AEROMISTRESS

ALMOST ENTIRELY CONSTRUCTED OF FOAM AND PLY, THE AEROMISTRESS HAS MANY UNIQUE FEATURES DESIGNED INTO IT. IT HAS HAD SOME ROUGH TREATMENT AND STILL CAME THROUGH WITH MINIMUM SCRATCHES.

BY LAWRENCE MARGOLIN

This article probably would have never come to be if Bruce hadn't lost a wing on the maiden flight of his brand new Aeromaster. Bruce is a member of the Q.C.R.C. It seems that Bruce was trying to do some sort of aerobatic maneuvers when the top wing blew off and, in turn, took the rudder with it. The rest was the classic swan dive. How or why the wing decided to solo, no one really knows. Old rubber bands, etc., etc. The only complete part of the wreckage was the top wing which, being relieved of its burden, came down last.

As we looked over the wreckage, Bruce decided it was beyond repair. The cabane ripped out on one side (maybe it ripped out in the air?), the stabilizer was gone and the lower wing was shattered. I was on my way for matches and marshmallows when someone remarked to Bruce, "Bet Larry could make it out of plywood - - - Hey, Larr, want an Aeromaster body?" I reluctantly threw the debris into the trunk. Some nights later I decided to see how this airplane was built.

I extricated the body and did a little pushing and gluing and suddenly realized the body wasn't too bad. The Aeromaster is a well designed plane.

I rebuilt the fuselage, made a new empennage and decided to try foam wings. Having never tried to build a foam wing, I was reluctant. I weighed the built-up wing that was still intact and then weighed the components for the same wing as supplied by Wing Manufacturing. I was surprised to find I could build a foam wing that was actually lighter than a built-up wing. I built one set using the Wing manufactured components and another using balsa sheet for covering instead of the material supplied by Wing Manufacturing. By being careful to use the contact cement sparingly and using light balsa of 1/16" thickness, I came out with a considerably lighter wing. This being the case, I might be able to build a fuselage mainly out of plywood and the total weight would be the same. I finished rebuilding Bruce's bipe and flew it. I had never cared much for bipes and, after flying it, I still didn't.

I let all the hot shot Aeromaster pilots try it out and they said it flew great. I was used to something more aerobatic, so I decided to make some modifications to this popular design.

After having designed a plywood structure for the fuselage that reduced the number of components and simplified construction, I went ahead and cut parts for four **Aeromistresses** simultaneously. If one flew, I wanted to be sure of repeatability. When I completed the first, I was sure I had a highly aerobatic biplane. The first design had the top wing the same span as the bottom. I then completed Number 2. This time I used the standard upper Aeromaster wing. This made the airplane more docile and still very maneuverable. In construction, one of my main concerns was to build the cabane so that I could plug the cabane in as a unit. I wanted to be able to finish a fuselage completely, then attach the cabane so that it was a permanent unit. The way I did this was to build the cabane as a unit by leaving one cross piece on the front of the cabane unsoldered and doing the same with the rear cross piece. By doing this, I was able to 'spring' the cabane apart far enough for insertion into four holes into the fuselage. After the cabane is in place, the front and rear cross pieces are wrapped and soldered on the fuselage.

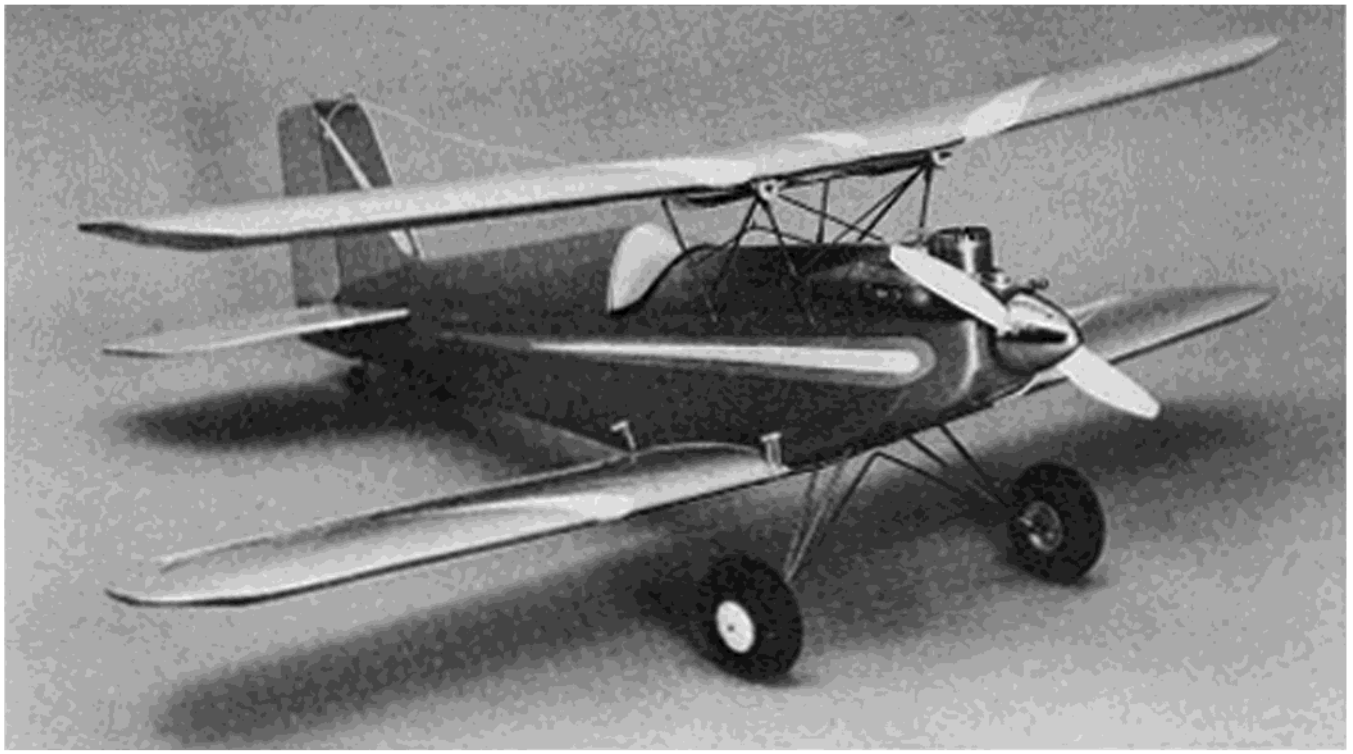
Another innovation was to have the top wing removable by using one nylon

