Model Flying Machines

By F. J. Camm, M.Ae.S.

A Long Distance Biplane

The accompanying drawings illustrate a hand-launched twin-screw canard biplane, or, as it would be designated by the type formula, a 1–2–P2 machine. It is one of the most successful of the simpler form of model the writer has ever flown, and is certainly more spectacular than the usual "flying-stick".

It will be pertinent to explain the meaning of the type formula just alluded to. The position of the letter P in the formula signifies the position of the propellers. Thus P1–1–1 means that a model so typified is a single-screw tractor-monoplane, i.e. the air-screw is disposed in the front of the machine; P1–2–1 a tractor-biplane; 1–2–P2 a canard or "propeller-behind" biplane; 1–1–P2 a propeller-behind monoplane, and so on. If the machine had a biplane tail or elevator, a 2 would be used in place of the 1 for the stabilizing or smaller surface. Thus, if it were a twin-screw tractor biplane, with a biplane tail, it would be a P2–2–2. If the model is hand-launched the expression is preceded by the letters h.l., and if self-launching by the letters r.o.g., which is an abbreviated form of "rise off ground".

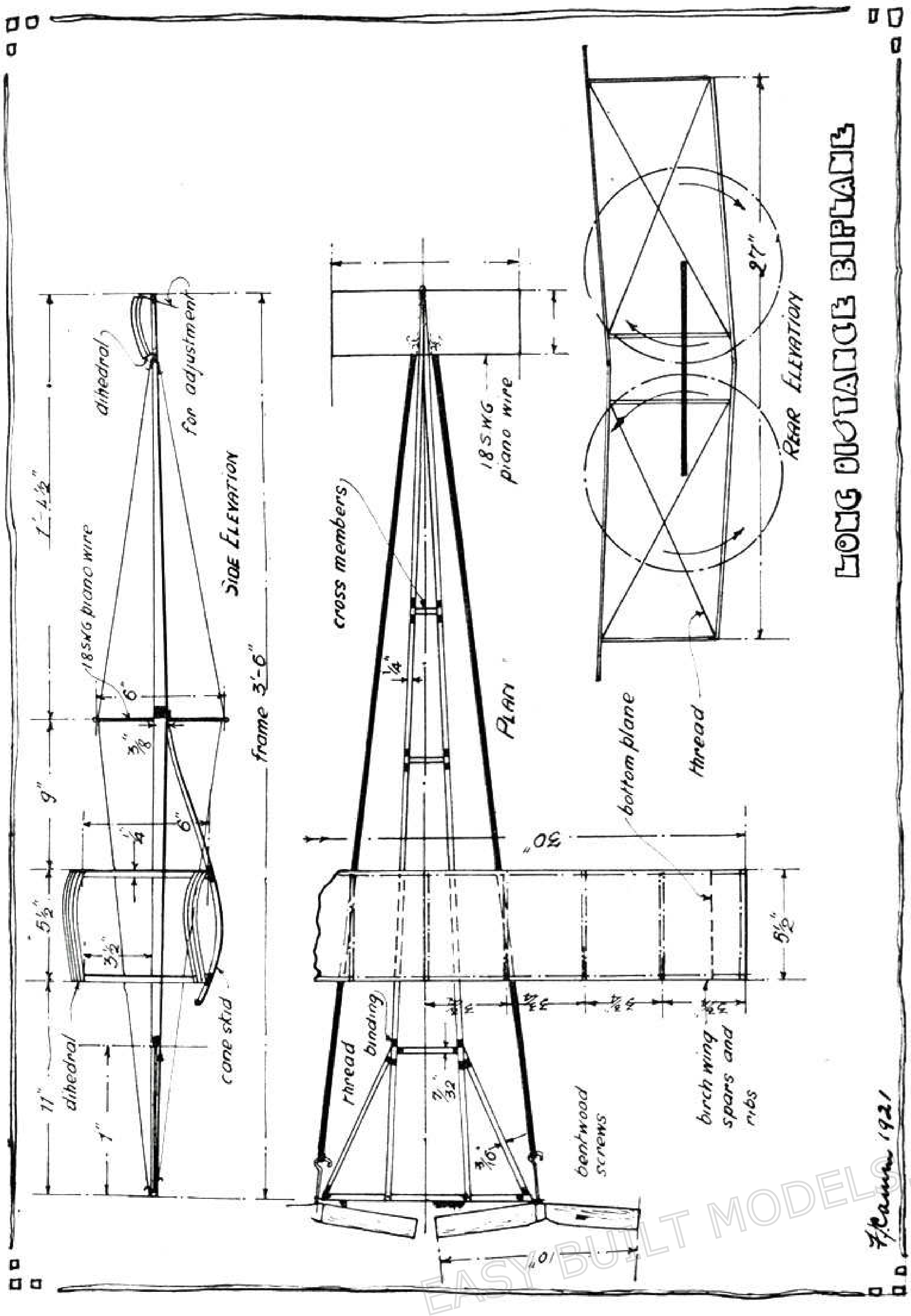
Reverting to the illustrations, Fig. 1 gives a side elevation of the biplane, and Fig. 2 a plan view. From the side elevation it will be manifest that the longerons taper in a fore and aft direction. This is to give maximum strength where stress is greatest. This taper commences from a point one-third the total length of the machine from the nose or front end. This type of fuselage is a combination of the A and T frame, and is exceedingly strong. Birch is to be used for the propeller-bar and supports, and spruce for the longerons and cross members. The illustration (Fig. 8) indicates clearly the form of joint employed for the cross members; it is known as the fishplate joint, thin sheet tinplate strips being bound to the cross member and longeron in the manner shown.

