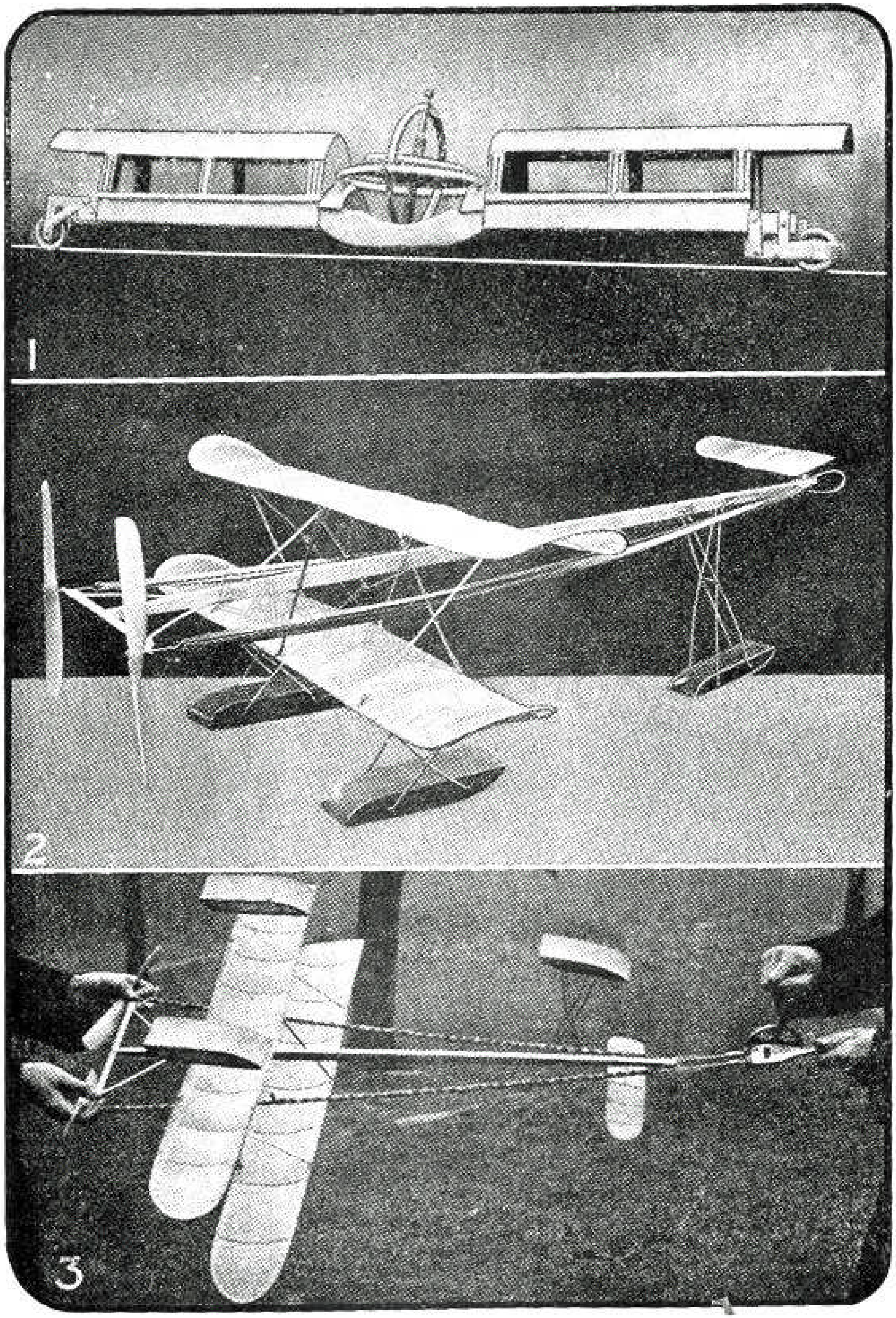
GYROSCOPIC MONO-RAIL AND SEAPLANES.



1. Gyroscopic Mono-rail model. 2. Seaplane model.
3. Winding Seaplane model.

[*Frontispiece*

MODEL SEAPLANE.

The construction of a model seaplane or water plane demands skill and patience, but no expensive tools or materials. The great point to keep always before you throughout is that the weight must be a minimum, owing to the extra weight and air resistance which the floats entail. But if the builder accurately and faithfully carry out our instructions, he will produce a model which, when cautiously placed on the water, the propellers being released and no push given, will skim along the surface, rise from it and make a flight of 30 to 45 or even 50 seconds' duration, according to the skill with which the machine has been constructed.

