



CHAMPION OUTDOOR TRACTOR PLAN

CHAPTER 24

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AMONG the various winners that made their appearance in 1936, this remarkable outdoor tractor, designed and built by Henry Struck, turned in some of the best endurance flights ever recorded. The author appreciates the permission given him by Mr. Struck to bring it to these pages. At the 1936 Junior Birdmen Outdoor Air Races this model demonstrated its worth by turning in an official winning time of 12 minutes and 47 seconds, when unfortunately it flew out of sight while still at a great height. Interesting to note is the fact that the shortest flight it made that day was over four minutes. In the calm air of the evening, this model has often flown for over three minutes, and flights of over two minutes are made consistently. It was designed to conform with the new rules governing stick models as drafted by the Junior Birdmen, which allows no landing gears and nothing but solid motor sticks. When the model is built, use nothing but strong balsa of medium hardness throughout.

MATERIAL LIST

- 1 pc. — $\frac{1}{8}$ " x $\frac{1}{8}$ " x 36" —Balsa (Leading edge spar)
- 2 pcs.— $\frac{1}{16}$ " x $\frac{3}{16}$ " x 36" —Balsa (Wing spars)
- 1 pc. — $\frac{1}{18}$ " x $\frac{1}{2}$ " x 36" —Balsa (Trailing edge spar)
- 1 pc. — $\frac{1}{2}$ " x $\frac{3}{4}$ " x 30" —Balsa (Motor Stick)
- 1 pc. — $\frac{1}{16}$ " x 3" x 36" —Sheet Balsa (Ribs and Wing tips)
- 2 pcs.— $\frac{3}{16}$ " x $\frac{3}{16}$ " x 6" —Balsa (Wing Mount)
- 1 pc. — 1" x 1" x 1" —Balsa (Nose Plug)
- 1 pc. — $\frac{1}{8}$ " x $1\frac{1}{2}$ " x $1\frac{1}{2}$ " —Sheet Balsa (Thrust bearing sides)
- 1 pc. —.034 x 12" long —Music Wire (Wing clips)
- 1 pc. —.040 x 6" long —Music Wire (Shaft and Hook)
- 1 pc. — $1\frac{1}{8}$ " x $1\frac{3}{4}$ " x 14" —Balsa (Propeller)
- 2 sheets —Japanese tissue
- Cement
- Banana Oil
- Sandpaper

MOTOR STICK. The motor stick is shaped from a $\frac{1}{2}$ " x $\frac{3}{4}$ " x 30" long piece of straight-grained, unwarped balsa. Its thickness is tapered from the leading edge of the elevator to its rear end, as shown in the top view. The

width is also tapered from a point 8" in from its rear end, which decreases from its original width of $\frac{3}{4}$ " to $\frac{1}{8}$ " at the rear, as shown in the side view. Round all corners of the stick with sandpaper. The thrust bearing consists of a small pocket into which fits a nose plug. Note this pocket at the front end of the stick. It is made up of three pieces of $\frac{1}{8}$ " sheet balsa. Note this construction under "Thrust Bearing." When assembling the sides of this pocket, see that the grain in these pieces runs at right angles to the grain in the stick. Make the opening of this pocket $\frac{1}{2}$ " square. Cement it in place on the leading end of the motor stick. The top of the stick is then rounded, as shown, and a nose plug made to fit the pocket. This is cut to shape from the 1" x 1" x 1" balsa block. Carve it as shown in the plan under "Nose Plug." Test constantly during this work for a snug fit in the pocket. This removable nose plug eliminates the necessity of the usual "S" hook that is so troublesome to fit on when the motor is wound. When the plug is finished, washers with bushings at front and rear are added for bearings. Note that the thrust line is tilted down six degrees and two degrees to the right. When completed, give it a single coat of cement to toughen it. The rear hook is bent from .040 music wire, as shown in the plan under "Rear Hook." It is then cemented with its end prongs buried into the sides of the stick, as shown in the side view. Three or four coats of cement should be applied around the stick and over the hook to form a strong binding.