A sketch of one of the bearings is also included; its total length is three-quarters of an inch, and the width of the flanges that engage the top and bottom surfaces of the propeller bar are three-eighths wide. The length of the lug projecting from the bar end and constituting the actual bearing is a quarter of an inch, and is bent round at right angles to the skein of rubber. The bearing should be of about 20 s.w.g. (Standard Wire Gauge) brass.

Fig. 3 gives an elevation of the machine looking through from the propeller-bar end, and the relative position of the various component parts will be apparent therefrom. Brass wire stanchions support the tips of the wings, to which the truss bracing is attached; this detail, however, will be dealt with in the next issue. Notice, however, that the planes have a dihedral angle of one and three quarter inches.

Fig. 4 shows the attachment and construction of the elevator. It will be noticed that the elevator frame is formed from one piece of wire only, the centre-rib being an extension of the trailing edge. Wire crutches of the form shown are attached to the trailing edge to provide means of attachment to the fuselage. All joints to the elevator must be bound with fine florists' wire, and soldered. From Fig. 4 will also be clear the shape of the hooks which embrace the rubber skeins; they are of piano wire of the same gauge as the elevator, and are bound into position with carpet thread.

Fig. 5 indicates the method of attaching the planes to the inter struts, the latter to the longerons, and also the method of binding the skid to the inter strut. Small birch distance-pieces are secured between the struts at the points of attachment of the planes, and also above the longeron to form a saddle-support. The struts are cross-bound to the longerons with black three-cord carpet thread, the joint being soaked with weak glue. Perhaps it will be


LONG DISTANCE BIPLANE
REAR ELEVATION
27"
SIDE ELEVATION
for adjustment
dihedral
1'-4½"
18SWG piano wire
6"
⅜"
frame 3'-6"
9"
6"
¼"
5½"
3½"
cone skid
11"
dihedral
1"
PLAN
18 S.W.G. piano wire
cross members
¼"
30"
bottom plane
thread
5½"
thread
binding
7/32"
3/16"
bentwood screws
birch wing spars and ribs
10"
F. Camm 1921

pertinent for me to point out (in case some readers wish to proceed with construction in advance of next month's issue), that the lower main plane is sprung into the notches shown in Fig. 5. Hence it follows that the lower main plane must be less in chord (or distance from leading to trailing ege of wing) than the top or head main plane to permit of this. The depth of the notches is an eighth of an inch, and the width of the inner struts three-

as a bending jig; or for rapidity in working a number may be made so that a quantity of ribs may be bent without waiting.