THE FLOATS—CONSTRUCTIONAL DETAILS.

As the Frontispiece, Fig. 2, shows, the model (of the pusher or Canard type) has three floats, one in front and two at the back. All three are practically of similar construction. The best wood to use is American whitewood or bass, on account of its lightness and freedom from knots and faults. We will take the front float first. Cut out two pieces of wood ($\frac{1}{16}$" thick) of the shape shown in Plate M, Fig. 1, but double the dimensions, the scale being $\frac{1}{2}$" to 1", with nicks at N and N^1, which must be made with a flat file, else you will almost certainly split the wood, which should be planed on both sides and well sandpapered, if necessary. Connect these pieces by four cross-pieces A A^1, B B^1, C C^1, D D^1 (Fig. 2), B B^1 and C C^1 are of square section and A A^1 and D D^1 are strip pieces, which must fit the nicks, N and N^1 tightly, and be thoroughly glued in: B B^1 and C C^1 should also be glued and secured by $\frac{1}{2}$" fine brass dome-headed screws. The section of these two cross-pieces is about $\frac{3}{16}$" square, not more. After having been glued they should be put on a flat surface and a small piece of board or a small weight placed on them to keep them in shape; they must be left for at least six hours to set. Of the two rear floats an elevation and plan are given in Figs. 3 and 4. The sides are no longer of solid wood, but cut out as shown, the thickness of the wood being nearly $\frac{1}{8}''$. Cut out the useless pieces carefully with a fret saw. In addition to the four cross-pieces corresponding to those in Fig. 2, we have two more, one at K and the other at L (Fig. 3). These may consist of pieces of straw like that used for sipping lemon squash; they weigh nothing and if cut without splitting have considerable compressional strength; failing these, use pieces of bass of $\frac{1}{8}''$ diameter, then glue them, etc., and leave to set as before.

Next, we have to cover all three frameworks with silk. Ordinary unproofed Japanese silk, which can be bought at any good draper's at 3*s*. to 4*s*. per yard, should be used. Cut out three strips sufficiently long to go right round the floats top and bottom, from end to end and overlap at least $\frac{1}{8}''$. Each should be $\frac{1}{2}''$ wider than the float on which it is proposed to glue it. The three floats are treated alike except that the two larger ones must have four pieces cut out to the dimensions of their elevation, and their four sides covered first. The treatment is the same in every case. It is of vital importance to get the silk taut, or it will bag, and flotational capacity be lost in consequence. In the case of the side coverings for the larger floats, first make the silk wet, wring it out lightly only, glue it and put it on wet, pulling and working it tight with the thumbs and fingers. The four pieces can be put on quickly one after the other, and the next twenty minutes or so spent in making them taut, again and again, until they stick without slipping back. Stand them on one side to dry naturally, using no artificial heat, and when dry they should be as "taut" as a drum. They should be left for at least twelve hours to dry and set thoroughly. To get the best results the putting on of the silk must be spread over a certain time; one part must be allowed to set and become dry and hard before another is glued on, or the former will slip and spoil the result.

Now proceed to glue one end of the long strips to A A (Fig. 2) in the case of the smaller, and D D^1 (Fig. 4) in that of the larger floats. When they have set, make the rest of the silk thoroughly wet, squeeze lightly, then glue the top edges and part of the sides of the floats and pull the wet silk tightly over the sides and also towards A A^1 (Fig. 4) and

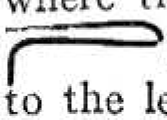
D D^1 (Fig. 2) as well, and finally towards D D^1 (Fig. 4) and A A^1 (Fig. 2), using both hands and working it as taut as possible. You must keep on doing this for a quarter of an hour, if necessary; this method presupposes that the end cross-pieces have been glued, and the whole done at one effort, including the overlapping of the silk at the starting-place. Take great care with the corners; they are best double-surfaced, because it is here where leakages generally occur. The work can be done in two portions, and it is easier for a novice to wet and glue down half the silk (that which will be the bottom half of the float) and then do the other later, after the first has set and dried. When completed and dry, it should all be taut everywhere. Before putting on the silk the corners and sharp edges must be rounded off with sandpaper. All superfluous pieces or threads should be neatly cut off, odd pieces, if any, stuck down, and everything left quite neat and smooth.

HOW THE FLOATS ARE MADE WATERTIGHT.