AEROMISTRESS
Designed By : Larry Margolin

TYPE AIRCRAFT
Aerobatic Biplane
WINGSPAN
Top 53 ½" - Bottom 48 ½"
WING CHORD
9 Inches
TOTAL WING AREA
876 Square Inches
WING LOCATION
Biplane
AIRFOIL
Symmetrical
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
Top none - Bottom 1 ¼"
O.A. FUSELAGE LENGTH
40 ½ Inches
RADIO COMPARTMENT AREA
(L) 8" X (W) 3 ½" X (H) 3¾"
STABILIZER SPAN
20 Inches
STABILIZER CHORD (Incl. elev.)
8 ½ Inches (Avg.)
STABILIZER AREA
100 Square Inches
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Mid Fuselage
VERTICAL FIN HEIGHT
7 ¼ Inches
VERTICAL FIN WIDTH (Incl. rudder)
8 Inches (Avg.)
REC. ENGINE SIZE
.61 cu. in.
FUEL TANK SIZE
12 Oz.
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Ail. & Throt.

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Foam & Ply
Empennage	Balsa & Ply
Weight Ready-To-Fly	120 Ounces
Wing Loading	19.7 oz./sq. ft.

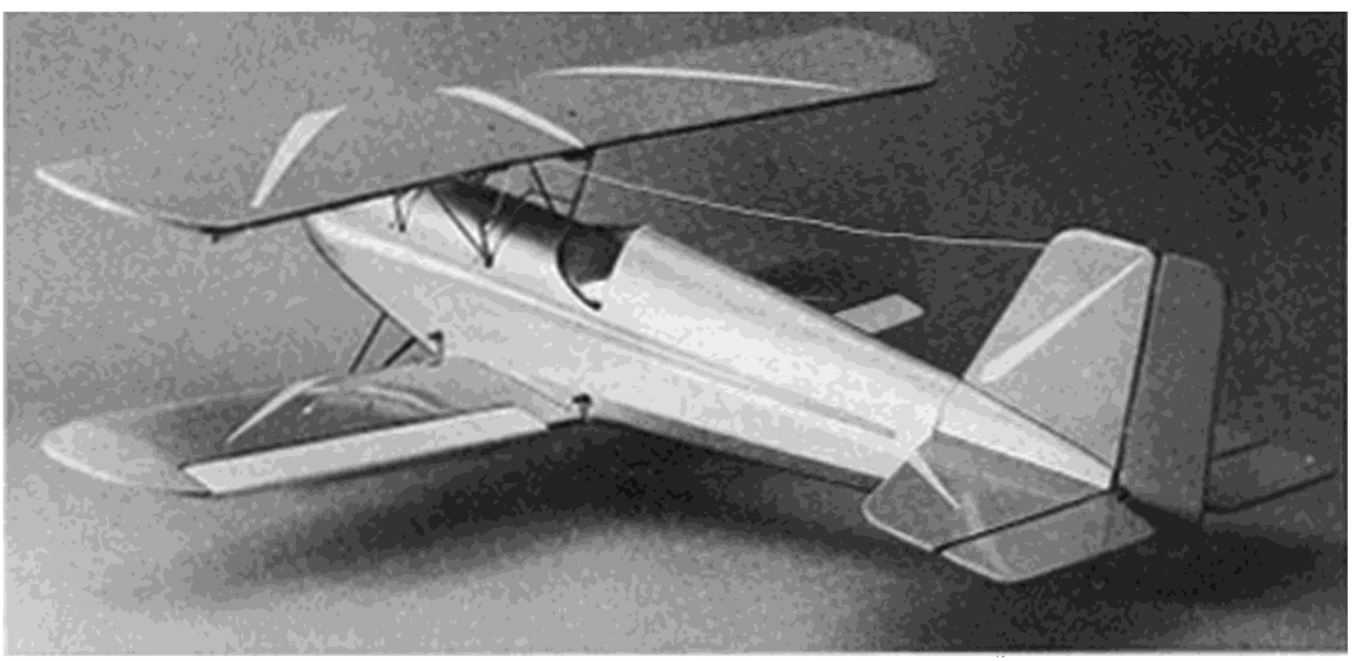


screw. I did this by using a swiveling block that is threaded. The block is attached to a rear cross piece and, as the screw is tightened, the piano wire cross piece is pulled up exerting a continual spring force on the wing. The block comes into intimate contact with the wing and the shearing force is very high. The single screw is effective for any aerobatics but, at the same time, will shear under impact before much damage is done. I avoid the use of nylon bolts in the bottom wing because the lower wing is usually hitting on tips, etc., and rubber bands are more practical. I know the fuselage is somewhat heavier than the standard configuration, but the strength to weight ratio is extremely high. On some of my early flights I was having trouble with the elevator hinges. They were sliding in and out of the stabilizer and I didn't spot this immediately. This caused three "landings" that, in one case, knocked the landing gear and top wing off; in another case, bent the prop shaft and shattered a lower wing. The fuselage structurally was undamaged. The same semi-crashes would have definitely required major repairs had straight balsa construction been used.

A jig saw is a necessity for the construction of the body parts. The only part of this airplane that really requires some detailed information for building is the fuselage. Most builders have

ABOUT THE AUTHOR

Lawrence Margolin, age 45, has been modeling since the age of ten. He stopped for a period of twenty years because of work and schooling and became re-involved when R/C equipment became more reliable and available. Most of his designs have all been based on plywood construction. The Aeromistress design is his tenth and he is presently creating new designs. Larry is a member of the Jericho Flyers and the Queens County Radio Control Society and is a teacher of General Science in Rockaway Beach, New York.



experience with foam wings and the empennage is just regular balsa construction. The cabanes require a little study, but are not really difficult. We will start the construction part of the article with the fuselage.

