

CHAPTER 24

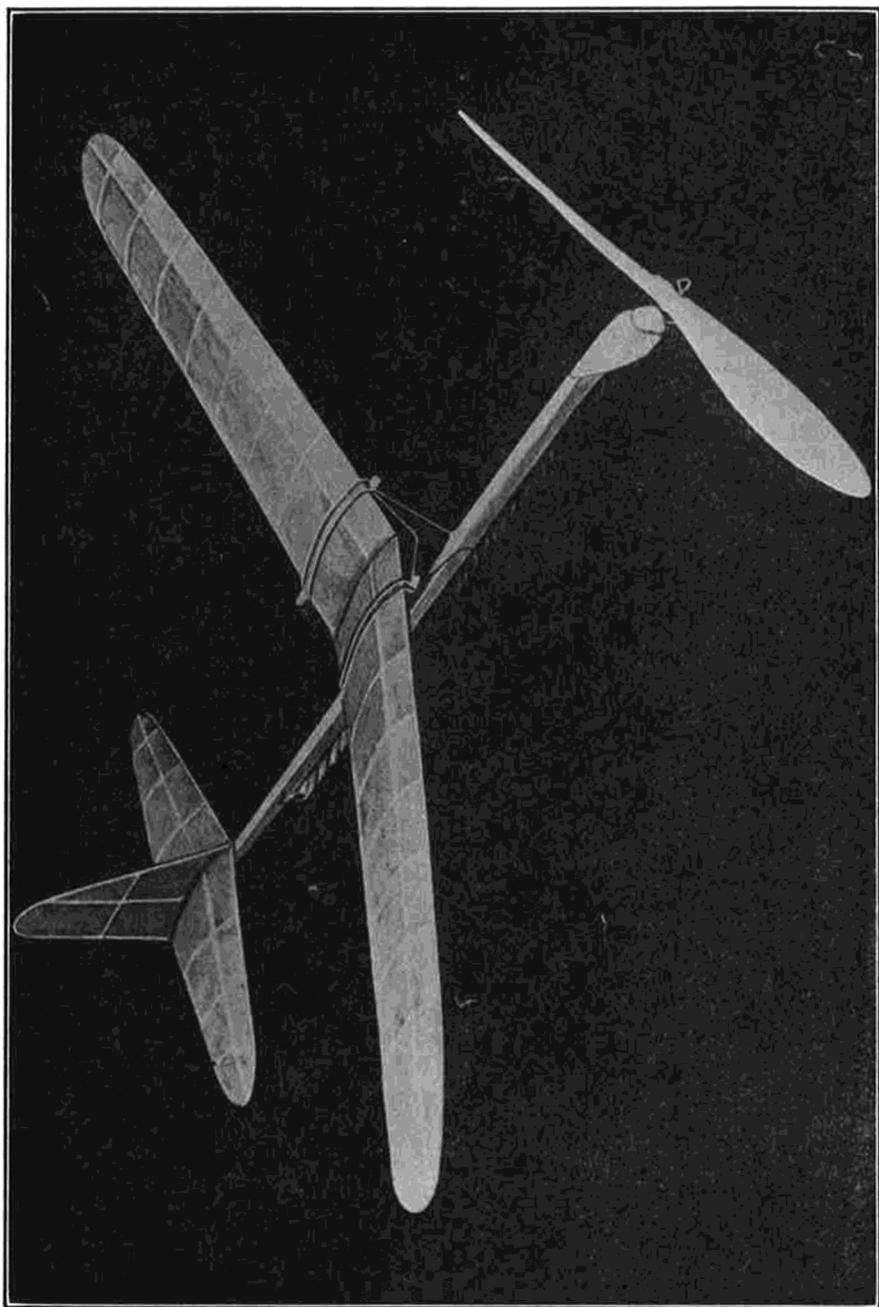
CHAMPION OUTDOOR TRACTOR

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. — $\frac{1}{48}$ " 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



CHAMPION OUTDOOR TRACTOR

CHAMPION OUTDOOR TRACTOR

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 $\frac{1}{8}$ " 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.