The float must not leak, for if it is not watertight it will be useless. On no account use shellac varnish or paraffin wax, or ordinary varnish or paint, such as you can buy at the oil shop.

Perfectly satisfactory aeroplane varnish which does not discolour in the water can be procured in tins. I have had floats coated with it, and immersed for a whole week in water without leaking. Most varnish turns white, becomes brittle and scales off. Give the wooden frame a coat of varnish before putting on the silk; it must be left at least twenty-four hours to dry. Each float must have two coats of varnish at least, and two entire days must elapse between the first and second coats. A method adopted by the maker of this varnish is to cut a small hole near one end of the silk at the top and pour in some varnish, thinned with a little turpentine, and allow it to flow well over the inside and then drain it off through the hole. The float is left for three days to dry, a small patch is then glued over the hole, and when dry is varnished. Two coats are then given on the outside. To make good floats the process must be spread over at least a week, the longer the better. When finished and thoroughly set, immerse just below the surface of the water; if they stand a ten minutes' immersion without leaking, they may be considered all right.

HOW FLOATS ARE ATTACHED TO THE MACHINE.

The floats must be attached to the machine by steel wire struts, the two larger floats directly to the lower plane, and the front one to the motor rods or fuselage of the machine. The distance between the inner sides of the two rear floats is $11\frac{1}{2}''$ and the flotational base $16\frac{1}{2}''$. Four separate pieces of wire are used to each float, gauge about 20; they are crossed in pairs in order to give the thin wire the necessary strength and rigidity. They are fastened to the floats by the brass screws round which their ends are twisted. Unscrew the screws, twist the ends of the wires round something of the same diameter as the screws, put the screws through, and screw up fairly tight. Tighten when the wires are in the correct position. Where the wires cross one another they must be neatly bound with a few turns of bright florist's wire and soldered. Do not solder without binding. The distance of the middle part of the top of the front float from the bottom part of the motor rod is $7\frac{3}{4}''$, and the length of the wire struts, allowing for twisting and bending, about 10". At the tops they are bent at right angles for about $\frac{3}{4}''$ and soldered to strips of thin sheet metal, bent to the shape of the motor rod and fastened to the latter in the required position with twisted copper wire (Plate N, Fig. 8). The distance of the top central portions of the rear floats from the middle portion of the lower plane is about 4". The length of the wires is about 8", which allows nearly 2" where the wire is bent first at right angles and then thus:

, the portion after the right angle being sewn either to the leading or trailing edge of the lower plane, as the case may be. The wires are "spread-eagled" laterally from the sides of the floats to where they are sewn to the edges of the plane; for instance, at their attachment to the floats they are nearly $2\frac{3}{4}''$ apart, where they are fixed to the planes $4\frac{3}{4}''$ (Plate N, Fig. 7). The wires, etc., must be so bent and adjusted that all the floats shall have their prows

higher than their sterns, the front float having about twice the angle of the rear ones. The correct angle for any machine is best ascertained by experiment; roughly try about 10° for the front and 6° for the rear. When placed on the water, the wires will "give" and these angles become considerably lessened; generally speaking, however, the angle of the rear floats should be as small as will permit of the machine's rising readily from the water. The leading edge of the two rear floats should be about $1\frac{1}{2}''$ in front of the vertical plane containing the leading edge of the lower plane.

THE FUSELAGE OR MAINSPAR.

This is simply a tapering, hollow, built-up spar, of double **U** section, so that it shall offer as little resistance to the air as possible and possess minimum weight and maximum strength. It is 3' long and $\frac{5}{16}''$ broad, flat-sided, and tapers from a depth of $\frac{3}{4}''$ to $\frac{7}{16}''$. Such a motor rod requires no steel wire stay, and is the best in every way. Its successful construction can only be acquired with some practice, and the builder may prefer to purchase it from one of the firms who make a speciality of hollow and section spars for model aeroplanes.

CROSSPIECE AND STAYS FOR THE PROPELLERS.

