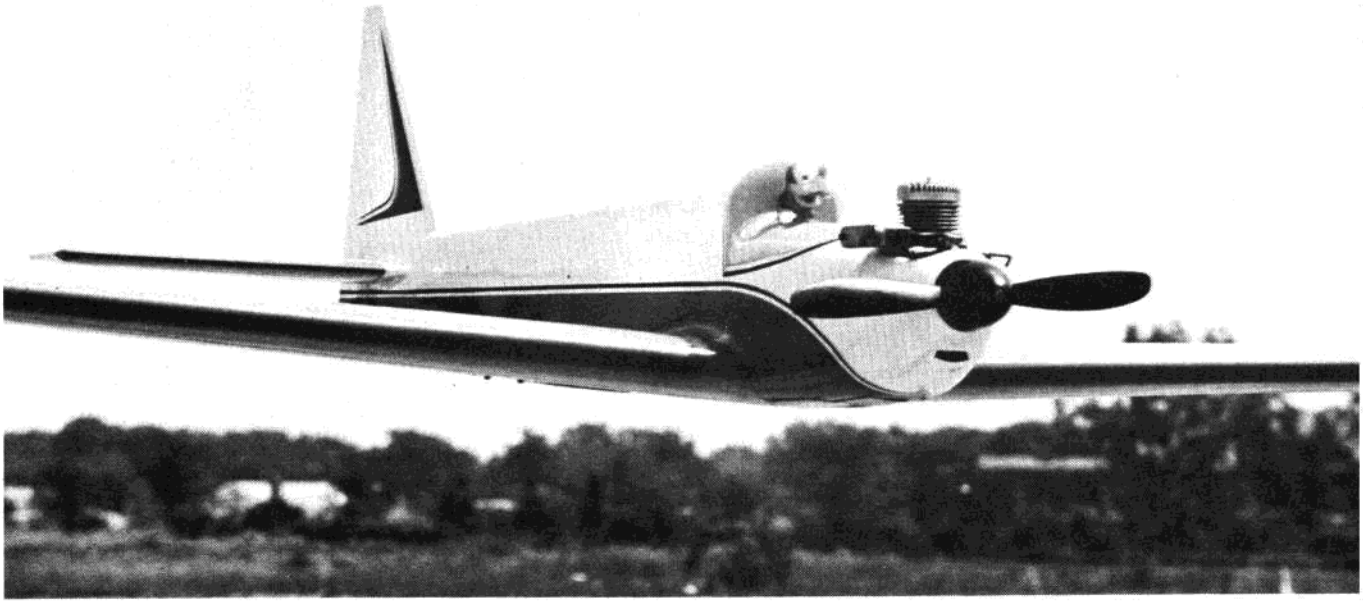
PRAIRIE DUSTER



Photos by Ed Sweeney

Wheels up, Prairie Duster poses for the camera. It is a very "clean" airplane except for the engine cylinder which is out in the open and upright for easy operation.

What considerations must one make when designing a new airplane? Probably most important is that it be able to carry the equipment necessary to operate it. This is not as much of a problem in these days of miniature radios as it was five years ago. Nowadays the main consideration is which engine to use. Prairie Duster was designed around the old Supertigre 60, probably the oldest of all of the 60s now available. It has been changed many times over the past twelve years and now even sports a new name, "Saturn 60." But it is basically the same engine as the 56 introduced in 1960.

Why not use a more modern engine? Well, the old ST is light, runs smoothly and reliably, and, although it may not have as much power as some of the newer 60s, it doesn't gulp fuel at a fantastic rate. And the price is right.

Having decided on the engine, we determined that the ship should weigh in at about 6½ lb. A plywood fuselage had been tried before and we chose that method of construction for the new ship because of ease in building, strength and lightness. Balsa frame construction was selected for the wing because we wanted built-in ailerons. The method shown on the plans for making the tail was used because it results in a rigid surface with pleasing contours and is simple to build.