Having prepared the wooden scantlings for the ribs, each is tied down to the form of the bending jig and held under a jet of steam from the kettle for two or three minutes, afterwards being placed in front of the fire to draw the moisture from the grain. If upon removing the piece from the jig it is found to have returned

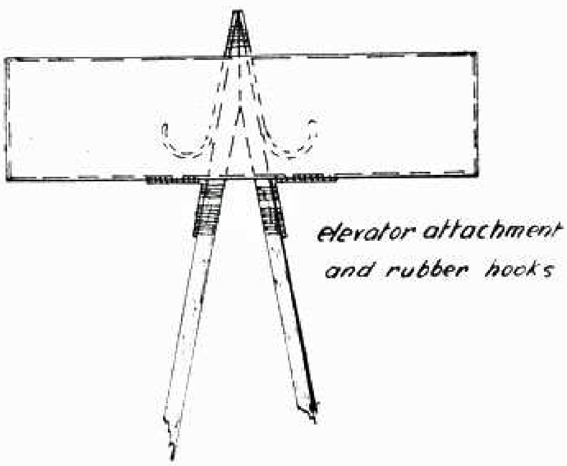


Fig. 4.

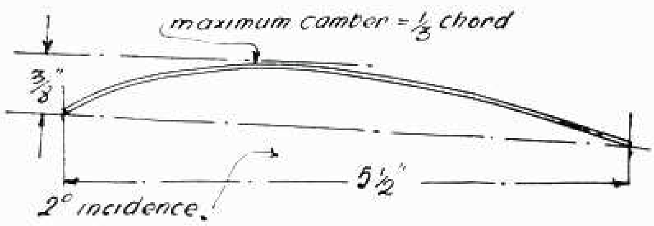


Fig. 6.

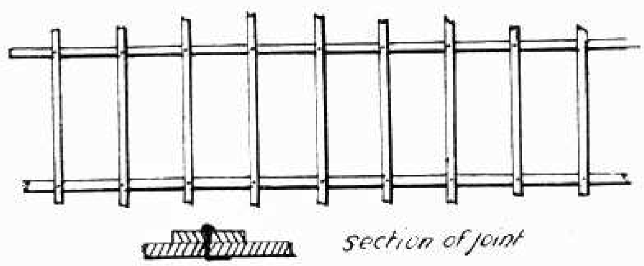


Fig. 7.

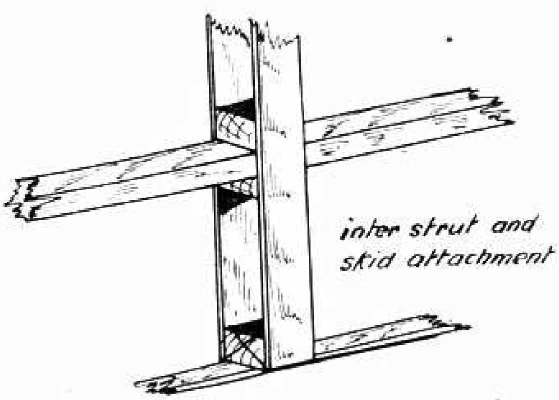


Fig. 5.

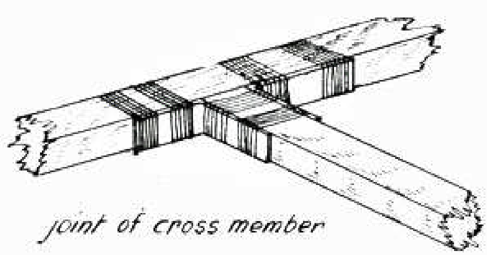


Fig. 8.

eighths, so that the chord of the lower plane is $5\frac{1}{2}$ in. less $\frac{1}{2}$ in. = 5 in.

The ribs are to be cambered, or bent, as shown in Fig. 6. The maximum depth of camber, it will be seen, is a quarter of an inch. The curvature of the ribs must be set out full-size upon a board, with the greatest depth of camber disposed approximately one-third the chord from the leading edge. A wooden block is to be carefully cut to this contour, to serve

a little from the intended form, the operation must be repeated. The mainplane is to be built up as shown in Fig. 7. The spars and ribs are left longer than necessary, and are pinned and glued together after their positions have been marked with a pencil. The pins are driven through into the bench, and the plane is left so secured until the glue has set, when it may be prised up with a pocket-knife, and the pins clenched over, as shown in section.