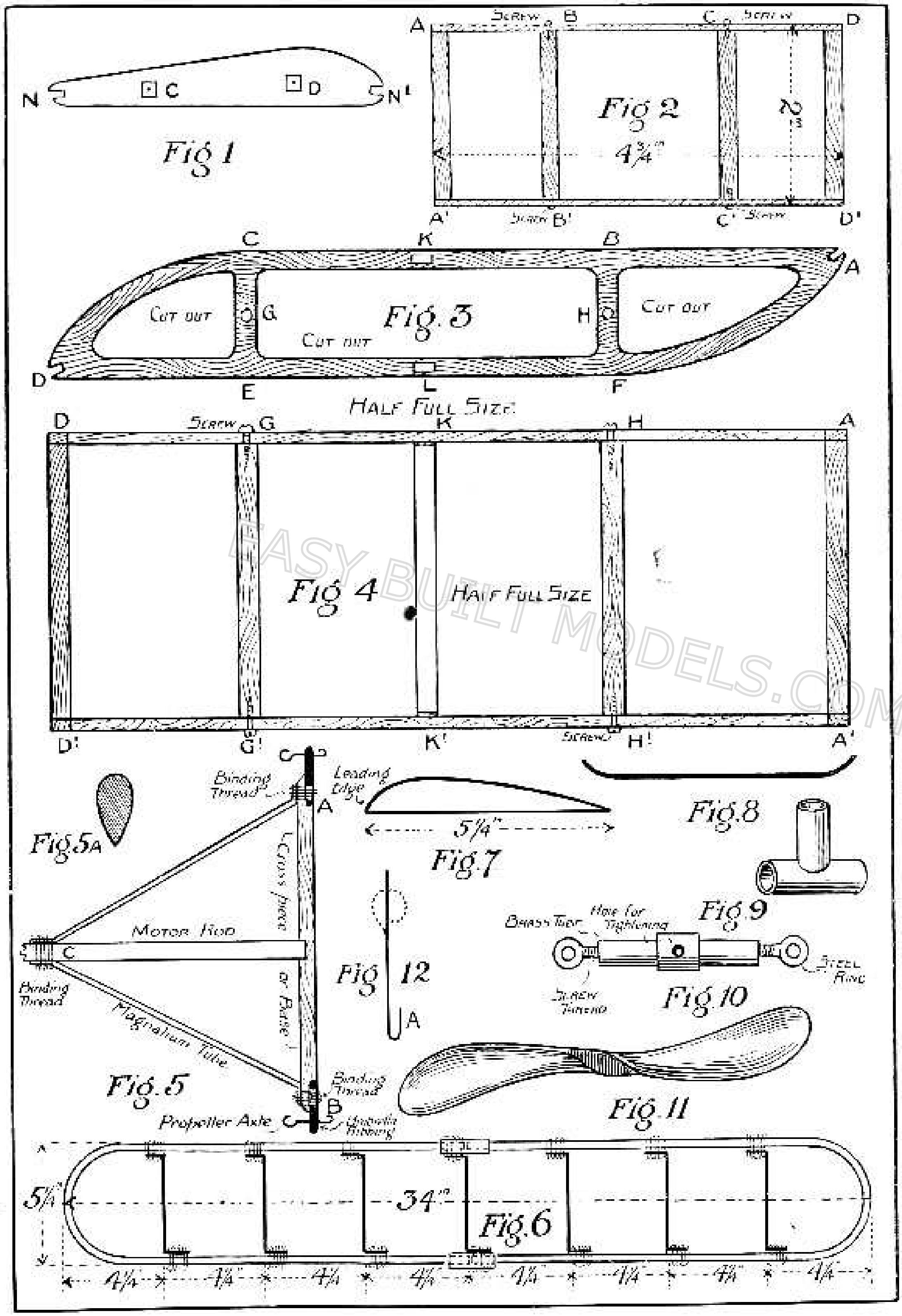
We must first fit on to the motor rod the crosspiece, A B (Plate M, Fig. 5) of solid spruce or bass, of "streamline" section, placed with its blunter edge forward (Fig. 5A). A slot must be cut in the end of the motor rod to receive it; the fit should be a good one, and it must be neatly glued and pinned, and left quite untouched until it is well set. The struts or supports, C B and C A (Fig. 5) are pieces of the thinnest magnalium (not aluminium) tubing procurable, the ends being bent and flattened so as to lie along the motor rod and A B for about half an inch. Drill a small hole and pin and tightly bind with thread; this can be varnished afterwards. If unvarnished when bought, give the motor rod a coat of Bragg-Smith varnish.