We each needed a new ship and we each wanted a spare, so we cut out parts for four airplanes and built jigs for construction before opening the glue bottle. Assembly started in September and continued leisurely through the winter. We were slowed for a time because the landing gears were not available and it is impossible to complete the wing or fuselage without knowing how they fit. The four ships were completed in March, identical except for color schemes. Test flights proceeded routinely—the ships literally flew off the drawing board. Mark hit the contest trail and I tagged along. Now we are looking for places to put the trophies. Though Mark is still looking for a first place, he is very proud of his second place win in Class B at the NATS. He has since been moved into Class C, but continues to place.

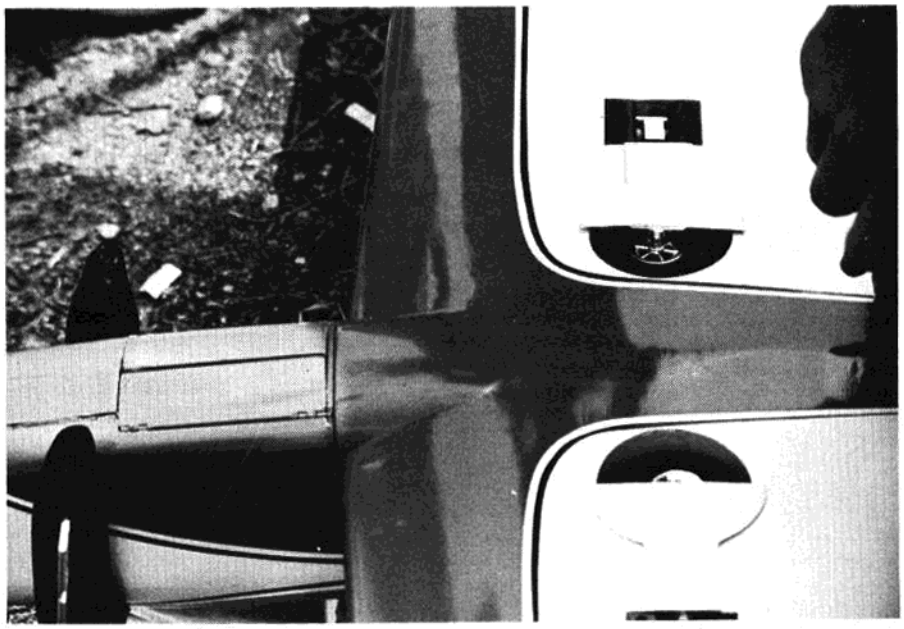
Our faith in the old Supertigre was proven when we started experimenting with fuel. This probably would not have occurred had we not been asked to test prototypes of the new Du-Bro muffler. We were concerned that some fuels would dirty it up, but Frank Garcher assured us that "Racing X" by Midwest was extra clean burning. So we switched to Racing X and then learned of the additive available to increase nitro content. We now add two cans of the Racing X additive to each gallon of fuel and that little ST 60 is hauling our ships around like one of those expensive engines.

If you are now ready to start construction, don't! Read on through the instructions and make plans on how to go about it. You can't finish the wing if the fuselage is not nearly complete, and you can't put the tail on until the wing is complete, and you can't finish the fuselage if the wing is not nearly completed, and so on. So read on before beginning construction. A few days spent in cutting parts ahead of time will reap benefits during construction.

Construction

When building four wings there can

Six-and-a-half-pound, fully equipped,
pattern plane designed for inexpensive and lightweight 60s
is attractive and competitive. / by Mark and Weldon Smith



This is the first serious contest-going plane to be seen with full wheel doors. Don't omit the doors, gaping holes where wheels retract cause lots of drag.

be no doubt about the value of assembly in a jig. Time spent in making the jig is short compared to the time required to assemble several wings. We would suggest, however, that the jig be used even though you only plan one wing in it. It eases construction and assures a true wing. Make it from two pieces of plywood or chipboard hinged at the center. Lay out the wing planform on these with strips of pine as shown in the jig cross-section. Place the complete jig on your workbench and raise each tip 1¼ in. Check each panel of the jig for flatness by placing a yardstick across the center and another across each end in turn, and, sighting across the yardsticks, adjust the blocking under the ends to make them parallel. Lock it all down and you are ready to build.

