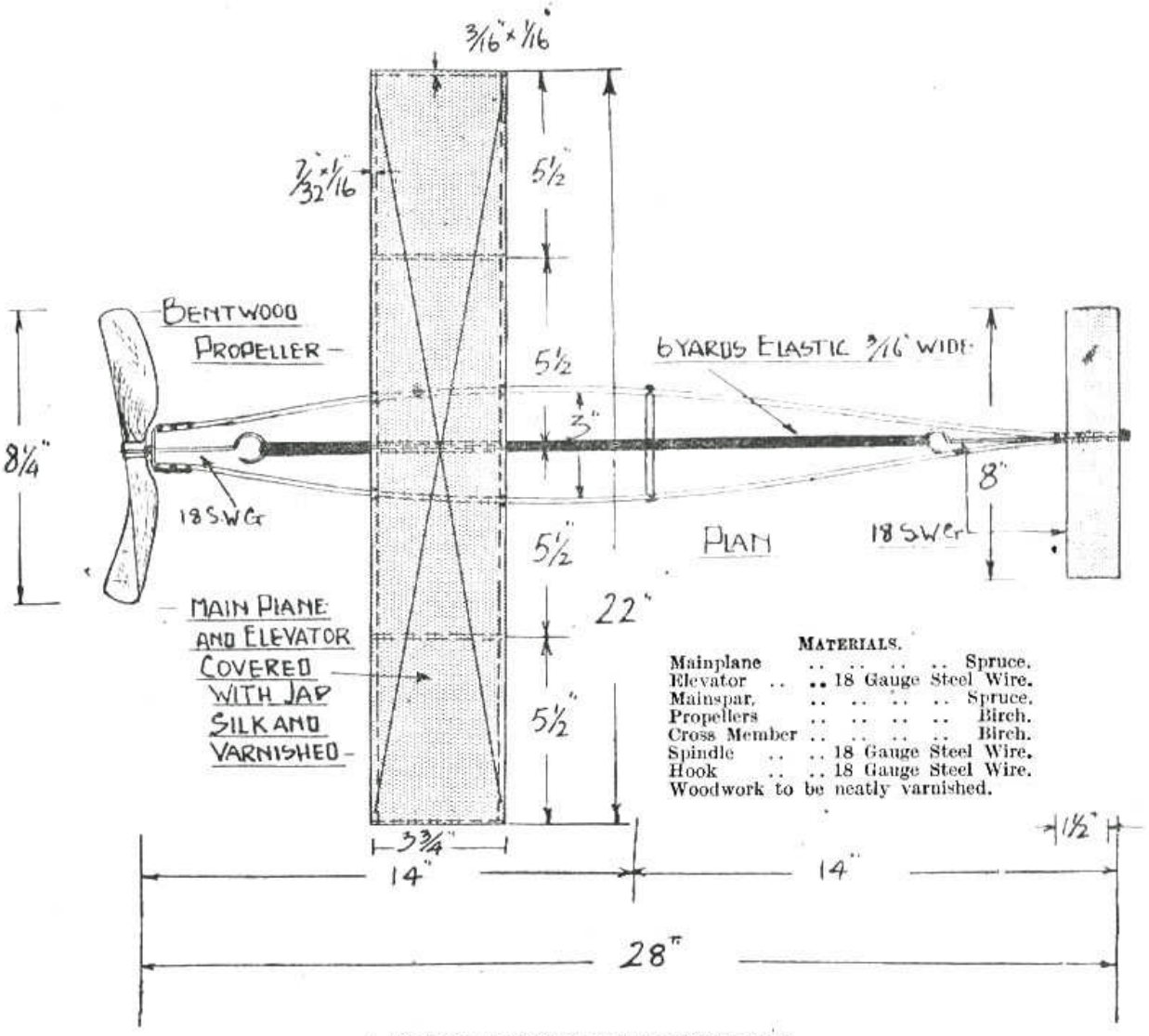
A Simple Single-Screw Monoplane

A glance at the drawings will convey the form and general arrangement of this model. It is a single-screw monoplane, and it flies with the propeller *behind*, not leading, as in most of the full-size machines. In other words it is a "pusher," not a "tractor." The screw is



MATERIALS.