CHAPTER 25

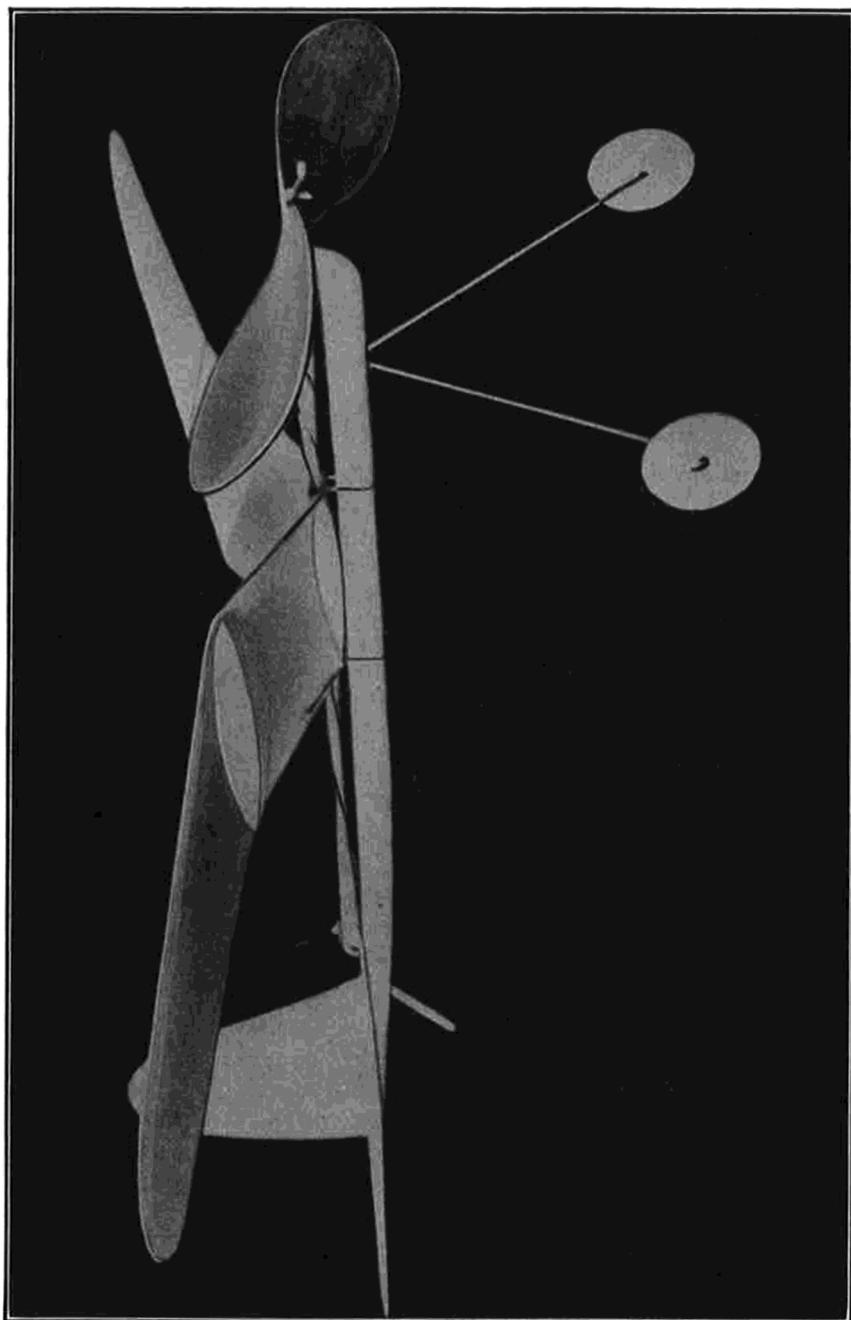
GULL WING

IF you have ever seen a gull pointed for flight on a sandy beach, you will know the incentive that prompted Louis Garami to design and build this all-balsa tractor model. Not only has he incorporated into it the grace and beauty of the gull, but he has also designed a model having considerable of the flying and soaring ability of that well-known bird. The author wishes to thank Mr. Garami for permission to reproduce his successful effort here.