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A Long Distance Biplane *(continued)*

The perspective sketch, Fig. 1, of the propeller support construction shows clearly the method of halving the propeller bar into the longerons. In order to ensure that the bar is collateral with the lateral axis of the model (i.e. perfectly true with the planes) both longerons should be secured together with a small fretwork cramp and the two slots cut with a fine fret-saw as if they were one solid piece of wood. It is important that the bar should be quite true laterally, so that the centres of thrust of both propellers lie in the same plane.

By cutting both slots in one operation thus, not only is it possible to secure accuracy with regard to the thrust centres, but also (since both slots will be cut of the same depth) with regard to the position of the bar in relation to the lateral axis; that is to say we are assured that the bar is not heeling towards either skein of rubber.

Glue must be brushed within the slots prior to the insertion of the bar, the joint being pinned and clinched on. The propeller bar is tapered off from the point of its attachment to the longeron, to the propeller. The diagonal supports are pinned and lashed to the longerons at their front ends, while a pin is driven through it at the other end, from the trailing edge of the propeller bar. This will be obvious from the sketch.

Turning now to the main planes, before we can commence the assembling, four 18 s.w.g. brass wire stanchions, to maintain the correct "gap" at the wing tip, and also to provide an anchorage for the wing bracing, will be required. Fig. 2 gives details of them. A piece of flat mild steel $\frac{1}{16}$ in. by $\frac{3}{16}$ in. is secured in the vice, and the brass wire pulled round this to form the eye. A hole is drilled in the wing-spar to correspond to 18 s.w.g. wire, and the end of the stanchion passed through and clinched over, fine 35 s.w.g. tinned-iron or

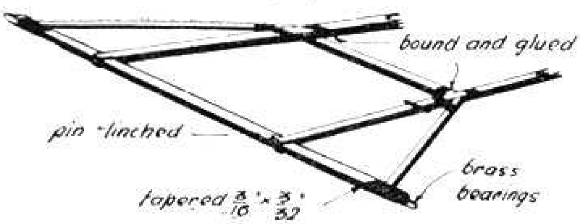


Fig. 1.

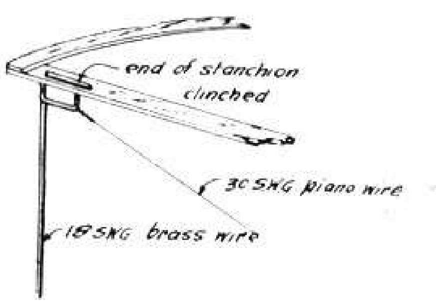


Fig. 2.

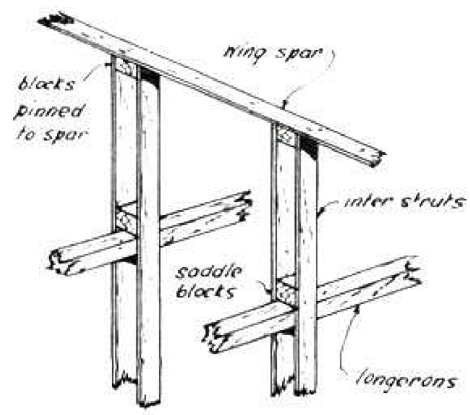


Fig. 3.

Fig. 4.