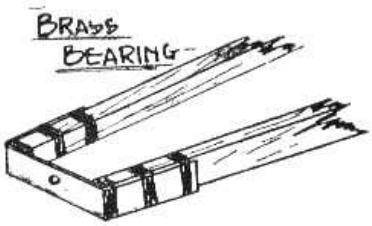
Mainplane	Spruce.
Elevator	18 Gauge Steel Wire.
Mainspar	Spruce.
Propellers	Birch.
Cross Member	Birch.
Spindle	18 Gauge Steel Wire.
Hook	18 Gauge Steel Wire.

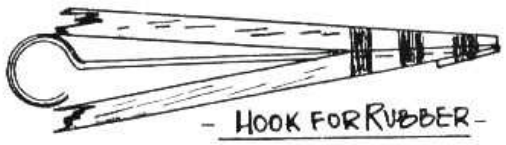
Woodwork to be neatly varnished.

A SIMPLE SINGLE-SCREW MONOPLANE.

placed in the rear because it is much simpler to fly the machine thus, and not nearly so much adjustment is necessary.

The first thing to do is to plane the wood for the frame, or body, to the sizes shown on the drawing. Great care must be exercised to ensure that both pieces are of exactly the same length and section, so that they are of the same weight. It is a good plan to weigh each





member separately, gradually planing a shaving or so off the heavier until they are equal in weight. The pieces can be finished up smoothly with fine No. 00 sandpaper. It will be noticed that the frame members taper slightly off towards each end. This is to prevent the completed frame from buckling or twisting under the stress of the elastic motor.

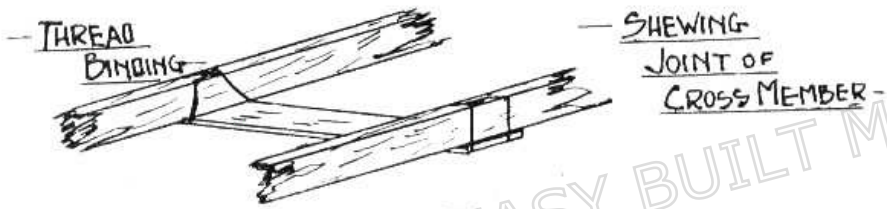
A narrow strip of brass will next be required to form the bearing, as sketched. It should be about $\frac{1}{32}$nd of an inch in thickness, the two lugs which engage the frame members being so bent that they follow the contour, or curve, of the bowed frame. A $\frac{1}{16}$th hole must be drilled in the centre for the spindle of the propeller to pass through, as will be seen from the plan view.

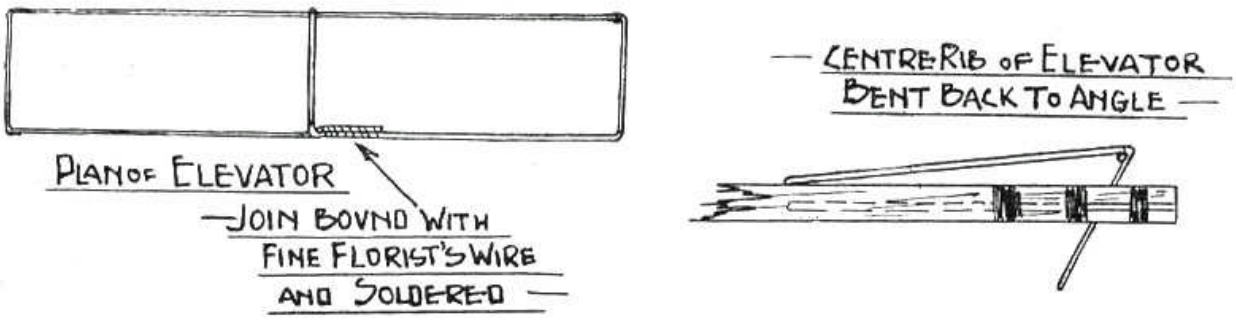
The bearing is to be tightly bound to the members with black three-cord carpet thread, the thread being afterwards smeared with weak glue to secure it. It should be lashed after the manner of the binding on a cricket bat and the ends pulled through out of sight.