MATERIAL LIST

2 pcs.— $\frac{1}{32}$ " x $2\frac{3}{4}$ " x $5\frac{1}{2}$ "	—Sheet Balsa (Wings)
2 pcs.— $\frac{1}{32}$ " x $2\frac{3}{4}$ " x 2"	—Sheet Balsa (Center-section)
1 pc.— $\frac{1}{32}$ " x $2\frac{1}{2}$ " x $2\frac{1}{2}$ "	—Sheet Balsa (Rudder)
1 pc.— $\frac{1}{32}$ " x $2\frac{1}{2}$ " x 6"	—Sheet Balsa (Elevator)
1 pc.— $\frac{1}{8}$ " x $\frac{3}{8}$ " x 12"	—Hard Balsa (Motor stick)
1 pc.— $\frac{1}{16}$ " x 3" x 6"	—Sheet Balsa (Ribs and Wheels)
1 pc.— $\frac{3}{4}$ " x $1\frac{1}{8}$ " x 6"	—Balsa (Propeller)
1 pc.— $\frac{1}{16}$ " x $\frac{1}{16}$ " x $1\frac{3}{16}$ "	—Bamboo (Tail skid)
1 pc.—.028 x 18" long	—Music Wire (Metal fittings)
1 pc.— $\frac{1}{16}$ " O.D. x $\frac{3}{8}$ "	—Aluminum Tubing (Bearing)
2 pcs.— $\frac{1}{16}$ " O.D. x $\frac{1}{16}$ "	—Aluminum Tubing (Wheel Hubs)
6 — $\frac{1}{8}$ " diameter	—Washers (Shaft and Hubs)
1 pc.— $\frac{1}{8}$ " x 17" long	—Flat Rubber (Motor)
Cement	
Sandpaper (00)	
Clear Dope	

MOTOR STICK. The motor stick is shaped from a $\frac{1}{8}$ " x $\frac{3}{8}$ " x 12" long piece of hard balsa. It remains this size with the exception of the taper given it along its under side. Note this in the side view in the plan. This starts $4\frac{1}{2}$ " from the rear end and tapers to $\frac{1}{8}$ " wide at the end. Round all edges, as shown in the "A-A" and "B-B" cross-sectional views, and then cut the small thrust bearing mount shown on top of the stick at its entering end. This is $\frac{1}{8}$ " thick, $\frac{1}{4}$ " wide, and $\frac{7}{16}$ " long. It is of balsa and should be grooved along the top to take the tubing. Note that the stick is notched out to accommodate it. Cut this notch now and cement the block in place.



