How to Build the Submarine Scout

Complete Instructions and Plans For You to Create a Flying Scale Model of the U. S. Navy XS-1

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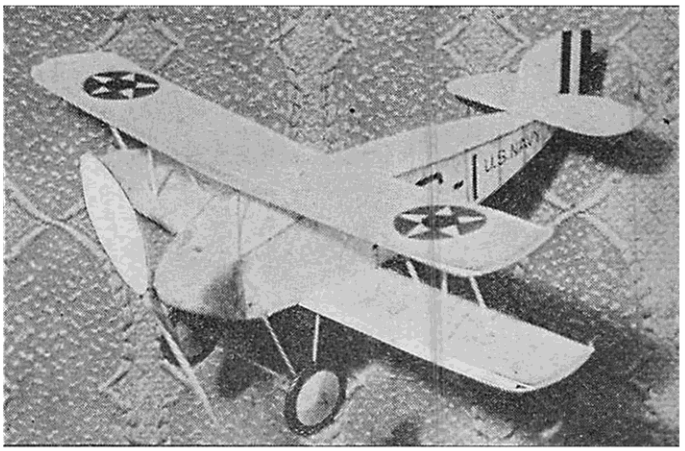


A flying scale model of the U.S. Navy XS-1. It flies for 60 seconds.

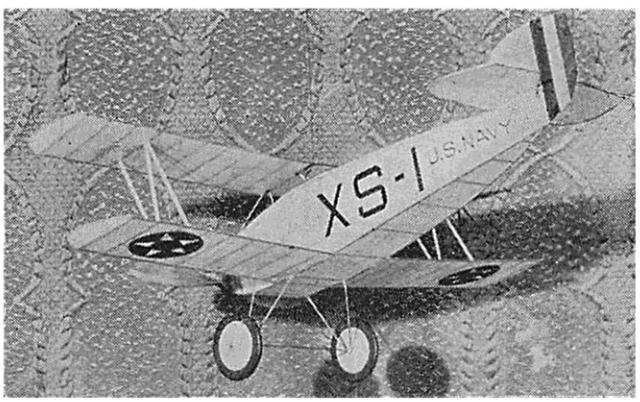
IT HAS long been the dream of the airplane designer to create a super but miniature craft so compact in form that it could be housed readily aboard a submarine. This rather formidable task was undertaken by expert Navy designers, with the resulting production of the extremely small U. S. Navy XS-1. This was the first of what may prove to be a deadly weapon in warfare.

It is a small biplane of approximately eighteen feet span which can be carried in knockdown form within a cylinder that is carried upon the afterdeck of a submarine. This little ship, built by the D. Martin and Cox Klemin Companies, can be assembled in a very few minutes. The power is supplied by a Wright "Gale" 60 h.p. engine. Pontoons were used but the undercarriage was interchangeable so that the ship could be equipped with wheels when required.

This type of airplane lands itself readily to the construction of an excellent flying scale model. After having built and flown a model of this type, the author was well rewarded by its performance.

If you follow these instructions carefully, you should be able to build one of the finest flying scale models that you have ever seen.

Before constructing the model, the reader should understand that in order to get the performance of which this model is capable, he should make it reasonably light. The model shown in the photographs weighs .63 oz. minus the rubber motor. All the balsa used is of medium weight grade. If other wood is used, vary the sectional dimensions accordingly.



Though this model is exactly to scale, it flies beautifully because of its excellent design.

Fuselage

From a 1/16" sheet slice out 7 or 8 1/16" square lengths. Drawings No. 2 and No. 3 giving the side view, are used by laying two pieces together for the top pair of longerons and two for the bottom pair. By spreading the drawing over a board and using pins or brads the longerons are bent and held in shape. Do not bend by heat or steam, it is unnecessary.

The inside braces are then cut and inserted by pairs. When completed and dry, separate the sides and cement in the top and bottom braces, beginning from the front. The turtle-back formers, plate No. 5 are cut from 1/32" balsa sheet as shown. After assembly, the other two notches and stringers, 1/16"x 1/32" are added. Notching after assembly insures a *lined*-up job. The cowling, plates No. 2 and No. 4, is made up of two separate pieces with the seam or joint lengthwise. A piece of 1/64"x2⅝"x1½", is cemented to the top center longerons, half-way overlapped. Since it is difficult to bend the balsa both ways as required by the curved fuselage, the sheet must be forced down and held until it remains close to the top longeron sides. The other side is treated the same way. It is advisable to have the nose block cemented on to the fuselage before the cowling is attempted.