Now bend to the shape shown in the sketch the hook which passes through the nose of the machine, and to which the other end of the elastic skein is attached. It will be clear from the sketch that its end is bent round flush to the frame member, and is tightly lashed and glued into position. Before the two frame members can be bound, however, they must be cut off to an angle as shown in the sketch.

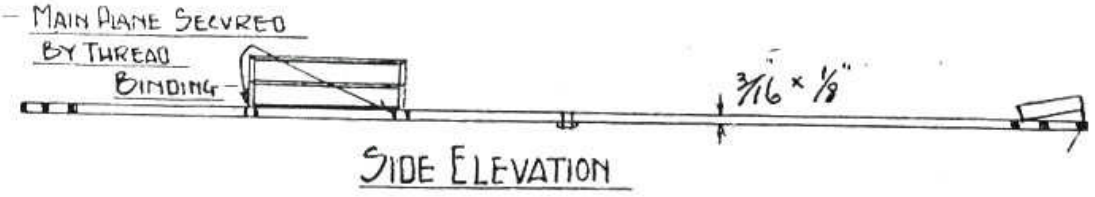
We now have the bearing and the hook attached; it only remains to bow the frame to complete it. This is effected by fixing a cross member, also shown in perspective detail, across the frame and firmly securing it by pins, glue, and binding.

The elevator is formed from either piano or tinned iron wire—the former for preference, since it is more durable and not nearly so likely to buckle should it receive a knock during flying. It is made

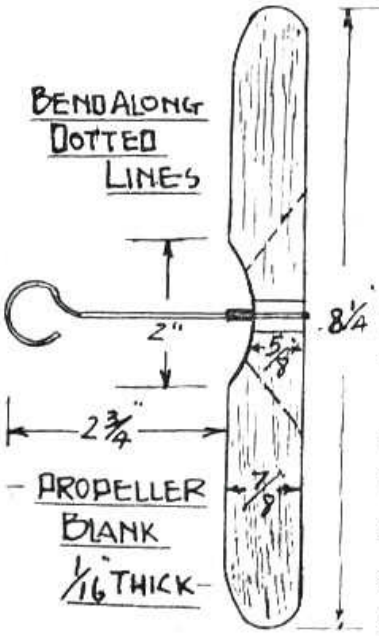




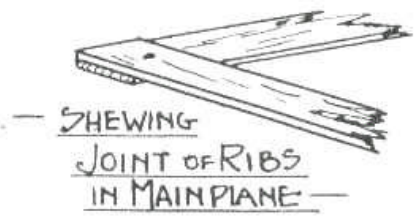
in one piece, as a glance at the elevator plan will show. The centre rib continues over the leading edge, being bent downwards and backward, as shown in the sketch of the centre rib of the elevator. This projecting spoke provides the means of securing the elevator to the frame. It is passed through a hole drilled in the



nose of the frame so that the spoke is a nice fit within it; the spoke being bent back at an angle, causes the trailing edge of the elevator to bind on to the spar. No further security will be found necessary, as the elevator will remain quite rigidly in place during flying, although, should the model strike a tree, wall or other object, it will swivel round and so will not be damaged. The joint in it (which, it must be noticed, is located at the centre of the back, or trailing, edge) must be bound with fine florists' tinned wire and lightly soldered. It will also, of course, require to be soldered where the centre rib passes over the front, or leading, edge and continues downward to form the adjusting spoke. Finally, carefully true it up with the pliers so that it lies quite flat.