Prepare the four spars by gluing the doublers to them before installing in wing. Pre-assemble the 1/8" square keys to the back side of the leading edges. Be sure to get them on straight. We cut a small slot (using a table saw) in the 1/2 x 1" leading edges and glued the 1/8" square in the slot. This assures that they are centered and straight. Make a line along the center of the front side of the leading edges to use as a guide for shaping later. Pin the leading edges into the jig, beveling the centers for a good joint. Join them at the center with a piece of 1/16" plywood, clamping until glue sets.

Prepare the two bottom trailing edge sheets from 3/32 x 4" balsa, using the tapered scrap to increase the width as required near the center section. Note that the aileron cutout should be made before placing in jig. Since the two top trailing edge sheets are the same size, make them at this time also and set aside for future use. Pin two of the sheets in place on the jig and cut the center joint for a good fit, gluing it together. Now lay R-2, R-6, and R-10 in place. Insert the aileron torque rods through the bearings and check that everything lines up properly. If not, you may have forgotten to shim R-10 temporarily with 3/32" scrap. When all is aligned, glue these ribs in place, using a square to get them 90 degrees to the jig base.

While glue is setting, glue in the full-depth spar between R-6 and R-10 and to the bottom trailing edge sheet. This spar should be hollowed slightly on the rear side for clearance from the aileron. Double the bottom TE sheeting in the center section between ribs R-2 with 1/8" plywood. This will later serve as a bearing for the wing attachment screw. We soaked the plywood in water for an hour or so, then bent it to the proper angle in a simple wood and screw press several days before wing assembly was started.

If you read this all through before starting you won't be delayed now. Fill in above this plywood with balsa cut at a 15 degree angle. Now remove the aileron torque rod and glue in the remaining ribs. Replace the torque rod, pressing the thrust bearing in place. Fill in between R-2 and R-3 at the TE using more of that balsa cut at a 15 degree angle. Install the top spars, getting a good butt joint at the center. Now put on the top TE sheet, using "backward" clothespins to clamp it at the TE. (Take ordinary spring clothespins apart and place the flat sides together, replace the spring between them in the opposite direction to which it was originally, and pinch together the "wrong" end; the original "pinch end" becomes the clamping end.) Fit and glue in the four full-depth false spars between R-1 and the two R-2s. Now plank the leading edge from the LE spar back over the main spar, add the rest of the top planking, and add the cap strips over R-5 through R-10.

The wing is now ready to remove from the jig. Right? Wrong! You have yet to frame the ailerons. If you still haven't figured out how to make them while you're building the wing, do it now before removing the wing from the jig. Roughen up the aileron torque rod with sandpaper for better glue adhesion. Lay a strip of 3/32 x 1/2" balsa along the TE jig and pin down in position. Glue aileron ribs between the torque rod and this TE strip using epoxy. It is wise to have the aileron horn studs in place and parallel to each other at the inner ends of the torque rods before gluing ribs in place. Space the inner and outer ribs of the ailerons 1/32" from their fixed counterparts in the wing structure.

Next, glue a narrow strip of 3/32" balsa in front of the aileron ribs, beveled to meet the aileron torque rod. This strip must be tapered to match the taper in thickness of the wing. It is easier to install and taper it before the top TE sheet is put on the wing. If you have read this far before building, you will remember to build the ailerons right along with the wing. To taper it to conform to the wing, use a long sanding block with R-6 and R-10 as guides. Now glue the 3/32 x 1/2" aileron LE on top of the ribs and add cap strips to complete the top of the aileron.