The actual bearings for the propeller axle consist of two small pieces of umbrella ribs, $1\frac{3}{8}''$ long; mark the size of the pieces required, file on the convex side and then break off; file the edges smooth. Each of the two pieces must have three holes drilled in it, one for the propeller axle, and the others for two little gimp pins. To drill these proceed as follows:—Fit the piece of umbrella ribbing, convex side up, to a piece of iron or brass held in a vice, and of sufficient thickness to fit tightly the underneath side of the rib; with a steel punch make indentations in the three places where the holes are to be, two about $\frac{1}{4}$" from either end and one about $\frac{1}{2}$". These can now be drilled with a small archimedean hand drill, in which the drill revolves first in one direction and then in the other. The hole intended for the propeller axle (steel wire 20 gauge) must be a good fit. Having pinned these on to the crosspiece A B (Fig. 5) and made the hollow ribs fit nicely round the edge of the wood, bind neatly with thread.

THE MAIN PLANES.

The two planes are exactly similar, save that the span of the upper is 34" and the lower 31". We need, therefore, deal only with the construction of one of them, the upper. It is constructed of the thinnest magnalium tubing, with steel wire (20 gauge) ribs, and covered with Bragg-Smith proofed silk. Do not procure hard-drawn aluminium tubing, as only soft-drawn magnalium tubing will do. The ends must be bent round a pulley or something round of about 4" diameter, the spring of the metal making this about right for the dimensions given in Plate M (Fig. 6). There can be one or two joins, but, in any case, one or both should be at the centre where the central rib comes. Join the ends by slipping over them a piece of similar tubing of the next size, about 2" long. Pack the tube tight, if necessary, and smear a little mendine over it. The short outer piece of tube should have a few indentations punched on it. On no account drill holes, even of the smallest, anywhere in the magnalium tubing. The ribs are about $6\frac{3}{8}$" long and have about $\frac{1}{2}$" at both ends bent at right angles, as shown in Fig. 6, the long middle portion being given the curve or camber shown in Fig. 7; the camber should not be too great. These ribs are fastened to the inner side of the tubing by neat and careful binding. Take care that all the ribs are of the same length and have the same camber. A little adhesive can be smeared on the magnalium tubing before binding and a little varnish on the thread when all are bound on. Leave the plane on a flat surface, undisturbed for at least twelve hours. If the tubing is a little crooked anywhere, bend it until it is quite straight. The proofed-silk covering can be obtained from any model-maker or dealer. Unproofed silk is useless, while to try to proof it yourself will cost you much more and be far less satisfactory than to buy it. The silk must be cut so as to leave an overlap of at least ½″ all round. It can be stuck on with good glue, or sewn on. The latter is much the better, because stitches can always be undone and any "lagging" taken up; nor will it become slack, through water acting upon it, as is very likely to be the case when it is merely glued. There is a certain knack, only to be acquired by practice, in getting the silk on really taut, but if the directions given below are followed the results should be satisfactory. Before the fabric is stitched on, however, the two rounded ends of the frame must be bent upwards so as to form the so-called "upturned tips" necessary for stability (Fig. 8). The upward curve begins about an inch beyond the outermost rib, and is at first gradual; the extreme tip of the wing should be about 1½″ higher than the middle portion. Both wing tips must be similarly bent. To sew on the fabric, first pin it on all round the frame, using ten or a dozen pins; then sew on along the leading edges, putting the stitches about ¼″ away from the tubing, and next sew on the rear or trailing edge, putting the stitches about ½″ away from the tubing, pulling the fabric as tight as possible whilst doing so. Next sew around one end, pulling tight all the time. Lastly, sew round the other end, pulling it very tight. If there is looseness anywhere, undo that part and sew it again. If the fabric be stuck on, adopt the same plan, sticking fabric to fabric and not to the tube, which would be useless; you must, however, let each section dry thoroughly before proceeding to the next. In either case trim up the edges neatly and stick down with a little thin glue, carefully removing all lumps and unevenness. Such a plane will last months even with very rough treatment. The lower plane is dealt with in a precisely similar way.

Plate M. SEAPLANE CONSTRUCTION.



1. Elevation of front float. 2. Plan of front float. 3. Elevation of rear float. 4. Plan of rear float. 5. Propeller bracket and bearings. 5A. Section of crosspiece. 6. Plan of top main plane. 7. Curve or camber of main plane (exaggerated). 8. Upturned tips-elevation. 9. Tube piece. 10. Wire strainer. 11. A carved propeller. 12. Wire axle.

HOW THE TWO PLANES ARE FIXED TOGETHER.

The distance between the upper and lower plane is $5\frac{1}{2}''$. They are "staggered" to the extent of about $1\frac{1}{2}''$, *i.e.*, the leading edge of the upper plane is about that distance in front of the leading edge of the lower. The two planes are connected by six struts, two (in the centre) of thin umbrella ribbing, and four of magnalium tubing, crossed in pairs, at a distance from the centre of $7\frac{1}{2}''$.