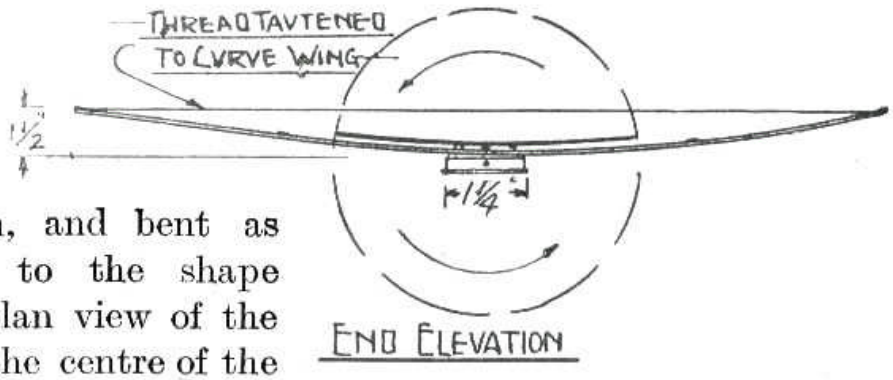
So much for the elevator; we can now turn to the main plane. This is built up of thin strips of wood pinned and glued together as shown in detail. The best method to adopt for its construction is to leave both spars and ribs a trifle longer (say half an inch) than



necessary, so that they do not become split during the pinning operation. Mark ribs and spars off to correct lengths and pin them together, placing the ribs on the *top* of the spars, smearing glue with a camel hair brush between the joint, and driving the pins right through into the bench.

The plane should be left thus secured until the glue has thoroughly set, when it may be prised up with the blade of a pocket-knife, the pins bent over or "clinched" into the spars, by tapping them back with a small hammer (the wing being supported on an iron block during this operation), and the ribs then trimmed off flush with the spars. Carefully remove with fine sandpaper any sharp edges which might tear through the fabric, and the wing frame is complete.

It will be the better plan, I think, to complete all the components before covering the two planes, so we may proceed to the final and, be it said, the most important part of the machine, the propeller. This is to be cut from very thin wood (birch for preference), of the shape and dimensions shown, and bent as explained below to the shape indicated in the plan view of the model. Around the centre of the blank a tin strap is to be soldered, and on to this, in turn, the shaft is also soldered. It must be clearly understood that the shaft passes over the centre of the blank, and thus must be soldered to both sides of it. Before forming the hook, a short length of brass tubing must be slipped on the shaft to act as a distance bush to allow the propeller to clear the frame when it is revolving. Now hold the blades in a jet of steam and gently twist along the dotted bending lines shown in the drawing until, under the warping effect of the steam, it remains where twisted. One blade only must be operated on at a time, and each must be bent to exactly the same degree. Too much care cannot be expended on the making of the propeller, for on its efficient working the whole success of the machine depends.



END ELEVATION

Readers who prefer to buy a propeller can do so from any of

the London model-dealers for a shilling or so, although it is obviously more interesting for the reader to prepare his own. Take note that the screw is made to revolve in the direction of the arrows in the end elevation of the model. When satisfied that the propeller is quite true, it can be sandpapered and polished with a couple of coats of good coach varnish, and then left to dry.

Reverting now to the question of covering, nothing better or lighter can be used than yellow Jap silk, which, when varnished, is of a rather pleasing golden hue. It can be purchased fairly cheaply, and half a yard will suffice. The edges of the fabric are to be glued along *underneath* the spars, so as to present a neat top appearance. First, cut the fabric out to size, allowing sufficient to pull under the spars, and then glue it to the under surface of either of the two end ribs and leave to dry. When set, pull the fabric tautly over the frame so that the latter bends up slightly as shown in the end view, and glue along under the second end rib. The bowing up of the frame, it will be noticed, has a tendency to prevent this end from sticking, so drawing pins must be inserted, being pressed partially home into the rib until the glue has set. Finally, stretch the fabric over the leading and trailing edges of the plane, using drawing pins as before, and taking care that all wrinkles in the fabric are effaced. All rough edges should be cut away with the scissors. In order that the main plane may maintain its upward curve as shown in the end view it is to be diagonally braced with carpet thread.