Fuselage: Using some drafting vellum, trace out the crutch, being sure to include the holes for wing dowels and cabane. Spray contact cement onto a 3/32" ply sheet and lay the tracing paper on it. Tack the plywood to another plywood sheet so you will be cutting two crutches simultaneously.

Drill holes for the cabanes and dowels. Where the triangular sections are removed from the rear of the fuselage, drill a hole using a 1/4" drill in each 'triangles' corner. This avoids a lot of maneuvering with the jig saw. Next, trace out all the formers and follow the same procedure. The engine mounts are cut from 3/4" maple or other hardwood. If you can't get this, you could laminate 3/8" ply to get the thickness. Cut the fuselage top and turtle deck out. At this point in the fuselage construction, let's stop and do something that will ease later assembly.

The plywood skins are very easy to work with if they are shaped before assembly. Trying to clamp ply skins onto a structure can be a pain, in wherever you are sensitive, if they have not been formed first. There are a number of ways to shape the skins to a round configuration. By soaking the outside of the skin for an hour, they become very pliable. I used an old towel saturated in a solution of hot water and Top Job detergent. (The detergent kills the surface tension and lets the water become more penetrating.) I lay the towel on the skins and after an hour I form the skins in a number of ways. You can clamp the skins around a pipe or Laly column so that the skins are in a horseshoe shape. A good diameter for the front fuselage skin is anywhere from 2" to 3" diameter. After the skin is dried, it will spring out some so that the fuselage curvature will be pretty close and all you have to do is slide the skin down over the formers and clamp the sides. Another method is to bend the sheets into a 'U' shape (the radius will occur naturally). Then slide the shape between two surfaces that will hold the width. Can't think of anything? How about nailing a couple of boards to a 3" wide base to form a channel? Too hard? How about moving a dressing table away from a wall and shoving the skin between the furniture and the wall. Another way to bend the 'U' shape is by using rubber bands or masking tape wrapped around.

For the turtledeck, the same procedure is involved except the tail end is a much smaller radius than the cockpit end. You can do the furniture routine by having the furniture touching the wall on one end so an angle is formed, then push the 'U' shaped skin into the angle and let it dry. Let the skins remain in this position until you are ready to use them — the longer the better. If you are pressured into restoring furniture to "normal", wrap some rubber bands around the skins and they will lose their memory for flatness . . . where was I? Oh yes, formers . . . cutting out . . . uh . . . yes, now start the assembly by epoxying F2 and F3 to engine mounts. This sub-assembly will facilitate the rest of construction. Cement F4 and F4A, F5 and F6 to one side of the crutch. Then epoxy the motor mount assembly to the same crutch. After the cement has set, epoxy the remaining crutch onto the assembly.