If you managed to get yourself into a bind by not reading this all the way through and you have the wing top completed without ailerons, don't despair (we didn't). Glue the front strip of the aileron down against the torque rod and against the front of the ribs making it high enough so that it projects above the top sheeting. Then add the 3/32 x 1/2" aileron LE behind this strip and sand the projection down flush. We did ours both ways and either way worked out well. Leave about 3/32" to 1/8" gap at the inner end between the aileron and the wing and you will have plenty of throw clearance.

At this point you have completed most of the wing structure and should check that the following items are installed: (1) LEs; (2) all ribs; (3) top spars; (4) top and bottom TEs on wing and ailerons; (5) top LE sheeting; (6) center section planks and cap strips. If all this good stuff is there and the glue is dry, remove from the jig.

Now reverse the jig, letting the tips touch the table and raising the center only one inch because of the taper in thickness. Place the wing back in the jig

and get the landing gear installation worked out. We used 1/32" plywood to form the wheel wells. We wrapped it around a beer can and joined the ends with a scarf joint, then fitted and sanded until it was ready to glue in place. The Rom-Air gear pressure lines were easily installed in the wing while the bottom was still open. Some other landing gears may be more easily installed from the top. If this is the case, reverse the "top" and "bottom" of these instructions and start the wing upside down.

After the gear installation is worked out, add the bottom spars, the 1/4" spar joiner, and the spar webs. If you forgot the false spars in the leading edge center section, put them in before adding the LE sheeting. They do strengthen the dowels to be added later. Add center sheeting and cap strips, and wing structure is almost complete. Shape leading edge and radius trailing edge after removing from jig.

All that remains before covering the wing is to add the tip blocks and sand to shape. Before doing this, however, consider the "Vortex Degenerators." Leave them off if you will, but we will not guarantee adequate aileron control without them. In addition to improving aileron effectiveness, they have another benefit which we considered when designing, and which was proven at a contest in Minneapolis. Mark suffered the embarrassment of having a main gear leg fall out on landing. The ship skidded to a stop in a gentle turn on the left main gear, the nose gear, and the right wing tip. This was on asphalt, and the only damage was a slight scraping of the "Vortex Degenerator." No other damage to the ship!

We glued the tips on leaving a 1/8" slot along R-10 from the spar aft. The tips were shaped, the wing sanded, and then covered and prepared for paint. Before the final coats of dope were applied, the silk was removed from the slot and the 1/8" plywood tip skids were slid into place and glued. The slots in the tip plates are there to clear the nylon bearing for the aileron torque rod; we installed them after covering to make the procedure easier.