GULL WING

COMPLETE MODEL AIRCRAFT MANUAL

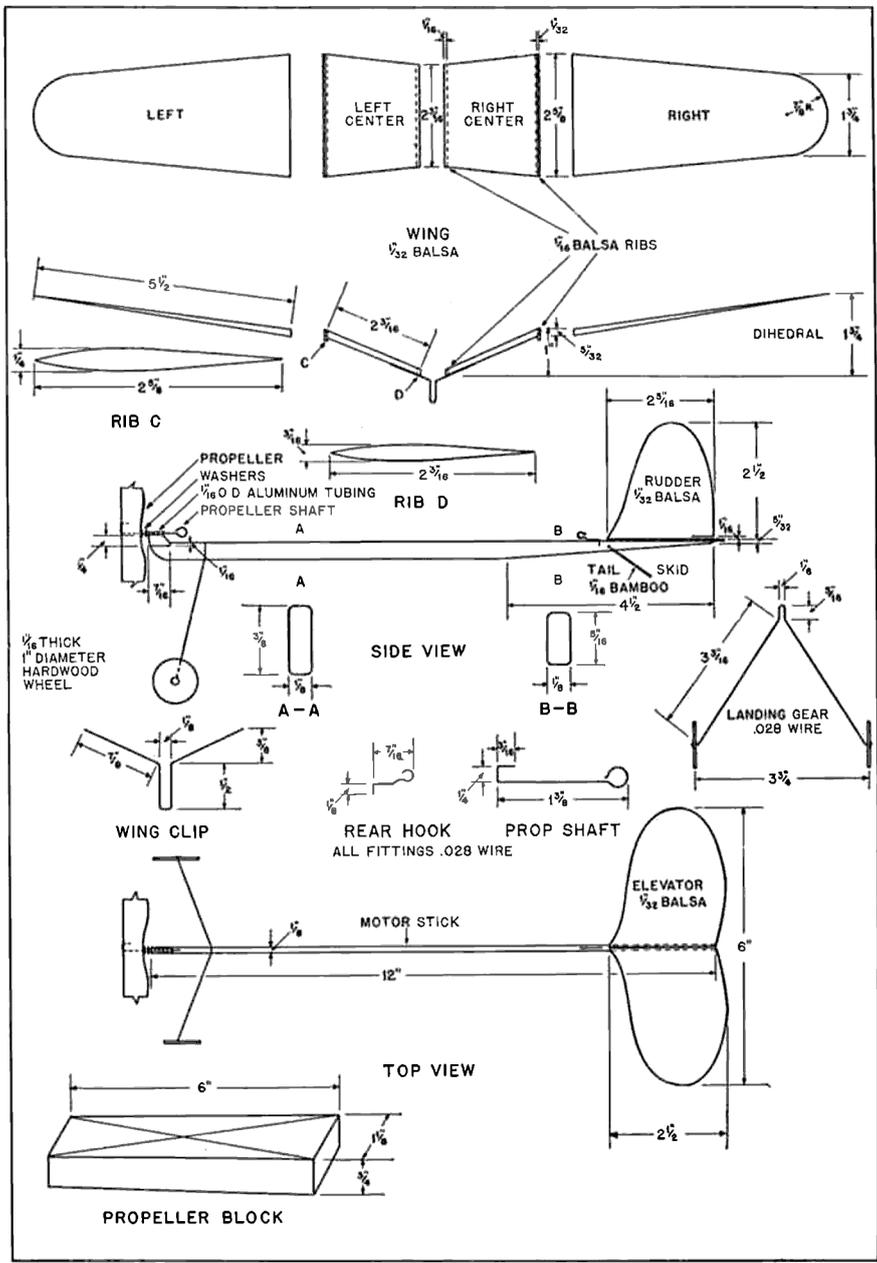
The under edge of the stick is then rounded directly under this mount. Cement the $\frac{3}{8}$ " long aluminum tubing in place on the thrust bearing mount, as shown in the side view. Use plenty of cement for this joint. Bend the rear hook of .028 music wire, as shown under "Rear Hook," and after thrusting its end into the top of the stick $2\frac{3}{8}$ " in from the trailing end of the stick, cement is applied to hold it firmly in place. The tail skid is a length of $\frac{1}{16}$ " split bamboo inserted in the under side of the stick $2\frac{5}{16}$ " in from the stick's rear end, as shown in the plan. Apply two coats of dope to the stick rubbing down between coats with fine sandpaper.

LANDING GEAR. The landing gear details are shown in the plan. This is bent from a single length of .028 music wire. Two solid balsa wheels are cut of $\frac{1}{16}$ " sheet balsa to diameters of 1" each. Use hard balsa for these. Cement the $\frac{1}{16}$ " lengths of aluminum tubing in their hubs, thread on the wire axles, and bend the axles up to prevent them from falling off. A washer can be cemented on each side of the wheels over the aluminum tubing's ends if desired. Cement the landing gear $1\frac{1}{4}$ " in from the nose of the stick, as shown. The legs of the landing gear are bent forward so that the lower ends of the legs extend $\frac{1}{4}$ " in front of their upper ends connecting with the stick. The wheels must be in line with each other and $3\frac{3}{4}$ " apart.

ELEVATOR. The elevator is shaped from a single piece of $\frac{1}{32}$ " sheet balsa. It is $2\frac{1}{2}$ " wide and 6" long. Cut it to the shape shown in the plan and then sand it to streamlined form. Apply two coats of dope and sand between coats. Cement the elevator on top of the motor stick at its trailing end. Make sure that it is perfectly level and that it is at right angles to the sides of the stick.

RUDDER. The rudder is shaped from a single piece of $\frac{1}{32}$ " sheet balsa. It is $2\frac{5}{16}$ " wide and $2\frac{1}{2}$ " long. Shape it as shown in the side view and then streamline it with sandpaper. Apply two coats of clear dope and sand between the coats. A short groove is cut out of the lower edge from the trailing edge of the rudder to permit the rudder being adjusted either way without fear of cracking the wood. When completed the rudder is cemented to the top-center of the elevator at right angles to it. Note that the leading edge of the rudder fits flush with the leading edge of the elevator, which extends out beyond the rear end of the motor stick.