Once this entire unit is set, pull the fuselage together at the rear former and epoxy. You will now find that there is a space at the tail for the insertion of the tailwheel and block assembly. Let's see . . . what next? The nose has to be pulled together to make the body sides (crutch) come in contact with the motor mounts which taper in. Again wet down the outside of the crutch where the bend takes place, apply white glue and squeeze sides together with a furniture clamp. Install "cabane sockets" over the drilled holes, make the tailwheel block and glue in place. Install wing seat doublers. By now it is probably simple to see what comes next. Drill the cabane holes through the "sockets" with a 9/64" drill. Slide the front top fuselage skin down over the formers after applying cement at all contact points. Do the same for the turtle deck. Clamp or rubber band into position. Now you have probably noticed that the holes you drilled for the cabanes are covered by the plywood skins. How to find the holes? Take off your right boxing glove, pick up a 3/32" drill bit, shove hand and drill into fuselage. Insert drill into each cabane hole and twist the bit. A hole will appear in the plywood as the drill comes through from inside. If your hands are too big to fit into this fuselage, see a doctor, you have Acromegaly.

Now would be a good time to decide what kind of linkage you need for rudder and elevator and throttle, if it's NyRod, do it.

The fuselage can be closed up by installing F1-A and F2-A. These parts are installed after adding a 1/4" doubler into the inner fuselage sides and under the motor mounts. The rear lower fuselage is cross grained 1/8" balsa (soft). Finally, epoxy F1 into position. This adds a great deal of strength to the nose assembly. Add 1/8" x 3/16" hardwood stringers to the fuselage. The stringers start under the cockpit and end at the tail. The stringers should be sanded to a feather edge at the front and rear. The landing gear blocks are installed and the remaining spaces are filled with scrap 1/8" plywood. The entire fuselage is now cleaned up. The nose can be beveled round on the corners. All the other corners should have at least a 1/4" radius. Methods for tank installations vary a lot. I usually shove the tank in as high as it will go. Then I put a removable wire retainer under the tank. There is a lot of room in this fuselage so many options are available. The engine can be positioned and the mounting holes drilled #6-32 x 1¼ long screws and self-locking nuts are used. I usually fuel proof the entire engine compartment at this point. I find fiberglass resin great for this application. The photos show a 1/4" thick doubler (balsa) at the top of each engine mount. This helps the MonoKote to adhere, but doesn't do much structurally. You can add a piece of balsa sheet here and sand it to the shape. It's no big deal. It is optional. Do this before installing the plywood top cover.

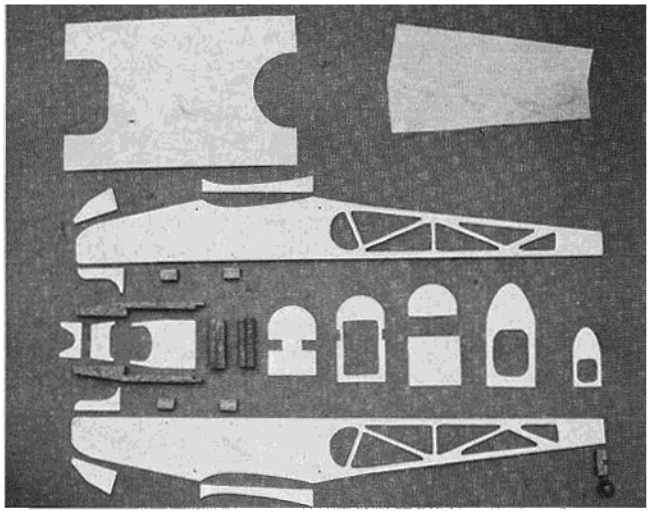
Cabane: The next most interesting part to develop is the cabane assembly. Bending wires that are highly tempered is difficult. What I have done is to heat the wire to a dull red color and let cool. This takes the high temper out of the wire and makes the wire easier to bend accurately. I use a heavy vise and a hammer. This is the best way I can get accuracy.

First mark the wire for each bend with a dab of dope or nail polish. Do this on both wires simultaneously. Put the wires into the vise both at the same time with marks located at the vise jaw line. Now by tapping the wires with the hammer, the vise acts as a bending brake and both wires will bend identically. The most critical wires are the two side pieces that plug into the fuselage. This determines the wing incidence and lateral positioning. The other wires are not critical and should not be softened.

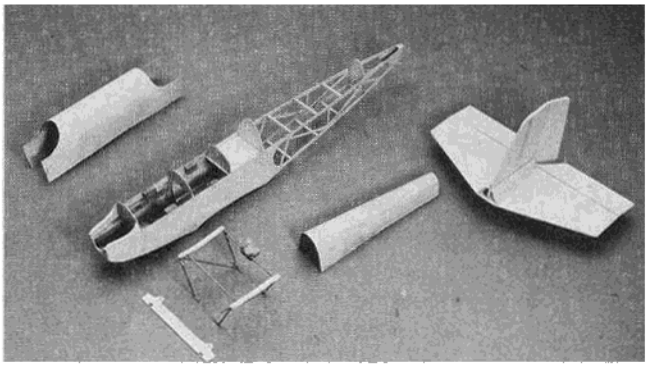
The wing retainer block should be completed and then slid onto the wire along with the washers for soldering. There is one joint on the front and one on the rear of the cabane that is left incomplete. After the cabane is installed, two joints are completed.