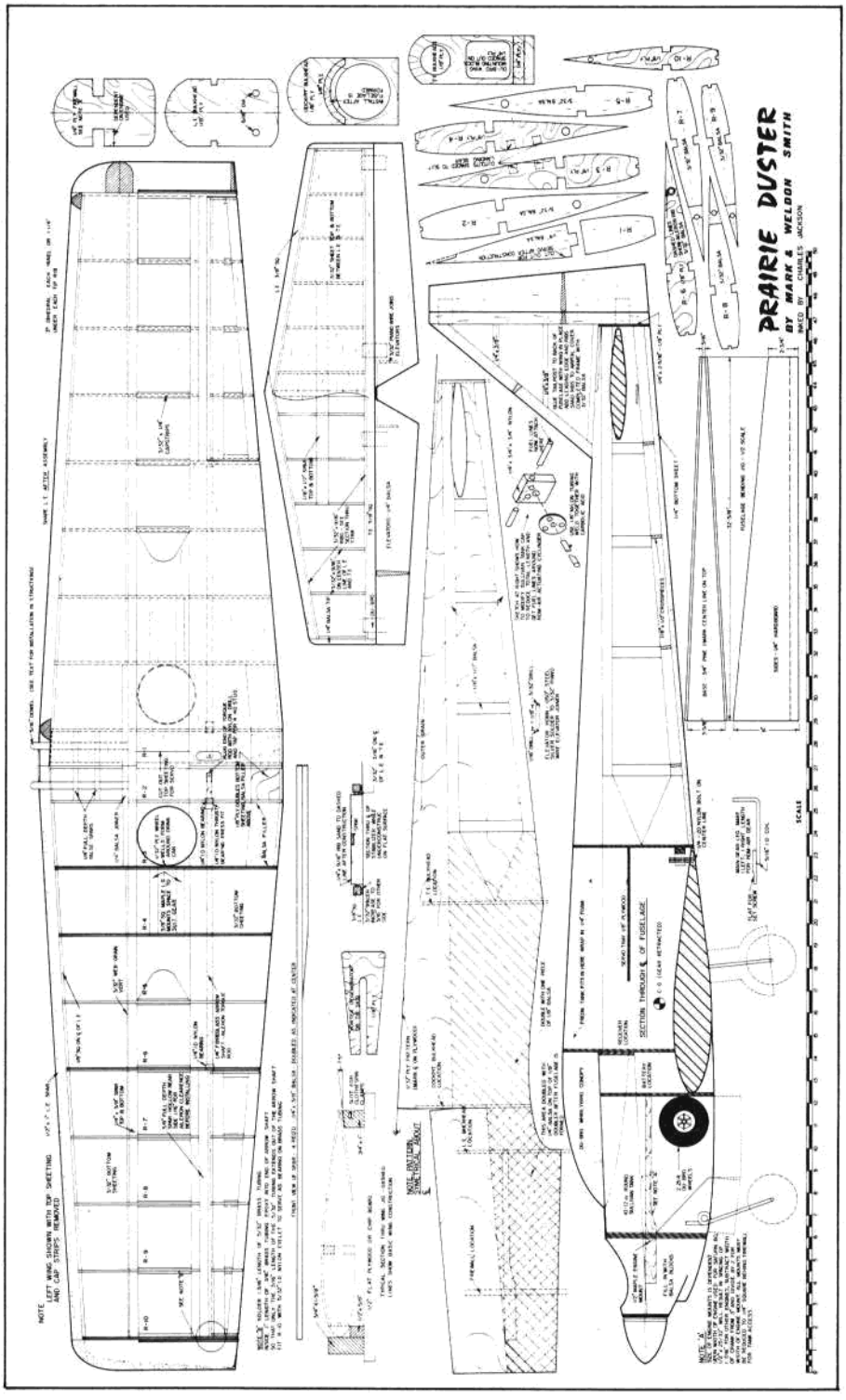
Begin the fuselage by cutting its shell out of a sheet of 1/32" birch plywood, 18 x 48". Next double from the nose back to behind the wing with 1/8" balsa as indicated on the pattern. Finish the 1/8" balsa doubling of the aft fuselage with 1/8 x 1/2" balsa strips. Use slow-curing epoxy for all this and weight down for a good bond. While the epoxy cures, prepare the engine mounts and bulkheads. (See Note "A" in regard to the engine mounts.) The forward portion of the fuselage will be 3" wide inside the 1/8" doublers after the bend is made, so you want the engine mounts to be the width which will result in proper space for your engine after forming the fuselage. Epoxy the mounts to the 1/8" doubler.

While they cure, you may want to make a simple jig in which to bend the plywood. We made four planes at once so that we would each have one and a spare, and the jig was well worth the short time involved in making it. However, the fuselage can be formed using tape, rubber bands and "C" clamps. With the jig completed and all epoxy on the shell cured, bend plywood in your hands with doublers inside and push down into jig. Align centerline of ply with centerline of jig. Now push cockpit and trailing edge bulkheads and the 1/4 x 2-5/16" tailpost into place. At this point you will agree that this is the best way to make a fuselage, so take out the bulkheads and replace them, using epoxy to make everything permanent. With the jig, you can use a five-minute epoxy to speed it up. Note that the fuselage begins to taper at the cockpit bulkhead, and at this point of construction the nose portion is still flared outward ahead of the jig. Leave it like this until the epoxy cures.

