 118 lbs., is powered by a 12 HP McCulloch engine and has a wing span of 17'. It is designed for 50 mph with a fuel capacity of 1/2 gallon which keeps it in the air for 15 minutes.

The three-views were found in the library of the Aerospace Museum in San Diego and I thought what an unique model this would make. The flight picture included with the three-view showed the sun shining through the wing so that all spars, diagonals, and ribs showed, which made me decide then and there nothing else but silkspan would do for the wing covering.

It was my intention to keep the plane as near scale as was practical without making the construction too difficult. This decision nearly ended the project on the first flight. The stab is full flying with 1/3 forward of the hinge line and 2/3 behind. The smallest movement available with the servos used would probably have been enough for the full size plane. Needless to say it was way too much for the model. After an uneventful hand launch, it flew well until the first stab correction was necessary then it went wild. Every time I touched the stick it was too much and it looked as if it was locked to the tracks of a roller coaster. The ensuing touchdown, if that is what you want to call it, wasn't too bad, but it did indicate that the boom had to be much stronger and the stab had to be changed. I put the stab in o° position and epoxied the hinge line then cut off the rear 1" of the stab, hinged it and added the horn — this turned out almost perfect.

In the plans stage, I thought about using aluminum tubing for the boom; this turned out to be unavailable so a built-up boom was tried. It consisted of two layers of 1/32" balsa wrapped with cloth and the whole thing given two coats of epoxy. The tubing was formed around a 3/8" dowel baked dry in the oven, then another tube formed around that, then baked dry. The two tubes were cemented together then wrapped with the cloth strip and given the two coats of epoxy. This was just great until I tried to get the two outer Gold-N-Rods down the tube - - - they just wouldn't go. I contact cemented two turns of a sandpaper strip on the end of the 3/8" dowel and reamed out the center of my fabrication - - - this was just enough to let the Gold-N-Rods pass through. This boom shattered in three places on the first flight. I turned to the expert on gliders and hang gliders, Mark Smith of Windward and Windfree fame, and he came up with a piece of aluminum tubing from one of his old hang gliders which fit the bill just perfectly. It was 1/2" OD seamless aluminum tubing 6061 T-6 and is not much heavier than the built-up boom, but much more rigid.

WD II

Designed By: Paul Denson

TYPE AIRCRAFT
1/2A Stand-Off Scale/Sport
WINGSPAN
42 Inches
WING CHORD
7 Inches
TOTAL WING AREA
588 Square Inches
WING LOCATION
Biplane
AIRFOIL
Flat Bottom/Overlapping T.E.
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
1½" (Both Wings)
O.A. FUSELAGE LENGTH
31¼ Inches
RADIO COMPARTMENT AREA
(L) 6" X (W) 1⅝" X (H) 1¾"
Plus Rcvr. Comp.
STABILIZER SPAN
14 Inches
STABILIZER CHORD (incl. elev.)
4½ Inches (Avg.)
STABILIZER AREA
60 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Boom
VERTICAL FIN HEIGHT
7½ Inches
VERTICAL FIN WIDTH (incl. rudder)
4½ Inches (Avg.)
REC. ENGINE SIZE
.049-.051 Cu. In.
FUEL TANK SIZE
2 Ounce
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
2
CONTROL FUNCTIONS
Rudder & Elevator
BASIC MATERIALS USED IN CONSTRUCTION
Fuse. ..... Balsa, Ply, w/aluminum boom
Wing ..... Balsa, Ply, Spruce, Music Wire
Empennage ..... Balsa & Ply
Wt. Ready-To-Fly ..... 25-28 Oz.
Wing Loading ..... 6-7 Oz/Sq. Ft.

I cannot claim credit for designing the bucket seat; I read about the idea in some literature quite some time ago. Ask you pharmacist to save the proper size pill bottle for you. Since I teach chemistry, all I had to do was look up and down the chemical shelf, pick out the right size plastic bottle, and transfer the contents to a glass jar, and I had my bucket seat. I hope no one looks for the Paradichlorobenzene! You can outline your seat with black rubber tubing and secure it with Hot Stuff.