The fuselage, at this point, makes a handy jig for assembly of the cabanes. The wing saddles can be made from banding iron (the stuff that is wrapped around crates for shipping). The width and thickness are ideal. Sand off any finish on the iron and solder to upper cabane wires as shown.

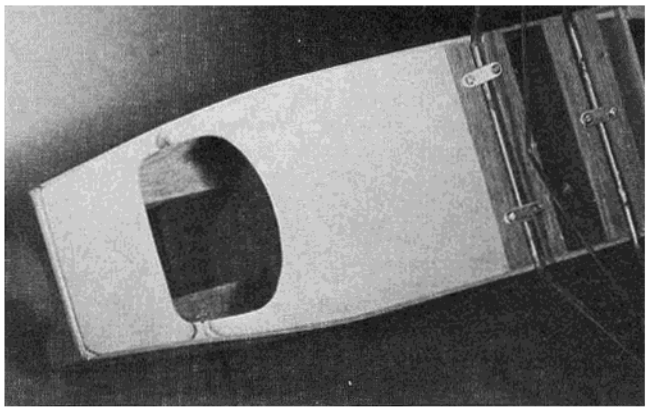
One additional piece of information that could save the day. I just read the November issue of RCM and in Chuck Cunningham's article "Lazy Ace." He describes a great way to get alignment for cabane wires. He cuts the wire that supports the wings and installs a piece of brass tubing. After he gets the exact length, he solders the tube in place. In other words, if you make the cabane sides and you don't get exactly the same size, cut the cabane sides and slip four lengths of tubing over the ends, lay the



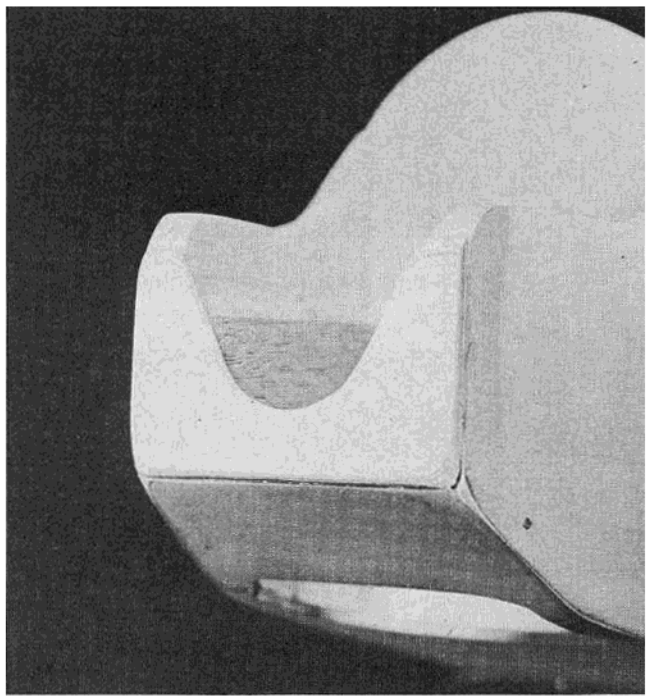
Complete fuselage parts kit cut and ready to start assembly.



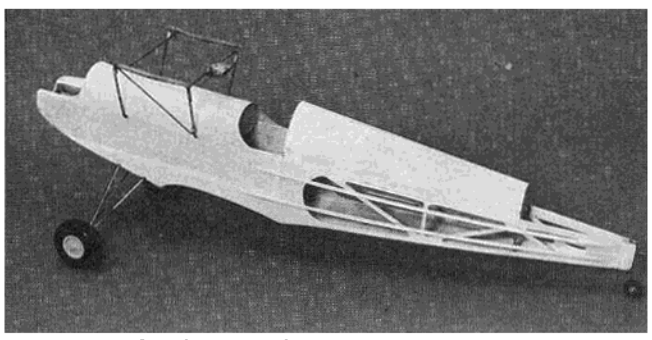
Fuselage assembly almost to the completion stage and ready for sanding.



Bottom view of nose section.



Close up of nose section of fuselage.



Completed fuselage ready to cover.

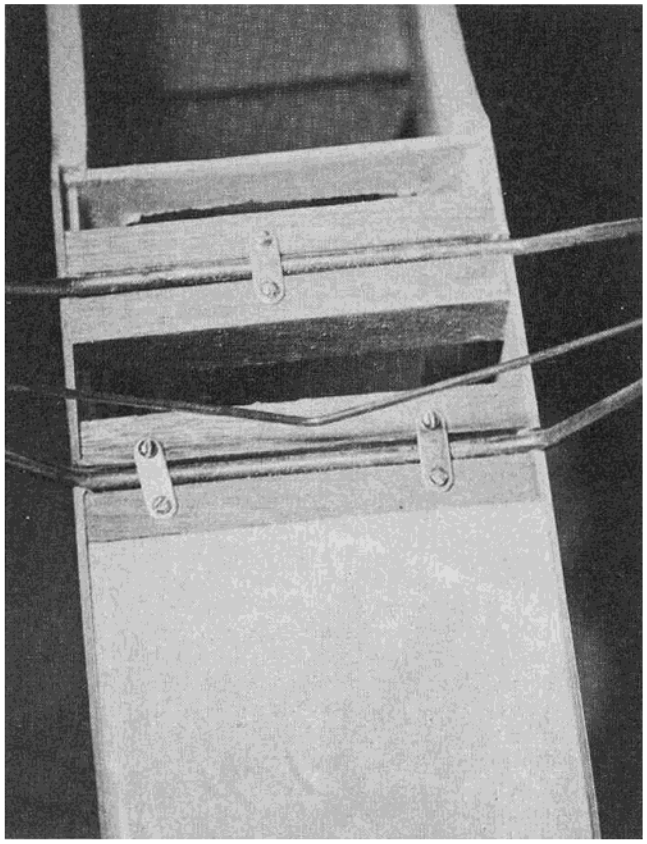
cabanes down over the plans and adjust to exact size, then solder the tubes in place. Great idea, but four **Aeromistresses** too late!! But that inspires an idea for a new parasol wing design.