Next install the leading edge bulkhead and the firewall, sliding them over the engine mounts and pulling the nose together with "C" clamps. (Let's hope that you made provisions for mounting the nose gear behind the firewall before gluing it in.)

When these bulkheads are set you will have a nicely tapered rear fuselage shell and a big ugly blob out in front with two thin plywood tabs sticking up on each side. Don't despair! It will soon look beautiful. Gingerly, so as not to

FULL-SIZE PLANS AVAILABLE—SEE PAGE 84



split the plywood, cut down along the front of the cockpit bulkhead just far enough so that the plywood will curve over the firewall and LE bulkheads tightly. Now install the 1/8" plywood ring segment on the front of the cockpit bulkhead. Trim each side of the 1/32" plywood for a neat butt joint at the center and cut off that portion which extends forward of the firewall down to the 1/8" doubler, then glue down using a straight piece of hardwood to clamp down on the center joint. Use a 6" length of cloth 1" wide to reinforce the inside of the joint. This completes the bending process. There are no compound curves in the plywood, and, consequently, no "swaybacked" appearance which results from attempts to bend plywood in more than one direction.

You still have that unsightly blob sticking out in front, however. Let's work on that now. Set your engine in place on the mounts and locate it so that you have the propeller drive in the right place, then mount the engine. Fill in the area below and around the engine with balsa until you have a big "U" shaped balsa block sticking out ahead of the firewall. (The inside of the "U" must taper forward of the engine mounts to conform to the top view of the engine.) Face off the front of this to accept a 1/8" plywood ring and with the engine firmly in place, glue the ring on.

Now you are almost ready to shape the nose. Note that the balsa added in front of the firewall has braced it considerably. But the backside of the firewall is still just a butt joint against the balsa doubler. Take care of that now by fitting a piece of 1/4" balsa sheet on each side from the firewall back to the leading edge bulkhead and from the engine mounts down to 1/2" below the existing sides. Now sand the nose to shape, using the nose ring and the bulkheads as guides. All that remains now to complete the fuselage is to glue on the 1/4" sheet bottom aft of the TE bulkhead and sand the edges round.

There still remains a 2½ x 6" hole in the bottom of the nose which can be treated as you wish. Fill it in with 1/2" balsa leaving a hole and slot for the nose gear to retract into, or, better still, fit doors which close the nose completely with gear retraction. The latter choice is the one we made for two reasons: (1) Tank is accessible; (2) They sure look nice when they snap closed. The doors are not detailed on the plan, but are relatively simple to make, though time consuming.

The two rear doors are 3-5/8" long and are hinged on the inside of the 1/4" balsa doubler which locks in the firewall. Start with a piece of 1/32" plywood for each which is wide enough so that both doors and the pin portion of the hinge fit inside the fuselage sides. Remove the pins from the Du-Bro hinges and glue the leaves in place at the corners of the plywood with a piece of 1/32" piano wire through the hinges to align them. A piece of 1/16" nylon tube is fitted between the hinges (on the wire) and glued to the plywood at the same time. Cut a piece of 1/32" balsa to

Mark Smith at the 1972 Nationals where he placed second in Class B. He's now competing in Class C with the same model and same engine.

the same size as the door and cut the corners away where the hinge leaves are located, then glue this to the plywood. Now glue another piece of balsa 3/16" thick on top of the 1/32" balsa. You now have a door 1/4" thick with hinge leaves sandwiched between the plywood and the balsa. Glue a piece of 1/16 x 1/8" hardwood across the front of the LE bulkhead 3/16" above the bottom to act as a doorstop. Now install the mating hinge leaves to the door with a 1/32" piano wire hinge pin and glue the loose hinge leaves to the inside of the fuselage sides with the door held in place against the stop. Remove the pin and drill a hole through the LE bulkhead. You will need this hole to install and remove the hinge pin later. Make a slight saw cut on the back side of the LE bulkhead in line with the hinge pin hole to recess the bent end of the hinge pin.