WING. The wing is made in four parts consisting of two center-sections and two outer panels. All four pieces are cut from $\frac{1}{32}$ " sheet balsa. Start by squaring up two pieces $2\frac{5}{8}$ " wide and $2\frac{3}{16}$ " long. Taper their sides from this width to $2\frac{3}{16}$ " wide at their opposite ends. Sand carefully. The outer panels are cut from original pieces squared up to measure $2\frac{5}{8}$ " wide and



GULL WING PLAN

COMPLETE MODEL AIRCRAFT MANUAL

5 $\frac{1}{2}$ " long. Rule a straight line along their lengths directly through their centers. Set your compass at $\frac{7}{8}$ " and using this center line as a center, scribe a half circle at one end of each piece. This circle must touch the end of each piece with the center line as a pivot. Rule straight lines from the opposite end of the piece to connect the sides of the drawn circles and the sides of the piece at the other end. Cut out these forms and sand smooth. Note that the piece tapers from the wide end to the tip end. Sand this taper in each piece. All four pieces are doped and sanded between coats. Cut two "D" and two "C" ribs from $\frac{1}{16}$ " sheet balsa. Bevel their tops and cement the two "D" ribs under the short ends of the center-sections. The long ribs "C" are cemented halfway under their wide ends. Use pins to hold the sheeting to the curve of the ribs until dry. Bend two wing clips of .028 music wire, as shown in the plan under "Wing Clip." Cement the clips to the under sides of the center-sections at their leading and trailing edges. Test each clip for alignment and proper dihedral. The outer panels are then cemented in place against the outer ends of the center-section pieces and over the exposed half of the "C" rib in each case. Check for required dihedral and proper alignment, and make any corrections required by bending the wing clips.

PROPELLER. The propeller is carved from a block of medium balsa measuring $\frac{3}{4}$ " x $1\frac{1}{8}$ " x 6" long. Full instructions covering this work will be found on page 91 under "Carved Propellers." Sand the blades to $\frac{1}{16}$ " thickness at their tips. A large copper washer and a small eyelet cemented in its hub hole completes it. Apply a single coat of dope to the propeller and sand. Bend a propeller shaft of .028 music wire. Cement it in the hub, thread a washer over the protruding shaft, insert it through the aluminum tubing bearing, and bend the hook. A single loop of $\frac{1}{8}$ " flat rubber forms the motive power. Tie it in a loop and place it over the shaft and the end hook. The model is now ready for flight.

CHAPTER 26

SINGLE-STICK OUTDOOR PUSHER

THE pusher airplane is so called because the propeller, being in the rear, pushes the model through the air, instead of pulling it as in the case of tractor models. Many pusher models have proved successful at national meets recently, and it would be difficult to say which type of model airplane is more popular.