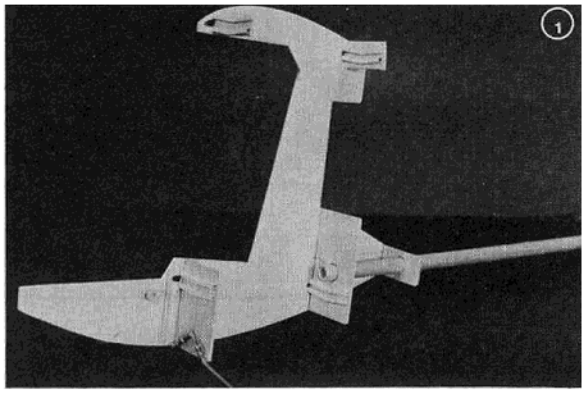
The rigging is not only nice to look at, but it is functional. If you tighten the turnbuckles just right you can take out wash-out or wash-in and, furthermore, it keeps the wings attached to the fuselage. The #1 turnbuckles are available from Proctor Enterprises.

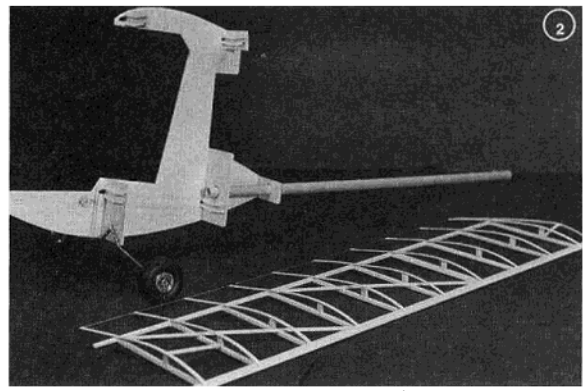
All brass fittings are made from .005" shim stock available in the K & S rack in your hobby shop. .005? that's what the micrometer says it is - - - .005. I don't believe it is that thin, but that is what it says — .005". (Grumble - grumble, gonna' throw that dumb micrometer away.)

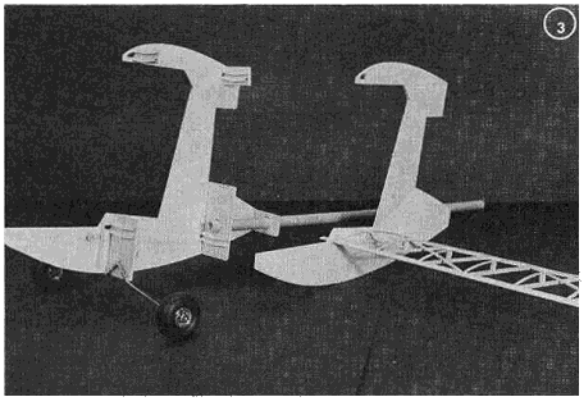
There are three hatches in the fuselage, the front hatch under the stick is for ballast and the small 500 mil. battery. I am sure a 250 mil. battery would work just as well. The hatch cover is sprung in place being held down with lips at each end. The cover for the receiver compartment is held in place by the seat, the servo mounting tape sticks only to the seat back. A screw through a hole in the seat holds down the cover to the servo compartment.

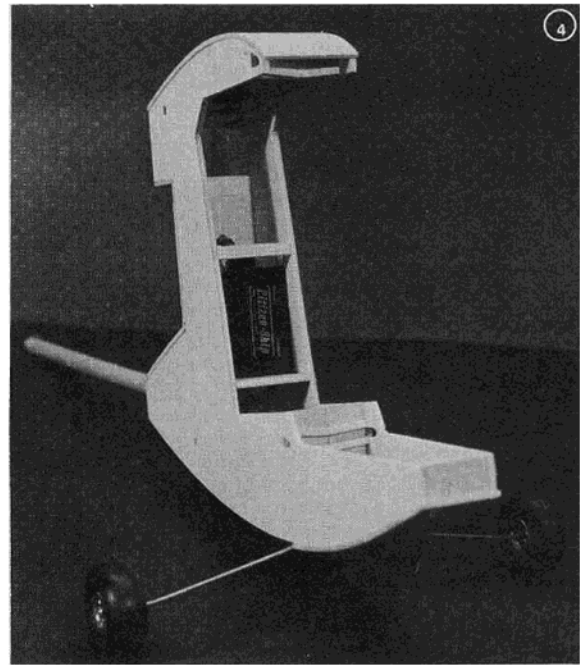
Wing:

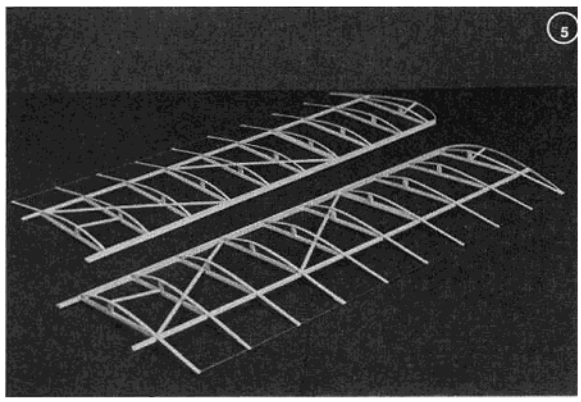
I am different from most people, I like building wings and there is where I start - - - besides this wing is so different from the normal wing, it is much more fun to build. My building board is made of Celotex for ease of shoving in pins. Drape the plans over the edge of the building board in such a way that the spar is exactly on the edge. Pin the spruce spar in place, add the leading edge after it has been tapered. While drawing the plans, I envisioned using trailing edge stock here but, the taper is wrong and it is less expensive to use 3/16" x 3/8" stock and plane your own bevel. Cut and glue the 1/8" square spacers. From a 7" long sheet of 1/32" ply, cut the 1/8" wide cap strips. Glue and pin the forward end of the cap strips to the leading edge and allow them to stick up into the air; make sure they are perpendicular to the leading edge. When they are absolutely dry, put a drop of glue on the top of the spacer and on the spar, bend them down and back over the spar, glue in place and pin. The excess will hang out over the edge of the building board. Add the diagonal braces. When completely dry, remove from the