If you were making both doors at the same time, you can now install them in place to survey what has to be done with the 2½ x 2½" hole that is left ahead of them. We moved the hinge line of the front door inboard by gluing a triangular piece of 1/4" inside the nose from the firewall back to the back of the front door. Since there was another piece of equal size when we cut this one, and since it looked as if it would strengthen the firewall, we glued it to the other side (we hate to throw anything away!). We now had a width of 2" left on back of the firewall which was just right for installation of the Rom-Air nose gear. Next, we filled in part of the hole left in front of the rear doors by gluing a piece of 1/4 x 3/4" balsa inside that last piece we didn't want to waste. We now had reduced the opening to 1¼ x 2½" offset to the side to which the nose gear strut was coiled. Another door was made after door stops were installed as needed and all three rough doors were installed and sanded to conform to the fuselage contour.

We now had the doors but no way to activate them. Linkages to the nose gear strut would work but seemed to be too complicated for practicality and reliability. Simple things are usually best and when we were discussing the advisability of making the doors, Mark came up with the idea we decided to try which worked beautifully.

A Du-Bro hinge leaf was glued on the inside of each rear door so that the pin line began 3/4" aft of the front of the door and was 1/2" from the door hinge line, and parallel to the door hinge line. These were connected with a 2½" coil of .020" piano wire formed around a length of 3/32" piano wire held in a variable speed hand drill. The front door was fitted with a piece of 1/16" plywood glued to its inner surface and projecting back 1/2" under the rear door on that side. A hole was drilled through the rear door and the 1/16" plywood while the doors were closed, and a piece of 50-lb. test monofilament was knotted and threaded through both holes then knotted again so that when the rear door opened it would pull the front door open. In operation the strut retracts against the coil spring, and stretching the spring closes the rear doors. One rear door in closing contacts the plywood projecting aft from the front door and closes it. On extension, the tire starts the rear doors open, the spring straightens and holds them in position, and the monofilament meanwhile has pulled the front door open.

We had spent considerable time making the doors and were a bit apprehensive about using them, being fearful they might disappear into debris in one bad landing, or even be torn off by the grass on the field where we fly. So, needless to say, we flew our test flights without the doors, and didn't use them until the first contest on a hard surface. They worked without a flaw and we have learned that our fears were groundless and have left them on the rest of the season on all types of surfaces without damage. Mark even had two unscheduled nose gear retractions at the Milwaukee Pre-Nats warmup without damage. These, incidentally, were caused by mis-rigging of the monofilament which kept the front door from opening far enough, which in turn caused the strut to hang up on the front door and fail to lock. One last word on the doors: We are reasonably certain that they require a source of power separate from the receiver. Use a gas-operated gear or electric unit with servo power from a source other than receiver battery.

In joining the wing and fuselage, lay the completely sanded wing into the fuselage and check for proper fit. If wing does not fit between LE and TE bulkheads, remove wood from trailing edge until it does. Check fit of wing into fuselage opening and sand fuse until a good fit is attained. Align wing axis at 90 degrees to fuselage axis by measuring from tailpost to wingtip and adjusting until measurements are equal. Be sure wing is centered on fuse. Mark location of dowel holes by reaching through nose gear well. Drill 5/16" dowel holes parallel to chord line through LE false spars, and spar joiner. Install dowels, gluing well.