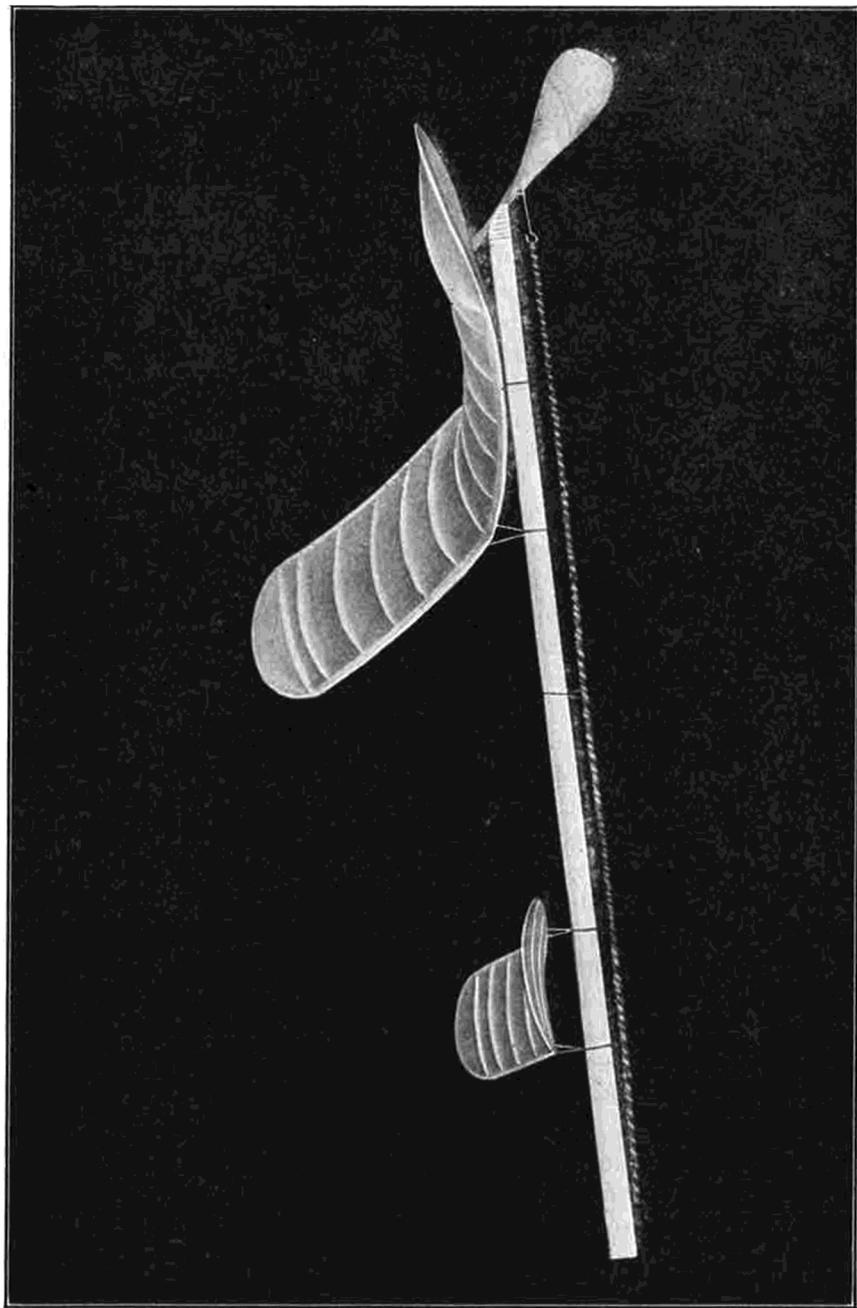
The model given here, while rather complicated in design and construction, embodies practically every detail found in pusher models, and has been chosen to represent this type of model because of this fact, plus its superb flying qualities. Each step in its construction should be carefully followed by the beginner, as many seemingly unimportant details in its design prove of utmost importance when the model is launched.

MOTOR STICK. The motor stick of this model consists of a $\frac{1}{8}$ " x $\frac{1}{4}$ " x 24" balsa piece. Study the plan of this stick. Note that its direction of flight is opposite to that of the tractor models. The regulation propeller bearing can be purchased or made. (See Chapter 6, "Propeller Bearings.") This is cemented and bound with silk thread to the end of the motor stick on its under surface. When in position, this end becomes the rear of the model.

At the opposite or front end, a nose hook is cemented over the end of the stick, which becomes the nose or forward end of the motor stick. This nose hook is similar to the regulation rear or end hook of the tractor model, except that it is attached differently. Its function, however, is the same as a rear hook. This nose hook can be bent from No. 9 piano wire, as shown in the plans. (See Chapter 6, "Nose Hooks.")

A can hook is provided to hold the rubber motor in place on the stick. It can be bent from No. 8 piano wire, as shown. (See Chapter 6, "Can Hooks.") The nose hook is cemented in place on the end of the motor stick, while the can hook is fastened in the same manner to the center of the stick.

WING. The wing requires two spars, two wing tips, and thirteen wing ribs. The leading and trailing edge spars are duplicates, both being $\frac{1}{8}$ " x $\frac{1}{4}$ " x 24" long. They are cut to size from balsa wood, and tapered as shown in the plans under "Camber of Wing Rib." The thirteen wing ribs are $\frac{1}{16}$ "



SINGLE-STICK OUTDOOR PUSHER

SINGLE-STICK OUTDOOR PUSHER

x $\frac{1}{16}$ " x 4" balsa wood. While the distance from the inside of the leading edge spar to the inside of the trailing edge spar is only $3\frac{1}{2}$ ", the ribs should be cut 4" long to allow for their necessary wing camber. This is shown in the plans under "Camber of Wing Rib." A single piece of $\frac{1}{16}$ " sheet balsa wood 1" wide should be soaked and bent to proper shape, and the ribs are cut $\frac{1}{16}$ " wide from this piece. Each rib will then have the same bend as all the others. (See Chapter 3, "Balsa Wood.")