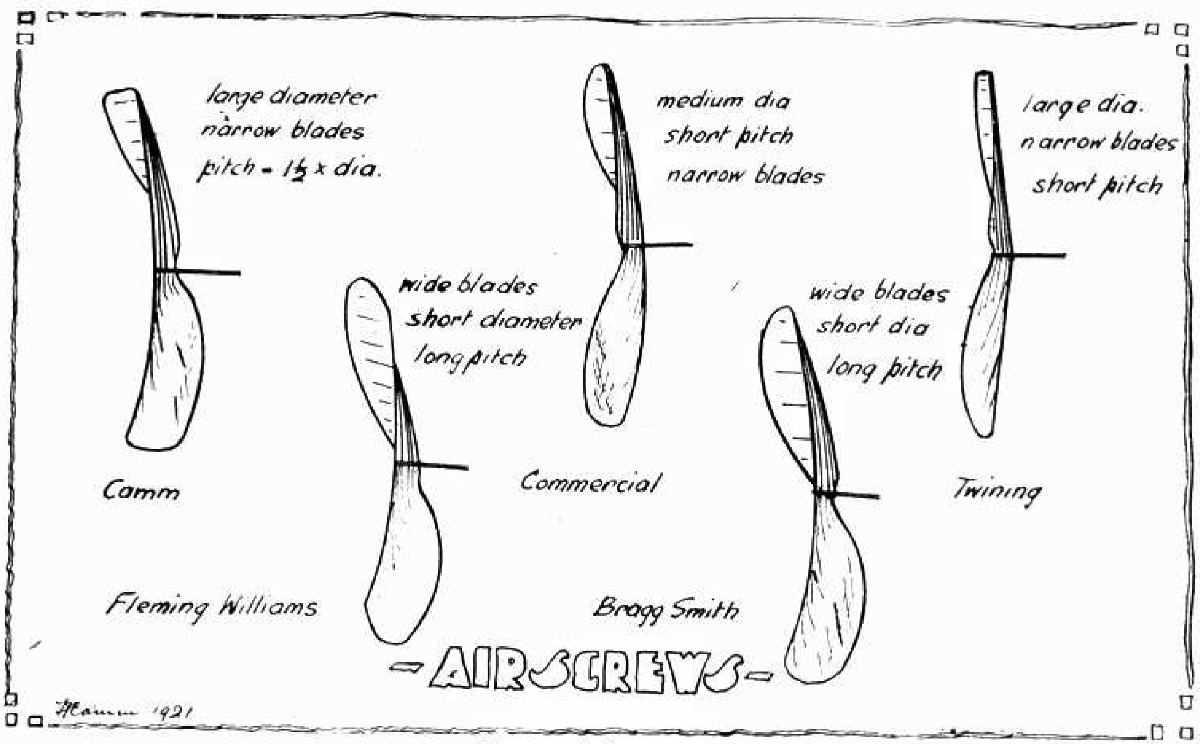
Details of the long-distance biplane.

florist's wire binding securing it to the spar firmly. Great care must be exercised to ensure that the distance between the eye centres is the same in each stanchion; also that the "gap" of the planes is correct at the four corners, otherwise a distorted wing will result. The eyes seat home on the wing-spars, and therefore, if the four stanchions have been correctly made, the "gap" is bound to be correct. In practise it will be found that the impacts sustained by the wing-tips of a model are considerable, and the brass wire will be found sufficiently ductile to yield them, and so prevent breakage, it being quite easily straightened out again.

longerons sufficiently freely to permit of a little adjustment in a fore and aft direction during tuning up; in other words, in order that the position of the wings may be varied in relation to the centre of gravity, so that the essential coincidence of the c.g. and c.p. is obtained.

It will, of course, be understood that the bottom blocks to which the said skid is secured are not fixed until the inter struts have been passed over the fuselage. A glance at Fig. 3 will render these points quite obvious.

In Fig. 4 we have an enlarged side elevation of the nose of the machine, from which the construction of the elevator will be apparent. The plan view (see last month's issue) showed