ELEVATOR. The elevator is made in one piece. The ribs "A" and "D" are cut from $\frac{1}{16}$ " sheet balsa. Cut out one "A" rib, locate its notches, and cut these $\frac{1}{16}$ " wide and $\frac{1}{8}$ " high. Cut out two "D" ribs without their notches. Cut two elevator tips from $\frac{1}{16}$ " sheet balsa. These have outside diameters of 3" and are $\frac{5}{8}$ " wide. Cement the two "D" ribs against the opening side of these half-round tips, as shown in the plan. Cut the straight inner spar $\frac{1}{16}$ " x $\frac{1}{8}$ " x $13\frac{3}{4}$ " long. Cement this spar in its notch in the "A" rib. Test to see that it is at right angles to the rib. Shape the trailing edge spar from $\frac{1}{8}$ " x $\frac{1}{4}$ " x $14\frac{1}{2}$ " long balsa. Rule a straight line on paper and place this spar on it. Snap the spar in its exact center and bring its ends forward of the line $\frac{1}{2}$ ". While in this position, cement the trailing end of "A" rib to the center of this trailing edge spar. See that "A" is at right angles to the drawn line. The inner spar already cemented on "A" should be parallel to it. Place a tip with its inner circle against the end of the spar on "A" and its trailing edge against the trailing edge spar. When in this position mark the point where the spar on "A" passes over "D" rib. Cut a notch for the inner spar at this point. The notch location on the other "D" rib is located in the same way. Cement the inner spar in these notches and against the inner circle of each tip. The trailing

CHAMPION OUTDOOR TRACTOR

edge spar is now trimmed to proper length, the tip notched to receive it, and the two joined with cement. Cement the other tip in the same manner to the opposite end of the trailing edge spar. Cut a leading edge spar of $\frac{1}{8}$ " square balsa, snap it in its center, and cement it in place against the tips and the three ribs. Cut ribs "B" and "C" from $\frac{1}{16}$ " sheet balsa, shape them exactly as the others, cut them to proper length and cement in place. The leading inner spar, which fits in the upper edge of the ribs, is now cut from $\frac{1}{16}$ " x $\frac{1}{8}$ " balsa. Notch each rib to receive it, snap the spar in its center, cement it in each rib notch and to the tips, and then trim to proper length at both ends. Cover the elevator on both sides with tissue, water spray, and dope.

RUDDER. The rudder is made in two parts, which form the fin (forward) and the rudder (rear). Note its construction in the plan showing the side view. Draw the upper curve of elevator rib "A" on paper. Cut the trailing edge spar of the rudder $\frac{1}{16}$ " x $\frac{1}{4}$ " balsa. Cut its leading edge of the same material and size. The tip of the rudder is of $\frac{1}{16}$ " sheet balsa. This consists of a half-circle 2" in diameter. Trim its ends on its outer-sides so that the trailing and leading edge spars fit it 2" apart from each other. Place these spars in position on the "A" elevator rib and cement the tip in place between these spars so that its highest point is $5\frac{3}{4}$ " above the lower end of the trailing spar. The two rudder ribs are cut of $\frac{1}{16}$ " x $\frac{1}{8}$ " balsa. Cement them in place as shown. Build up the fin in the same manner. The rudder is joined to the fin by two soft wire hinges cemented in place. Cover on both sides, water spray, and dope.

WING. The wing is made and assembled exactly as was the elevator. When covering it, dope the tissue to the under side of the ribs to hold their contour. Water spray and dope when held in position to the bench.

PROPELLER. Carve the propeller from the $1\frac{1}{8}$ " x $1\frac{3}{4}$ " x 14" long balsa block. When finished, sand smooth, and then cement a washer with a small bushing inserted on each side of the hub. Dope and sand between coats. Bend the shaft from .040 wire, pass it through the nose plug, and cement in place. Attach 14 strands of rubber.

ASSEMBLY. Bend the two wing mounts to shape and cement them to two $\frac{3}{16}$ " square balsa wing tracks cut $5\frac{1}{4}$ " long, which are set at an angle of three degrees incidence. Cement the elevator to the stick at a zero degree incidence. Cement just the fin of the rudder in place at right angles to the elevator directly over its center. Locate the center of gravity by balancing the stick when the elevator and rudder are in place, and cement the mounts so that this point comes directly halfway between them. Attach the wing with rubber bands, as shown in the photograph.