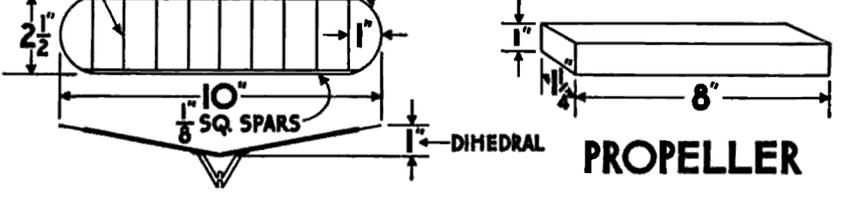
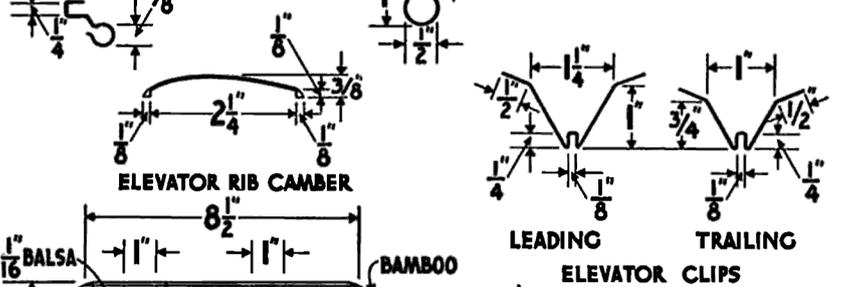
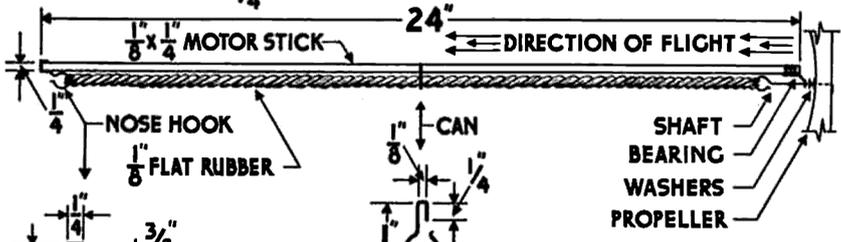
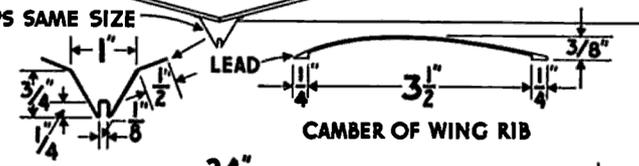
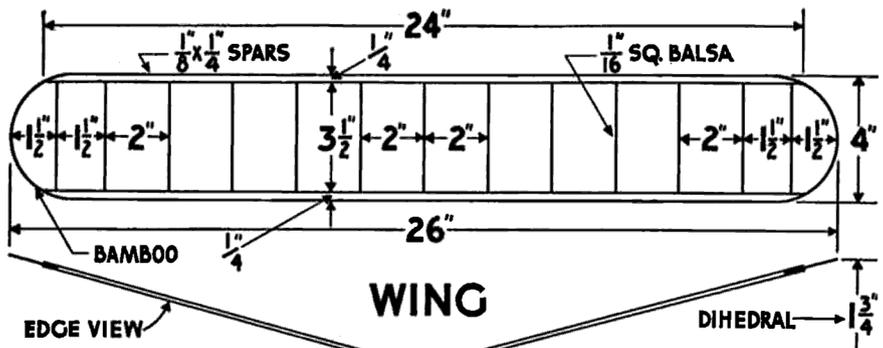
Place the leading and trailing edge spars parallel to each other and $3\frac{1}{2}$ " apart. Proceed to cement each of the thirteen ribs in place. Do not cement the center rib at this time, as this can best be done after the necessary wing dihedral has been obtained. Two $\frac{1}{16}$ " x $\frac{1}{16}$ " split bamboo wing tips are bent to proper form, and cemented in place to the ends of the wing spars. (See Chapter 3, "Bamboo.")