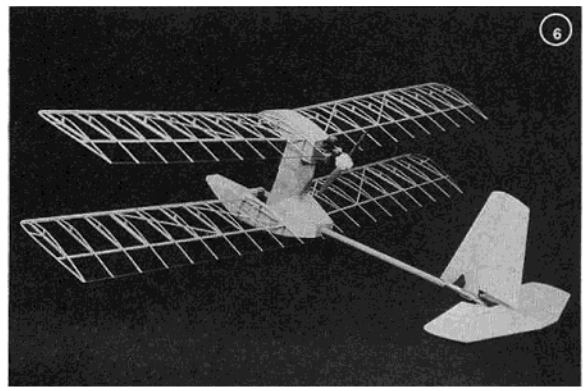


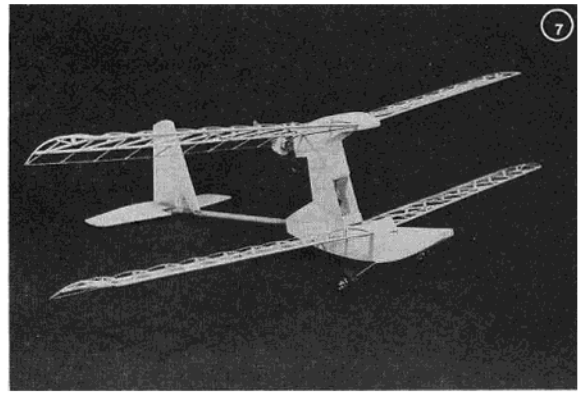




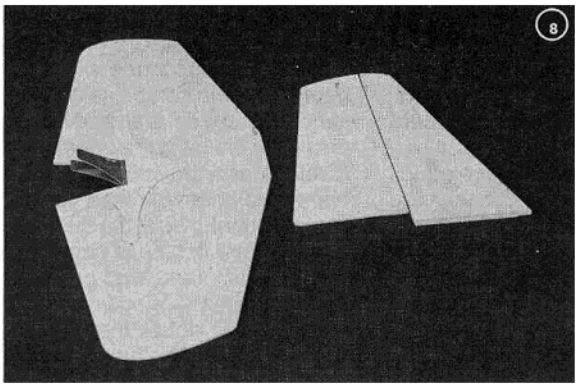


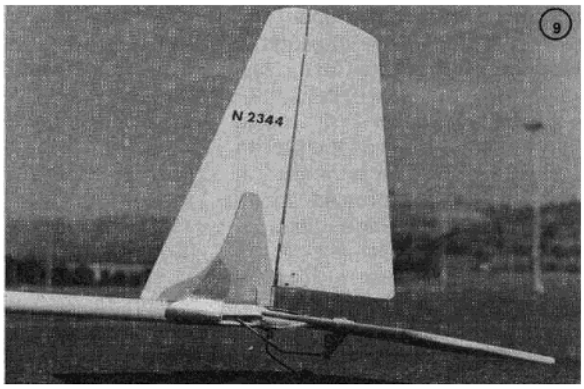


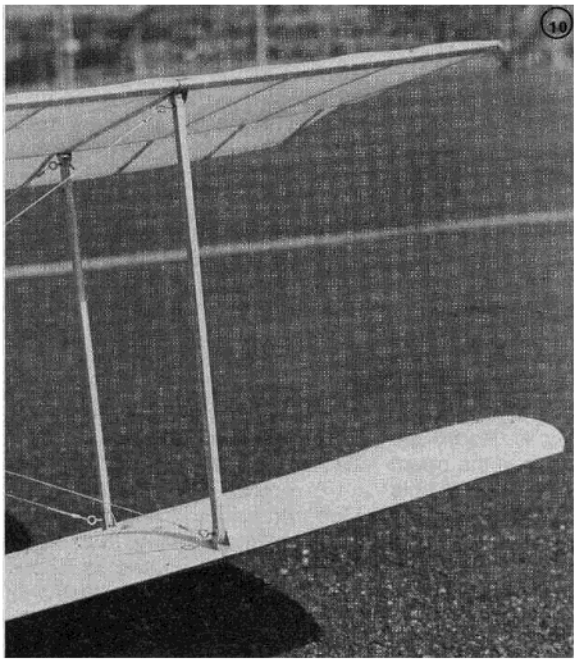


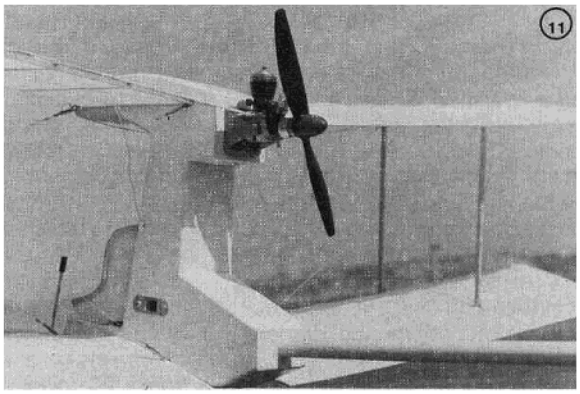


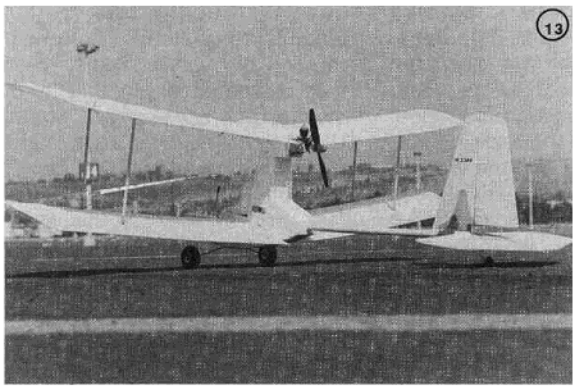
(1) Fuselage side shown with bulkheads in place. Landing gear has to be wired and epoxied in place before bulkhead is installed. Boom is not epoxied in at this point. (2) Another view of partially completed fuselage shown with one completed wing panel. (3) Left fuselage side ready to be joined to fuselage. Wing is shown set in leading edge and spar holes in fuselage side. 1/8" sq. spruce guides hold wing in dihedral position. (4) Fuselage approaching completion stage. Again note holes for wings to plug-in; these have to be accurate as they determine the wing incidence. Note receiver location. (5) One completed wing shown ready to be covered. Note ultra light construction built very similar to full size aircraft. (6) Three quarter rear view of completed Whing Ding prior to the painting and wing covering. (7) Three quarter front view. Only thing missing is the three hatches and something to keep the wind from blowing through the wings.