THE cockpit portion is also covered with two separate sheets. The nose is shaped from a light balsa block and well hollowed. The nose piece No. 2 is cut off the shaped nose and a ⅜" cube cemented to the inside face. Washers are imbedded on both sides for the prop shaft. A ⅜" square hole is cut out for the nose piece. The landing gear is made by bending a piece of bamboo 1/16"x⅛"x6" near the center, cut to the correct height and carefully split so as to yield two identical pieces. The ends are then sharpened and coated with cement. Using a needle, force holes through the longerons and gussets, No. 2, coat insides with cement and then force in the landing gear struts.

When dry, add a little cement around the entire joints.

The spreader bar, No. 1, is of ⅛"x1/32"x4¼" bamboo, well streamlined. Two axles are then bent from No. 11 piano wire as shown, and fastened with cement and thread. The spreader bar is then lashed to the landing gear and wheels slipped on. A drop of cement on the axle tip will keep them on.

The "rudder" is made by heating a bamboo piece 1/32"x1/32"x9" to shape No. 3, cut to size, ends sharpened, coated with cement and forced into the balsa top stringer and bottom of the rudder post. Before adding the rudder post, the tail hook, No. 3, is bent from No. 11 piano wire and fastened to the fuselage end, using cement and thread.

The "elevator" is made by heating a piece of bamboo 1/32"x1/16"x9½", to shape No. 5, and carefully splitting so as to give two identical halves. The stabilizer end is spliced and after the fuselage is cov-

ered, it is cemented to the top stringer and the rudder post.

The construction of a cylinder for the three-cylinder motor is shown in detail on plate No. 2. From a 1/32" sheet, 15 balsa disks per cylinder are cut or punched out. A thin walled pipe 7/16" in diameter may be used as a cutter or punch. 16 paper disks are then cut out in similar fashion for the air-cooling flanges.

The cylinder is assembled as follows: A balsa piece 7/16"x1/16"x¼" is slipped on a wire pin, then a paper disk with a drop of cement on the inner side, then a balsa disk with a drop of cement, paper disk, etc. When completed, the cylinder is colored gray. Make the other two the same way.

To attach on nose or cowl, recess out a shallow hole which each cylinder is to occupy, cement in cylinder, add paper rocker arms and small wire pushrods as shown. Note photographs show model without motor (not finished) which necessitated adding a little nose weight in lieu of the motor. If motor is left out entirely, have that added weight in the form of a heavier prop.

The cabane or center section struts are made by bending a piece of streamlined bamboo 1/32"x3/32"x4¾" for the front strut at its center and a piece 3¼" long for the rear strut. When cut to the correct height, No. 1, 2, 4, they are cemented to the fuselage top longerons. As they will pierce the cowling, cement will be sufficient in holding them securely. The struts should give the top wing approximately 3/32" incidence. The bottom wing will be set at zero degrees incidence.

Wings

FOR a fuselage of such cross sectional area and size, the wings seem to be abnormally small when compared to other designs. We must remember that since the span of the original was only eighteen feet with a regular sized fuselage, the proportions are different. It is this unusual proportioning which gives us a design just suited for flying. The large majority of scale designs as far as flying is concerned, are handicapped with large wing area, small fuselages, tails, etc. In this design we have a fuselage as found in the 24" designs, but with the compactness of a 17¼" span.

Make a metal template of the rib on No. 3 and from a sheet slightly under 1/32", cut out with a razor 42 ribs. Separate into four sets, 11, 11, 10, 10 respectively, and notch each set at a time. After notching, do not mix ribs together because a wavy spar wing will probably result. From 1/16" sheet slice out 8 wing spars ⅛"x1/16"x10", four trailing edge pieces 1/16"x3/32"x9½". Sand these to a wedge as shown in No. 3 and from a sheet 5/64" thick, cut four entering edge pieces approximately 9½" long, sanding to shape down.

Using dividers and a soft pencil, space off rib positions on all spars. Using a set of ribs as an example, top right wing half, No. 4, add a little cement in all front notches and force front wing spar in all notches. Add cement to rear notches and force spar in. Line up all ribs and let dry. Entering edge is cemented and trailing edge after dry.

For other half of wing, do the same throughout except that the tips are reversed as noted. The bottom wings, No. 3, are also treated in the same way. The tips are made of bamboo 1/32"x⅛" bent to shape over heat and carefully split in four identical tips. After cutting to size, the wing tips are cut to the proper length and tapered, No. 1. The bent tips are then cemented and wrapped with a few turns of thread. The two top wing halves are cemented together with a 5/16" dihedral. When dry, the double thick center rib is notched slightly below both wing spars so as to fit to the cabane later on.