Drill and tap the nylon wing hold-down block 1/4-20 if you have not already done so, and screw a 1/4-20 stud with a point on it into the block so that the point projects slightly beyond a line across the fuselage sides. Plug wing dowels into their holes in the LE bulkhead and drop TE of wing down to mark the center of the screw hole. Be sure wing is aligned 90 degrees to fuse-

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(Continued from page 44)

lage as before. Remove wing and drill 1/4" hole through it. Spot face the bottom side for the wing screw head to the surface of the plywood doubler inside the bottom sheeting.

Make holes in a piece of waxed paper for the dowels and wrap the waxed paper around the leading edge. Install the wing and screw down tight. Prepare a bulkhead of 1/8" balsa faced with 1/32" plywood and fit it in behind the LE bulkhead, beveling it to match the wing LE. Holding it in place, mark with the outline of the LE bulkhead. Remove and trim to 1/8" less than the outline. Now glue it in place on the wing, tight against the LE bulkhead with the waxed paper between. When glue is well cured, remove wing from fuselage and plank with 3/16" strips from this new bulkhead back to the wing. Replace wing and sand the planking to conform to fuselage. Sand the TE bulkhead and bottom of fuselage to match TE of wing.

Tail Construction: The stabilizer is built on a flat surface as shown in the detail on the plans. Glue a strip of 3/32 x 3/16" balsa to the 3/8" square leading and trailing edges. Lay the LE and TE on the outline spacing them up off the table 3/32". Now glue in the 9/16" high ribs. After glue has cured well, sand the ribs carefully to a streamlined shape while the outline is still pinned down. This is best accomplished with a 12" sander making short spanwise strokes. Now notch the ribs and glue in the top spar. Cut the top sheet to shape for a good fit inside the LE and TE and glue into place, weighting down as required until glue cures. Turn over and repeat the process for the bottom side. Sand to shape.

Elevators are shaped from 1/4" balsa and the elevator horn-yoke is fitted to them. Do not join the elevators until stabilizer is installed in fuselage.

The stabilizer should not be installed in the fuselage until the wing has been fitted and attached so that the horizontal tail will be truly horizontal. When this lineup has been completed, glue the stab into the fuselage. Slip the elevator yoke through the fuselage behind the stab with the horn on the proper side. (You probably want the elevator horn on the same side as the throttle so that the rudder servo will be on the opposite side and the nose wheel steering cables or rods will not interfere with the throttle.) Now hinge one elevator and attach it to the yoke, using waxed paper between the yoke and the stab. When epoxy has cured, hinge the other elevator, making sure the two stick on top and bottom of both elevators until epoxy has cured.

Fin construction is similar to stabilizer except that the sheeting will go over the leading and trailing edges instead of between. Glue the tail post in position, lining it up at 90 degrees to the plane of the stabilizer. When dry, fit and glue on the leading edge. Get this piece on straight and you will have a straight fin. It is very difficult to warp a triangle. Install the ribs and sand to a streamline. Prepare *both* of the 3/32" covering sheets and glue them on simultaneously, clamping together with clothespins. By putting them on at the same time you will not introduce more camber to one side. When glue has set, sand fin to shape and hinge the rudder to it. Fillet the fixed surfaces to the fuselage. We used Epoxolite for fillets, smoothing it on with water. If you try Epoxolite for the first time, be sure the wood is waterproofed with the undercoats of your finish before starting.

Flying

Balance at four-in. behind the LE bulkhead with an empty fuel tank and gear retracted. Set all surfaces to zero degrees with transmitter trim knobs at neutral. If all your surfaces are true, the ship will lift off easily, and all surfaces will be easily within range of the trim knobs to establish straight and level flight at full bore throttle. Once you have established this trim, you should be able to do any of the C or D pattern maneuvers in fair to good style. It may be necessary to weight one wingtip, to eliminate uneven trim of the ailerons, before the inside maneuvers match the outside maneuvers, but with a little patience in trimming, your Prairie Duster will perform the complete pattern with an excellence to match your agility in stick manipulation.