With regard to the elevator, it will be found expedient to sew the fabric to this, first pinning it tautly into place and then securing it with an over and-over stitch.

We now arrive at the proofing stage. I cannot lay too much stress upon the importance of making the covering thoroughly impervious to air, as that is where so many beginners go astray. The fabric *must* be quite airtight. The best proofing to use is good varnish, slightly diluted with turps to dry it more quickly. This mixture should be thinly and evenly applied with a flat brush, one or more coats being given according to the appearance of the fabric after the first. The planes must be viewed after proofing (or "doping") for pores, and it is upon the presence or otherwise of those pores that the necessity for a second coat depends.

When the wing is thoroughly dry it may be bound to the frame (which should previously have been varnished), as shown in the side

elevation. As will be obvious, the binding passes over the spars of the wing and round the frame members, and thus secures it.

Now place the elevator in position, with its front edge about an eighth of an inch off the frame, as shown in the sketch of the centre rib (the trailing edge, of course, being down on the frame), pass the propeller spindle through the bearing, and attach the skein of rubber to the hooks. By the way, make quite sure that the correct elastic is procured, that is $\frac{3}{16}'' \times \frac{1}{32}''$. The hooks can also be conveniently covered with cycle-valve tubing to prevent them from cutting through the rubber. All joins or breakages in the latter must be repaired with thread, the elastic to be stretched while being bound with it.

Before we can actually fly the machine we shall require some rubber lubricant. This is used to prevent the strands from adhering to one another, and also to enable more turns to be given to the skein, which means, of course, more power. The ingredients are soft soap and glycerine in the proportion of 6 : 1, well boiled together and allowed to cool. When smeared upon the strands of rubber this solution has the desired effect of rendering them slippery.

And now with regard to the actual flying of the machine.

In the first place the model must be glided, to adjust its balance. Hold it aloft just above the head, the left hand supporting the front and the right grasping the propeller. Impart a gentle forward thrust to the model with the right hand, at the same time releasing the left. As the right arm comes forward, release the machine, and if it is correctly balanced it should glide to earth at a very slight angle. Assuming, however, that it has a tendency to dive, then the mainplane must be moved forward. If, on the other hand, it has a tendency to rise, the mainplane must be moved to the rear. This adjustment, of course, necessitates the removal of the binding holding the main plane to the frame. Hence I would suggest that it be only temporarily lashed in the first instance to facilitate its being quickly adjusted on the field. Unless the tendency to dive or ascend is abnormal, the mainplane must not be moved more than $\frac{3}{32}$nds of an inch, in either direction, at a time.

Having by this means obtained an even glide, the model can be tested in actual flight by giving the propeller from 100 to 150 turns in the correct direction, which must be such that the screw, when unwinding, drives a volume of air from the rear end of the machine.

There is a very erroneous idea prevalent among beginners that a propeller may be wound in either direction. Such is not the case, as the reader will see if he endeavours to fly the machine with the screw wound the wrong way round.

To launch the model grasp the screw in the right hand and support the nose with the left, as if about to glide the model. Then thrust it forward with the right, at the same time releasing the left; and when the right has travelled sufficiently far forward that, too, may be released. If all is in order, the model should rise and fly steadily.

Should it tend to dive slightly, or to "stall" (rise at too steep an angle) then similar adjustments as were made when gliding are required. Once the most favourable position for the wing is found it can be permanently bound there in the manner already described, and any small adjustments necessary afterwards can be effected by altering the angle of the elevator by pushing the spoke passing through the frame upward to increase the elevation or downward to lessen it.

The maximum number of turns the elastic will stand is 350, and this number should be gradually worked up to, and not applied until you are quite certain that the model is correctly adjusted.

Keep the bearing well vaselined, lubricating the rubber every third or fourth flight; and if the model has been made according to these instructions, circular flights of from 150 to 200 yards should be easily obtained.

Should the propeller have a tendency to chatter during revolution the propeller shaft must be adjusted until it revolves truly.