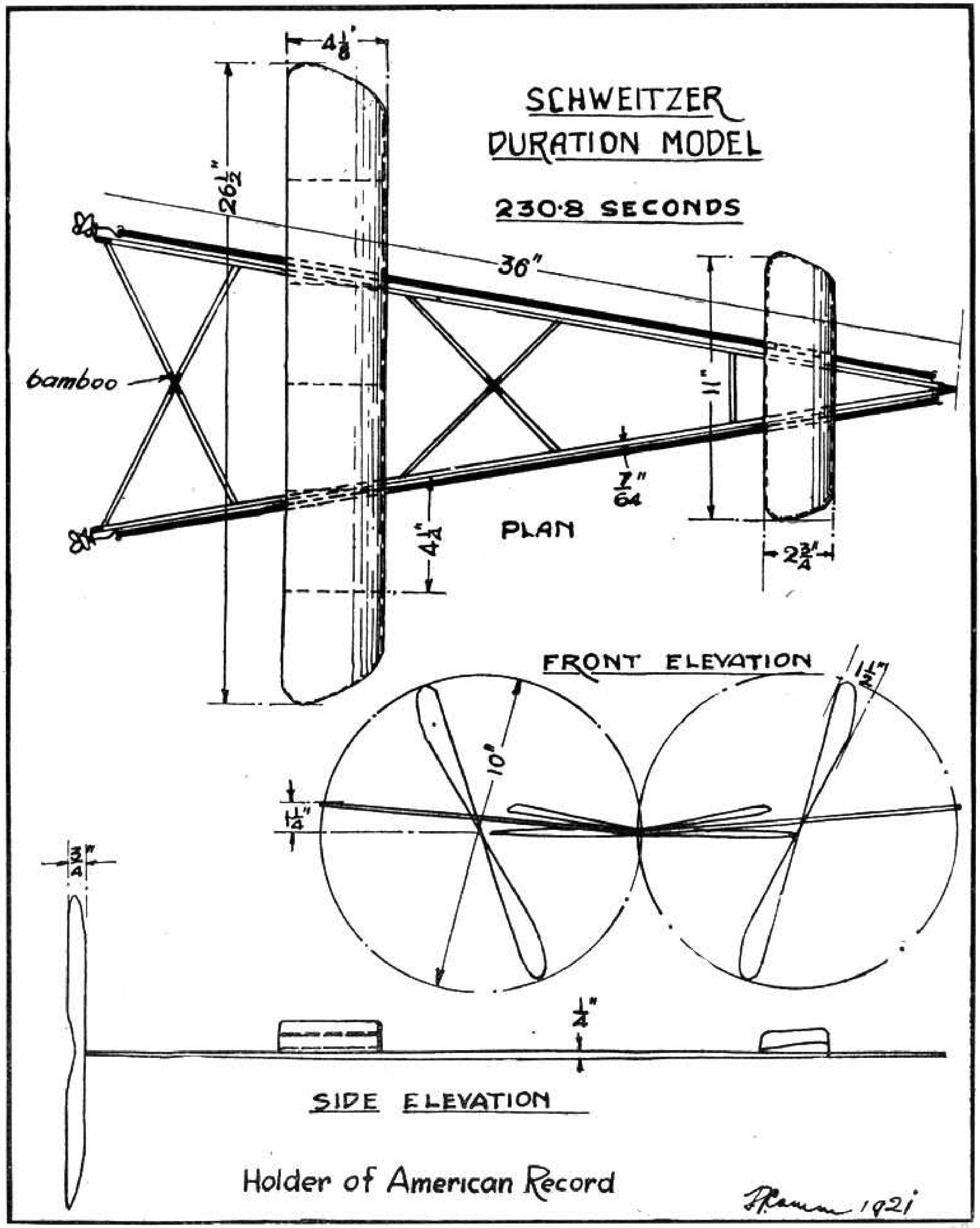


Types of airscrews.

To the centre of the top main plane two small blocks are pinned, made perfectly from birch, the distance from centre of each block to coincide with the span of the fuselage at that particular point where the wings will be fixed. Since, however, the exact position of the wings can only be found by trail and error, it is best to temporarily fix the blocks until the correct position has been found. The inner struts supporting the wings to the fuselage are prepared next, the saddle blocks which ride on the spar (thus deciding the location of the wings in the vertical plane) being glued and pinned into place and allowed to dry thoroughly. It should be seen that the section of the saddle blocks permits the inter struts to pass over the

exactly the location of the joints; this sketch makes clear the method of adjustment. It will be noticed that the centre rib continues over the leading edge of the elevator, and is bent down and back. So that when this continuation of the centre rib is passed through the hole in the nose of the model (shown dotted in the drawing) the trailing edge is caused to bind on the longerons, and so secures the plane in place, albeit permitting the plane to swivel in the event of it striking a wall, tree, etc., when flying. A bead of solder holds the rib to the leading edge. The covering may be of any light silk, the well-known Japanese silk is admirably suited to the purpose, and, moreover, only weighs about $\frac{3}{4}$ oz. to the square yard. A good commercial silk, such as Jones' or Clarke's, may be used; these have the additional advantage of being already proofed, whereas draper's silk requires to be made air-

To secure the fabric it must be stretched from end to end first, and then pulled over the wing spars, drawing pins being pressed into the latter to hold the fabric down until the glue is dry.



The Schweitzer model, holder of the American record.

and waterproof by being doped. Cellon is obtainable in small tins specially prepared for modellist's purposes; and this must only be applied *after* the wing is covered.