Between Lou Andrews, Chuck Cunningham and Wing Manufacturing, I don't have much left to do but draw pictures.

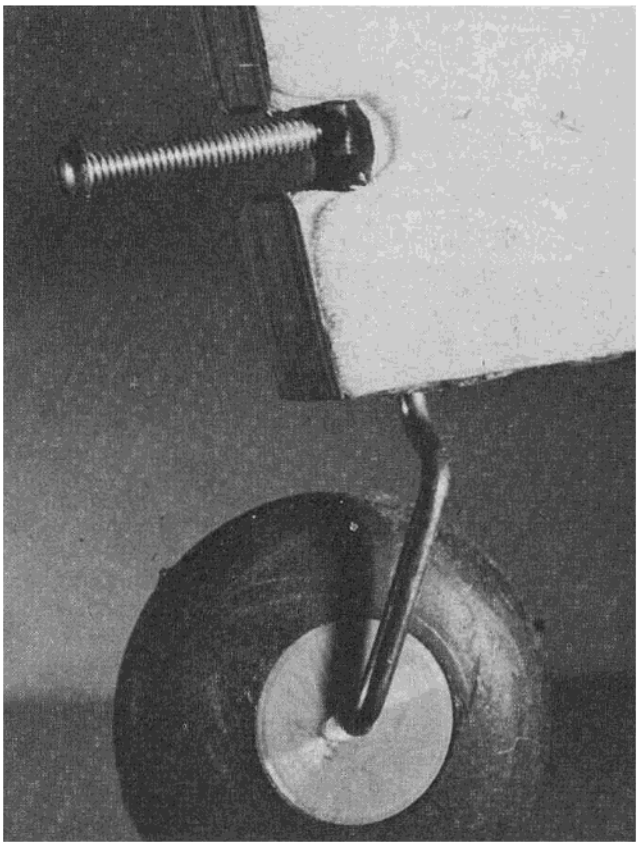
Wings: Most of us are pretty familiar with building foam wings by now. I know I was the last one in the Jericho Flyers and the Q.C.R.C. to do this. I asked questions for a year before I tried doing a foam wing. After doing one set, I decided which techniques I liked best. It seems for me, the most expensive way is best. Which means covering the cores with sheet balsa. My friends use the covering supplied with the wing kit and the results are great.

I don't think it is necessary to go into a big description about covering materials and procedure, but there is information that is probably unique to this plane, that is needed for the wings.

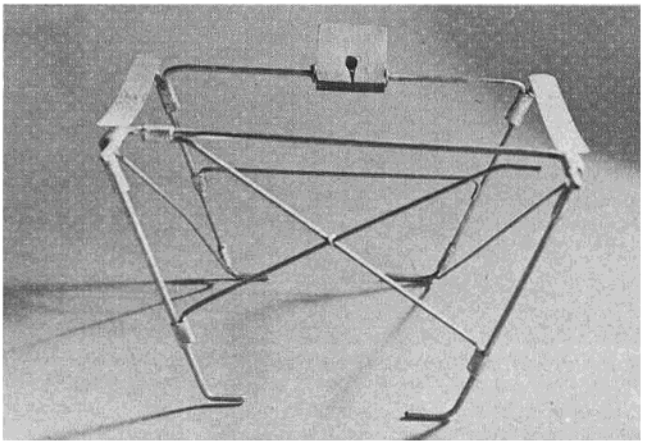
The top wing is built so it can be removed and attached with one nylon screw. The leading edge of the wing is held down by a retaining plate and the rear by a nylon screw. After the core is covered with whatever you decide to use, you can start making slots for dihedral braces and, in this case, the wing retainer plate. Measure 3/4" from the leading edge. Draw a centerline parallel with the leading edge and the length of the retaining plate. Now cut a 1/8" slot on the centerline and remove the wood. Use copper wire in a soldering gun to clean out the slot. The retainer plate has to sink into the wing so that the cabane will be seated correctly. If you have been following the sequence for building, you will have the cabane finished and we can use the cabane for locating the depth to which the retaining plate sits in the slot you made. Coat the retainer with epoxy and put enough epoxy in the slot so there will be good adhesion. Slide the retainer onto the two projecting wires on the front of the cabane. Push the retainer into the slot