Propeller

The prop is carved from a blank 7¼"x1½"x¾". The blank is cut out using a chisel or coping saw to the outline shown, No. 5. Do not round off tips of blank in any way. The underface of the blank is cut and carved out with an average under-camber of about 1/16".

When one underside is finished, do the other in the same way. After both undersides are carved, sand to take out knife marks. Then carve the opposite or top surface to about ⅛" average thickness. Do same to other side and finally, carefully carve to a blade thickness of 1/16" and hub of 3/16". Then cut out the hub and shape one blade to the approximate type of blade in photographs. Make a paper template of the shaped blade and use on the other blade. The knife is again used, trimming and cutting the entering and trailing edges to a typical airfoil section.

The prop is now sanded and balanced. To strengthen and give a smooth blade, the prop is finally doped and lightly sanded. The prop shaft is bent from No. 11 piano wire as shown in No. 2. First bend the triangular end. Force it through the prop hub, slip on and imbed a U shaped washer, fastening the shaft to the prop, using cement and thread wrapped around the hub and through and around the triangular bend. When this is done, the actual nose piece is slipped on, No. 2 and the shaft bent in a round hook for the rubber.

Covering

THE entire model is covered with natural tissue which incidentally resembles the Navy color with

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no added weight in the form of heavy pigmented dope. The fuselage sides and bottom are covered with one piece per side, the turtle-back because of a double curve, is covered in five pieces with the 1/16" overlapped edge in shingle-fashion. Start at the extreme end and work up.

After doping, the lettering may be done, using a straight-edge ruling pen and black waterproof ink. The top wing is covered in four parts. First cover the bottom right half, then the left, top right, top left. Use adhesive on the entering, trailing edges and wing tips only. Each bottom wing half is covered with two pieces, top and bottom. The wings are now doped and the circled stars may be added. In this case a stencil was made and the blue and red sprayed on, using a 5&10 insect gun.

The horizontal tail is covered with two pieces on one side only, the top, so as to have a light tail. The rudder is covered on one side with one piece. The red and blue stripes were sprayed on before covering. The tail is not doped. It is best to cover it near a radiator or warm stove so as to prevent warping. Use only one coat of dope wherever required, one part of clear nitrate dope plus three parts of acetone, will do nicely.

Assembly

To assemble ship, cement left half lightly to side of fuselage, No. 2 and No. 4. The wing may be pinned against the bottom longeron. Check for correct position and zero incidence, then add other wing half to other side and check for slight negative incidence (1/64"). No connecting spar or continuous bottom spar is required.

The top wing is now placed over the cabane struts and cemented in the center rib notches. If a righthand prop is used, give the top wing a little wash-in or more incidence to the left half. Otherwise give opposite to this and bottom wing.

The N struts are now made by sanding several balsa lengths to a streamline section No. 1. Cut to size and cement to the paper on the wings above and below the wing spars. First connect the two front spars, then the two rear spars. When dry, set in interconnector No. 2, thus completing the reversed N. Do same to other side.

Flying the Model

Before attempting to fly the model, it is important to get it to glide respectably. First see if the balance or center of gravity position is right. Support the complete model, rubber included, by the top wing, by the fingertips which are to be between the spars of the top wing. The model if built carefully, will balance on an even keel. Otherwise rectify the ship so that it will balance. With the tail surfaces set right, the model should have a glide of at least 5-1. When the model glides well, it may be given a test flight and will no doubt, fly right at the start.

If, after launching, the model flies level or drops a little but begins to climb as the power is used up, alter the line of prop thrust by placing a 1/32" more or less balsa piece between the nose piece and nose below the prop shaft. If the model upon launching, tends to climb abnormally or fly in a "stalled" position, insert a similar balsa piece above the prop shaft. To use a winder, attach to the prop shaft in that triangular opening, have an assistant to hold the model by the nose and steadied at the tail, stretch rubber and wind as usual.

With a prop carved from the specified blank, three strands of 3/16" flat is just right under a winder. For hand winding, use four strands of ⅛" flat.

To get a rubber motor into the fuselage, proceed as follows: Have a stick ¼" x ⅛" x 15" notched at both ends. Stretch the complete motor with an S hook across this notched piece, with the S hook at the extreme end out parallel with the stick, using the nose piece opening as an entrance. The stick with the stretched motor is carefully pushed towards the tail hook. By observing the S hook through the bottom opening, the S hook can be easily attached to the tail hook. Then the rubber is slipped from the opposite end notch, the prop hooked to the end and stick withdrawn.

To get a motor out, simply unhook from shaft, let rubber drop inside, detach S hook and shake rubber out through cockpit.

Indoor flights of 60 seconds are possible from this model: outdoors, time it with a calendar.