The corners of the fabric should be left unsecured, so that the inter struts may be clinched over (see Fig. 2). The wooden blocks to which the inter struts are attached must be secured to the wing before covering. After the brass wire stanchions are clinched over (that is, when the planes have been assembled) the fabric can quite easily be fixed down. The elevator is covered with silk, the latter being sewn with an over-and-over stitch to the wire frame.

The twin propellers are similar to those illustrated in the first article, but the diameter, it should be noted, is an inch longer, although the width is the same.

The sequence of assembly is as follows: Assemble the fuselage, inter struts and wings, pass the inter struts over the longerons, and assemble the lower blocks. Attach the skids to the latter, slide the bottom plane into position to the latter, slide the bottom plane into position, having marked it central with the fuselage, pin the inter struts on the top blocks and insert and clinch the brass wire stanchions or inter struts, afterwards sealing the fabric down at the corners. Next (and this is an exceedingly important operation) brace the planes. Let us deal with this operation in detail. Firstly, attach the four lower wires, applying sufficient tension to impart a dihedral angle of $1\frac{3}{4}$ in. Test the angle by standing the model on a surface-plate, or any level surface, and measuring the height of the bottom wing-tip from it.

Bentwood Screws

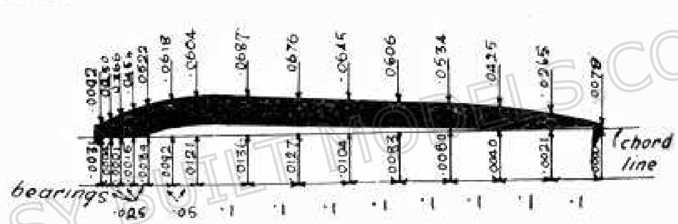
Birch or whitewood may be used for bentwood screws, straight in the grain and free from knots. The grain must be filled *before* bending with gold size to keep it true after bending, as bentwood screws have a tendency to flatten out. In the accompanying drawing some well-known types of screw are shown. My own type is typified by long diameter, fairly narrow blades, and a pitch about one and a half times the diameter. The Fleming-Williams type has wide spoon-shaped blades, short diameter, and long pitch.

A common type of screw much in evidence is the third from the left in the sketch. From observations I was permitted to make during some of the pre-War competitions, there does not seem to be any definite standard of proportion with regard to diameter and blade-width, but the pitches in nearly all instances (I am referring only to twin-screw machines) were extremely coarse, and the screws were made to revolve very slowly. Some of them, indeed, did not appear to be revolving at a greater speed than 300 per minute. The slower the rate of revolution, of course, the higher is the efficiency. The Bragg-Smith screw, like the Fleming-Williams, has spoon-shaped blades, long diameter, and short pitch.

The other bentwood screw shown is the Twining. This has a remarkable efficiency, and has long, tapering blades and short pitch. This type of screw conforms very nearly to my own, except for the tapering blades, and has given remarkable results. With regard to the direction of attachment of the shaft in relation to the cut-out portion the bending process is much simplified if fixed as with the Camm, Fleming-Williams, and Bragg-Smith types. The best method of attachment of the shaft is to fold a narrow strip of tin round the boss, and to tightly pull the spindle round, making off the end in a spiral round the main portion, and filing the end flat to present a true surface to the bearing. A left-handed screw should have a right-handed spiral, and, of course, a right-handed one a left-handed spiral. This ensures that the coiled end trails, which results in a smooth running bearing. The running is also much improved if some solder is melted into the spiral by means of the soldering bit. Also solder the spindle or shaft to the tin strip, central with the blank. The tinstrip may be fixed by sinking it into the blank with a couple of centre punch pops. Take care, also, to see that the shaft is central sectionally with the blank. A simple method of fixing the shaft to carved screws is shown also. This consists of bending fork on the end of the shaft and tapping back into the block. Another method is to use a spindle made from the screwed portion of a cycle spoke, the airscrew being locked to the shaft by means of a couple of spoke nipples. I shall be pleased to test any airscrews sent on to me.

Replies to Correspondents

A. E. P. (Portsmouth).—I replied direct to your letter. Here is a sketch of R.A.F. 14 section.



R-A-F 14 WING
All dimensions in terms of chord