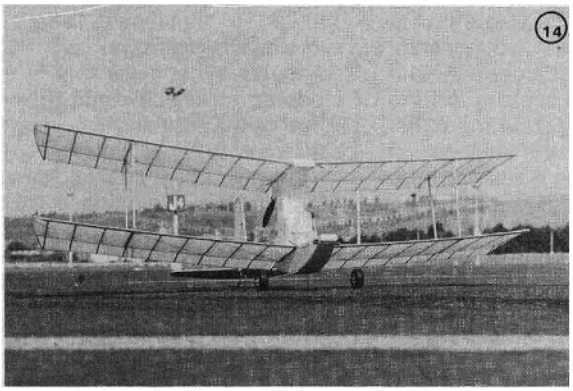












(8) Completed tail section. Note brass attachment plate on stab to attach to tail boom also 1/32" ply plates on both stab and fin. (9) Close-up of completed tail assembly on finished model. Boom slotted for pushrods. Rudder exits on right side. Brass sheet wraps around boom to help secure vertical fin. (10) Close-up of the wing struts and attachment brackets. Rigging wires are permanently attached at strut end. (11) Cox Tee Dee .049 set up on an Ace R/C 1/2A mount. Note Proctor #1 turnbuckles used on rigging. Turnbuckles placed at fuselage where rigging is taken apart when removing wings. (12) Plastic pill bottle makes a perfect pilot's seat. All that is missing is the pilot. (13) Photo looks like the real thing. Only the engine and receiver switch gives it away as an R/C model. (14) From this view it shows that the rigging is a very functional part of holding the wings on and in alignment. The wash-in or wash-out can be corrected by adjusting a turnbuckle on the rigging.

building board, block up the spar until the leading edge and the trailing edge of the tips just touch the board. Cut the tips to a straight line, put wax paper under them and glue a piece of 1/32" music wire to all of the tips to act as the trailing edge. This glue joint is only temporary, it will be necessary to reinforce each joint with a small strip of cloth cemented top, around the wire and back along the bottom side of each cap strip. The wing-tip is a cap strip turned sideways. Make four wing halves and be sure to allow the leading edge and spar to extend into the middle.

For your consideration, the wings did bow slightly as the paper tightened, this is not objectionable as the upward bow just increased the dihedral. It was intended to keep the WD-II as near scale as possible and the three-views did not show another spar - - - in fact, I added the spacers. I was reluctant to put one in place of the spacers. The rigging adds the necessary strength to the wings, but a 3/32" x 3/8" spar in place of the spacers might stop the bowing tendency. If you do this, the spar would have to be notched for the diagonal braces.

Fill in-between the cap strips on the leading edge with 1/32" x 1/8" balsa strips. When you cover the wings, let the silkspan extend 3/8" beyond the trailing edge on top, then fold under and cement. (Remember the newspaper and flour paste kites we used to build?) The bottom of the wing is covered from the leading edge back to the spar only.

Fuselage:

Cut the two sides to shape using 1/16" medium hard sheet balsa and duplicate each side from 1/32" ply, trying to keep the materials cross grain to each other. Laminate the ply to the balsa with contact cement. Sand the two sides together to shape. Cut out formers from materials indicated on the plans. In addition, you will need a compartment bottom under the fuel tank, and the receiver, and you will need two bulkheads in the upper wing area for channels to hold the top wing, cut from 1/8" sheet. These were not shown to shape on the plans as they will vary slightly depending upon your choice of tanks and radio equipment.

Bend the landing gear wire to shape and sew it to former #2 with copper wire or heavy thread. Using formers 1 and 3, the ply boom former and the firewall, build your fuselage box by gluing the formers upright on the right fuselage side. Add the compartment bottoms and the two formers in the upper wing area. It should now look like a maze and the task is to get from point A to point Z without passing Go or collecting $200.00. Now that you are out of Jail, you might glue the other side in place. I did not put the channel strips on the formers until I had the fuselage finished to the point that I could install the wings. Then the channel braces were installed to hold the wings in the dihedral position. Be sure and cut holes in the compartments for servo and battery wires, then most of the 3/32" edging may be applied. Keep the boom compartment open until the last when you will epoxy the boom in place (small wedges hold it in place until you are ready to epoxy).

Empennage:

The rudder is pretty straightforward except for the 1/32" ply stiffeners which are contact cemented in place. The stab, like the wings, is a horse of a different color. Even though you don't intend to use the whole thing for control, it is still a unique and good way to affix it to the boom. Cut it to shape from 1/8" sheet, cut the stiffener from 1/32" ply. Make the hinge by cutting the pattern shown from .005 shim stock, fold it around a 1" length of 1/16" ID brass tubing and solder. Cut a 6" length of 1/16" music wire and insert through the tubing. Cut a groove in the stab where shown and lay music wire in the groove; epoxy then cover with the stiffener. The long end of the hinge is attached to the boom. Before installing the empennage on the boom, make a tapered wooden plug from 1/2" dowel which is inserted in the tail end of the boom and epoxied. Form the hinge over the plug and onto the boom, bend to fit the curve of the boom and epoxy in place. Drill a 1/16" hole through the hinge boom and plug. Make the tail wheel pivot in the same manner as you did the stab hinge and fasten it to the fin with a 2-54 nut and machine screw. Roughen the top of the boom with a coarse file and epoxy the fin to it. To make sure it is at right angles to the stab, push a short piece of 1/16" music wire through the whole set-up till it hardens. Bend the right angle on the tail wheel wire, push it down through the pivot and on through the boom, slide on a wheel lock and secure. Bend the remainder of the tail wheel wire and add the wheel.