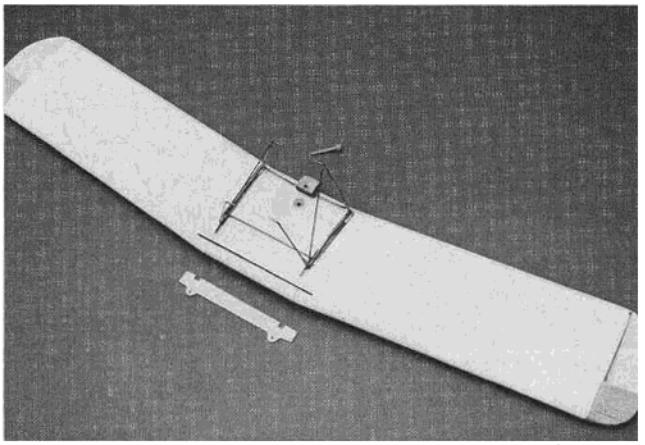
Landing gear mounting detail.



1/8" tail wheel wire with collar and 4-40 bolt. Bolt slides into rudder. Makes nice steering arrangement.



Cabane struts completed and ready to attach to fuselage.



Bottom view of upper wing. Note cabane wires slip into ply plate and is bolted at rear.

until the cabane is seated firmly against the wing. This establishes the correct depth for the retainer. Let the epoxy set up. While the wing is in this position, with the cabane in place, you can now locate the centerline for the wing hold-down screw. The wing hold-down block is used for locating the screw hole. By inserting a piece of wire or a drill bit through the mounting block hole, you can mark the location for the hold-down screw. A 3/4" hole is made in the wing for insertion of a length of dowel the thickness of the wing. This is epoxied in place. After the dowel is secure, the cabane is replaced and you do the same thing again. This time the hole for the screw will be marked on the dowel. Drill the dowel through with a 9/32" drill. This should now match with the hold-down block and the screw should line up. There will be a space between the wing and the hold-down block, but as you tighten the screw the cross wire that the block pivots on, will flex and provide a spring action for the wing mounting. Tighten the screw until the block seats against the wing. The wing will now be secured at the front by the wing retainer plate and held in the rear by the screw. One advantage of this arrangement is that you can position the wing so that it will be perpendicular to the body by simply shifting the retainer block on the cross piece and resoldering the positioning washers and, of course, you don't have big holes in the wing for rubber bands.

As far as the bottom wing goes, I used the material supplied in the wing kit for everything but the covering. Again, I used wood instead of the material

supplied. I used dihedral braces as shown. The simple aileron linkage makes the job easier than using bell cranks especially with foam wings. The wing tips are not supplied in the kit so they are as illustrated. Ailerons are done by first marking the foam and removing the aileron section with a fine hack saw blade. Then remove another 1/8" of foam from the aileron and the section of the wing the aileron came from. I then replaced the amount of foam removed with a 1/8" balsa facing, both on the wing and aileron. The trailing edges are done by cementing 3/16" square balsa stock on. The leading edge is cemented on and the wing ends have a balsa rib cemented on. Then sand the edges flush with the foam and apply the wood sheeting. In effect, the foam is surrounded by a wood edging for the sheeting to adhere to. After the sheeting is set up, it is easy to contour the sheeting and all the edging. The aileron linkage is set up with 15° of differential. (The aileron horn is bent toward the servo 15°.)

Empennage: The photographs do not go into great detail showing rudder and stabilizer construction because of the simplicity. The elevator is a structure and is covered with MonoKote. I have done this to keep the tail end as light as possible. A small difference in the tail weight of a plane requires a much greater addition of weight in the nose to compensate for the big difference in moment arms. The stabilizer itself is built-up and sheeted in order to maintain strength, but still retain some lightness. The rudder should be constructed of a fairly light balsa.

Landing Gear: The landing gear is conventional. I am, however, using large 4" Du-Bro wheels which are heavier than usual, but offer the advantage of good shock absorption and they tend to ride on rough surfaces and grass without digging in and causing nose-overs. The gear is retained by standard landing gear retaining straps.

Tailwheel: The tailwheel is operated by the rudder through a tiller bar that is held captive in the rudder cavity by 1/32" plywood sandwich. A flat should be filed on the tailwheel wire so that once the screw has been tightened, the gear will retain its position. A steel bushing should be used in the fuselage block so that stripping is minimized.

Covering and Finishing: Some of the boys at the field miss the appearance of stringers showing on the turtledeck. I must admit I do to, so on my last **Aeromistress** I Zapped a 1/8" square balsa stringer to the ply sheet and sanded the ends to a feather edge. It looks great! I asked some opinions and the opinion was . . . "But, it doesn't look racy," . . . from the sophisticates . . . "adds weight," . . . "increases parastic drag" . . . "leave it alone." So if it's what you like, don't look for opinions or you will be redesigning every flying session.