The wing dihedral on this model is more than average models require, being $1\frac{3}{4}$ ". This is now obtained. Snap the leading and trailing edge spars between the thumb and index finger in their centers, or at the location of the center rib. Place both halves in line with each other on a flat table. Holding them at the point of their broken joints, lift the tip of one half $3\frac{1}{2}$ " off the table. While in this position, cement the leading and trailing edge spars together again. Hold in position until dry. (See Chapter 7, "Wing Assembly.") The center rib is now cemented in place.

The wing is covered with Japanese tissue. Coat both wing tips, all spars, and ribs on their upper side, and then press the paper on them, making sure it adheres at all points. Use clear dope or banana oil for this work. After the dope has dried, trim all edges of the paper, and give the wing a thorough water-spraying. (See Chapter 7, "Wing Covering.") Two wing clips of the same size are bent from No. 9 piano wire, as shown in the plan. These are cemented over the center wing rib to the under side of the leading and trailing edge spars.

ELEVATOR. The elevator is built up in much the same manner as the wing. Two $\frac{1}{8}$ " x $\frac{1}{8}$ " x $8\frac{1}{2}$ " long balsa wood spars form the leading and trailing edges. These are streamlined, as were those of the wing. Note their form in the plans under "Elevator Rib Camber." Nine $\frac{1}{16}$ " x $\frac{1}{16}$ " x $2\frac{1}{2}$ " long balsa elevator ribs are now cut and bent, as shown under "Elevator Rib Camber." These should be made in the same manner as those of the wing. Assemble the elevator ribs between the spars as already instructed for the wing. Bend two bamboo elevator tips from $\frac{1}{32}$ " x $\frac{1}{32}$ " split bamboo, and cement them in place at the ends of the leading and trailing edge spars.

Give the elevator a 1" dihedral, by the same method used in obtaining the wing dihedral. Two elevator wing clips are bent from No. 9 piano wire,



ELEVATOR

SINGLE-STICK OUTDOOR PUSHER PLAN

SINGLE-STICK OUTDOOR PUSHER

as shown under "Elevator Clips." The larger of these is cemented to the leading edge spar on its under side, while the smaller one is located on the trailing edge spar. Note their location in the plan of the elevator.

The elevator is covered on its top side with Japanese tissue, which is held with clear dope or banana oil. Do this in the same manner as in covering the wing.

PROPELLER. This is cut from a 1" x 1¼" x 8" balsa propeller block, and should have its blades sandpapered until light will show through them. The regulation propeller shaft is bent from No. 9 piano wire. (See Chapter 6, "Propeller Shafts.") Thrust the end of the shaft through the center of the propeller hub, bend it around, and pull the shaft back until the point buries itself in the wood of the hub. A drop of cement at this bend will hold the shaft firmly in place. The builder must keep in mind that the propeller is to be a pusher propeller, and while it is carved in exactly the same manner as a tractor propeller, the shaft must be inserted through the hub from the opposite side to that of a tractor propeller. In other words, the hook of the propeller must be on the convex side of the blade on a pusher propeller, while it is on the concave side for tractor models. (See Chapter 9, Fig. 47.)

MOTOR. This consists of four strands of ⅛" flat rubber. Obtain a 92" length of this rubber, tie its ends together, and loop it into four strands. The propeller and motor assembly is now mounted on the stick. To do this, apply two washers to the propeller shaft and then pass the shaft through the hole in the propeller bearing. One end of the two loops of the rubber motor is looped over the hook of the propeller shaft, passed through the can hook in the center of the motor stick, and the other end of the loops is passed over the nose hook, which completes the motor assembly.

ASSEMBLY. Clip the elevator to the top of the motor stick about 3" back of the nose hook. The location of the wing should be determined by gliding tests. Change the wing back and forth on the motor stick until a long, even glide is obtained. It may be found that the elevator will also need adjusting, which can be determined by the same gliding tests. When launching the model, remember that the wing trails the elevator with the propeller pushing the model from the end of the motor stick. For the proper method of launching, see Chapter 16, "Correct Launching of Single-Stick Pushers."