Place the fuselage on the wheel wires and block up the tail end so that it assumes the position shown in the side view on the plans. Note the incidence of the wings. Cut the holes in the sides for the leading edge and spar extensions. Elevate the wing tips for the proper dihedral and block in place. Cut four struts 6⅞" long from 1/8" x 3/16" medium hard balsa stock. Use a strut to keep the top wing parallel to the bottom. Glue the 1/8" square spruce strips in place, as shown on the plans to form channels for the leading edge and spars. Remove the wings and cut notches just above the leading edge holes and spar holes for the rigging anchors. Put them in place just before installing the wings for rigging. Install your servos now before you add the edging. The servos may be removed through the hatch, but it is rather tedious; add your switch and harness. Install the bottom edging made from hard 3/32" balsa, line the battery-ballast compartment with 1/16" ply for strength. Add the remainder of the edging except for the piece over the boom. Add the soft balsa nose plug and sand. When you are ready, make sure the fin is parallel to the upright part of the fuselage and the stab is perpendicular, epoxy the boom in place and close the compartment. Give the fuselage, stab and rudder a couple of coats of sanding sealer, finish sand, and paint with white dope. Before the wings were given their final coat of dope, they were fogged white to match the fuselage.

Run your pushrods through the boom and attach to the servos and proper part of the empennage. Unless you are willing to take the consequences, do not fly the plane with the full flying stab. When the plane is blocked up with the tail in the air, make sure the stab is parallel to the building board then epoxy the hinge joint in place. Use the back 1" of the stab for the elevator.

Rigging:

Make the rigging brackets from .005 brass shim stock and affix to the wings. The front brackets bend around the leading edge and are epoxied there for strength. The rear brackets on the bottom of the upper wing bend around the spar and are pinned with tiny 3/8" pins. The rear brackets on the lower wing were also pinned through to the 1/8" spruce spar. Anchor pins have a loop on one end and pass through the bracket and strut end then they are bent over at right angles to secure. The turnbuckles are at the fuselage end of the bracing wires. The bracing wires are 10 lb. test monofilament fishing line, I used 1/16" OD aluminum tubing as swages. Cut the tubing into 3/16" lengths (16 of them). Thread a piece of the line through a swage, through the loop in the anchor pin, back through the swage, pull up taut and squeeze the tubing flat with pliers. Open the turnbuckle about half way, pass the line through the eye of the turnbuckle, pull taut, and swage. Do this for all eight lines. Look at the ends of the wings for wash-in or wash-out and relieve by tightening or loosening the turnbuckles.

Safety wire the turnbuckles:

It must be remembered that the maximum gross weight of the full size plane is 300 lbs., with the plane weighing 118 lbs. - - - that leaves 182 lbs. for the pilot who sits just forward of the C.G. We do not have that mass available for the model so it will necessitate quite a bunch of lead in the front end to get the plane to balance at 1/3rd of the chord.

No other engine was tried other than a TD .049, but I imagine a Cox Black Widow would work just as well. A right hand prop starter spring is available at most hobby shops. If you use the Black Widow, the fuel tank is unnecessary.

The stick and foot rests are just decoration and can be made of

whatever you have. The stick was made of 3/32" OD aluminum tubing with a piece of black fuel tubing for a handle. The foot rests were made of brass shim stock, soldered to pieces of 1/16" music wire which were Hot Stuffed inside aluminum tubing which went through the balsa nose piece.

Using multi-channel equipment, I would not want to recommend this plane as a typical beginner's plane. I did not go into detail about covering the wings with silkspan or, even better, with silk. Applying these coverings does take quite a bit of technique; furthermore, arranging the radio gear in the fuselage is not easy either.

The more I think of single channel, Ace type, the more I think it might be a fabulous challenge. When you get rid of all the weight back of the Center of Gravity and move everything forward, the plane would balance easier. There would be no problem running the torque rod down the boom and the rudder is set high enough to be wig-wagged. If anyone does single channel the WD-II, whether it is successful, or not, please let me know through RCM; it would be interesting to communicate with you regarding your experiences.

As for flying, it putt-putts around the field at a scale speed and is an instant attention getter. I would not recommend Immelmans or outside loops but, it is a real fun flier and I hope you get a lot of enjoyment out of your Whing Ding II. □

From RCModeler July 1978