I used MonoKote exclusively. It is a pleasure to finish the fuselage and just plug the cabane in. The finished assembly (fuselage and cabane) really looks slick. The cabane is somewhat complex, but this adds to the appearance as well as to the strength. Every wire in the cabane is functional. Spring the cabane apart far enough so the four angled wires enter the holes in the fuselage. Get someone to hold the fuselage while you pull the sides apart and slip them into the holes. Please be sure to trial fit the cabane before you MonoKote the fuselage. By tapering the ends of the wire where they plug in, insertion is a lot easier. Make sure you get the sides of the cabane far enough apart so you don't tear up your brand new covering job while attaching the cabane. After the cabane is on, simply clean, wrap and solder the forward and rear joint. This cabane is now a permanent installation. Someone asked me if I put silicone cement in the cabane holes to help seal against fuel. I said, "Of course" but, I didn't . . . you had better.

Radio Installation: I did three with three servos on a tray, one with three servos abreast on beams. I used dowel pushrods, I used NyRod, everything works if you do it right. It is the individual's ability and desire that counts. I do make sure the battery is up front as far as possible, the receiver has lots of foam around it, and that the antenna goes out the fuselage without hanging out near the servos or linkage. Make sure that all surfaces are rigged to correspond to the transmitter controls. You do not need to be impaired by a left turn when giving right stick, or down when you had something else in mind.

Flying: Make sure you connect the aileron servo when installing the wing. This plane is no big deal on rudder only. Run about a half tank of fuel out on the ground, taxi the plane around, see how it handles. Throttle up and down, let everything shake itself into position (or out of position). If you have a big field, taxi away to check ground range under vibration. The observers on the field will no doubt get nervous with this taxiing and engine running. You will probably hear remarks like, "When is he gonna' fly that thing? I know where to see R/C cars." Or, "When you gonna' take it back for the 3,000 mile check?" Don't let them bug you. It's your money, time and nerves. After you have burned out the fuel, check all flying surfaces for loose hinges, motor mount bolts, anything that can be affected by vibration. I had loose elevator hinges and didn't know it till I plowed into the ground three times (that plywood is tough). Check C.G., aileron throw should be at least 30° up. Okay, if everything checks out and the engine holds revs while sticking, straighten up - - - you are ready for some hot action.

I like to get up to flying speed before getting off the ground. Most guys think the plane is under control just because it left the ground. Half the time a plane is in a partial stall on take-off. Here we go. Hold full back stick (you pointed into the wind?), open throttle slowly (steer with rudder), let ground speed pick-up, open throttle all the way, move stick to neutral (tail comes up), stick a little forward (still on rudder?). She is going like wild now (see photos). Ease back on stick, you're on ailerons now (drop rudder), long flat climb-out (dyn-o-mite). Bank into your first turn (gently), get used to a very responsive, active and fast ride. Fly in a big circle, first one way then the other. Trim with controls if required. Notice how the responses are. If anything seems too far out, land and make adjustments. (You may need more or less throw on ailerons, elevator, etc. This can only be determined by the individual.) If there are no adjustments needed, then try the ship in aerobatics.

Rolls are fast and need little correction, spins are easy to induce and recovery is fast. Split S's are beautiful. Try the ship at part throttle, make some slow passes. You will be surprised at how well it flies at low speed. As I said before, my flying experience with bipes is really not extensive and my flying has been with aerobatic, low wingers. So my perceptions are somewhat new regarding bipes. Viewing this I let a few of the heavy bipe men fly the **Aeromistress.** They are all caught up with the performance and are building.

BILL OF MATERIALS

Fuselage
(1) 3/16 x 6 x 12 ply sheet (firewall).
(1) 1/32 x 12 x 48 ply sheet (top front, turtle deck).
(1) 1/8 x 12 x 24 ply sheet (formers).
(1) 3/32 x 12 x 48 ply sheet (crutch).
(2) 1/8 sheets 4 x 36 balsa (fuselage rear bottom).
3/4" thick maple stock (motor mounts, tail block & cabane 'sockets').

Wings
Kits supplied by Wing Mfg. Co.

Empennage
(3) 1/16 x 4 x 36 balsa sheets (stabilizer covering).
(6) 1/8 x 1/4 balsa strips (stabilizer structure).
(3) 1/4 sq. balsa strips (elevator structure).
(1) 1/4 x 3 x 36 balsa sheet (rudder and fin).

Cabane
(2) 1/8 dia. x 36 lg. piano wire.
(1) 3/32 dia. x 36 lg. piano wire.
(1) 1 x 1 x 3/4 maple block.

Landing Gear
(2) 5/32 dia. x 36 lg. piano wire.
(1) 1/8 dia. x 36 lg. piano wire.
One pair of Du-Bro 4" "Big Wheels".
One pair of steel wheel retainer bushings.

Landings I tend to do at a fairly good speed with part throttle. I want to land with control, although I am told that I am overdoing it. Other pilots have floated this ship in, but I feel 7.5 pounds need a little power available for a safe landing. One other thing - - - you will find this plane is good in the wind. It does not bounce around too much and penetration is good.

Well, I guess that's about it for now. This project was very interesting for me and I hope you have as much fun flying the **Aeromistress** as I have. □

From RCModeler Oct. 1978