The umbrella ribbing struts are made by taking two pieces of ribbing, about $7''$ long, and bending them at right angles for nearly $\frac{3}{4}''$ at both ends, bending always towards the convex side. The leading and trailing edges of the planes are fastened to these short bent pieces by means of twisted wire. It is best to put neither of these two struts quite in the centre, but one about $\frac{1}{8}''$ out in one direction, and the other the same distance out in the opposite; then let the motor rod pass between them and fasten them with the thickest twisted copper wire to the rod, one strut being on one side of the motor rod and the other strut on the other side, the motor rod, therefore, being, as it should be, central. To bend the umbrella ribbing it must be made red hot in a gas ring and bent while in that condition. It is best to experiment a little on an odd piece first. Of the magnalium tubing the two pieces which go from the leading edge of the bottom plane to the trailing edge of the top are $6''$ long, and the two other pieces are $8\frac{5}{8}''$ long. The ends are slipped into T- shaped brackets like those shown in Fig. 9, and the brackets fastened to the planes either by stitching or twisted wire. Half, or nearly half, the lower horizontal cylindrical portion is filed away to enable it to fit over the tubular edge of the plane; or, what is better, slip four of these fittings (which can be got cheaply of any dealer in model aeronautical goods) over the tube before joining up and place them in position before sewing on the silk. The tubes can be fastened by punching dents, not holes. Very thin steel tracing wires are now carried from the bottom of the rear central struts to the top of the front outer ones, and also from the bottom of the front central struts to the top of the rear outer ones. They should pass round the edges of the main planes (through the silk close to the frame) just beyond the struts, and are not actually fastened to the struts themselves, but secured by twisting. At some point along each of the four wires there must be fitted a wire strainer, which may simply consist of a piece of thicker wire (about No. 18 or 20) with curled-up end, thus  (to tighten, curl up; to loosen, uncurl). Or it may be like the one shown in Fig. 10, which can be bought for a few shillings a dozen. If any of these wires comes in the way of the rubber motor, they can be pulled slightly to one side with a piece of soft iron wire, attached to a suitable part of the wires and plane frames.

THE PROPELLERS.

These should be two carved propellers of the Centrale type (Plate M, Fig. 11), 10″ in diameter and, of course, of opposite pitch. These should be purchased: propeller blanks can be bought very cheaply, from which the blades can be carved, but this calls for considerable skill and practice. The experiment should first be tried on a simple, hand-launched model, where so high a degree of efficiency is not necessary to success. As sold, the propellers will be far too heavy, and they must be sandpapered down and the inner surface of the blades given a distinct hollow or camber. The pair used by the writer weigh, with axle, rubber hook, etc., just 19 grammes the pair (28 grammes = 1 oz. approximately). In any case they should not weigh together more than $\frac{3}{4}$ oz. When buying a pair of propellers notice (1) that they balance properly, and (2) that they are of the same size and weight. To test them for balance, pass a piece of steel wire, such as a hatpin, through the hole in the boss, and see that they balance in any position; buy none which does not. Now, imperfect balance means vibration, and vibration is fatal to good results. The next thing to do is to mount them: Take a piece of steel piano wire (No. 18 gauge) about 4″ long; sharpen one end and bend the wire right round, as shown at A (Fig. 12), the bend being made about $\frac{1}{2}$″ from the end. Push the other end (the straight one) through the hole in the boss and drive home the sharpened end with a hammer; slip on a piece of very fine brass tubing, about $\frac{3}{16}$″ long, to serve as a shoulder, and enable the propeller to clear the cross-piece A B (Plate M,

Fig. 5). Next bend the straightened end into the shape of a hook, as shown in the dotted line (Fig. 12). Next slip a "collett" over the hook, concave side first, insert the hook through the hole or bearing in A and B (Fig. 5) and slip a small piece of valve tubing over the hook to protect the rubber. Due care must be taken that the wire axle is put the right way through the propeller to make it drive the air backwards when mounted; accordingly, the hooks point forward in the direction in which the machine is to fly, namely, small plane first. Remember also that the propellers revolve in opposite directions. Having mounted the propellers and put on a few strands of rubber, test each separately with some 50 to 100 turns in a room, and see that both drive the air backwards when revolving in the right and opposite directions. The convex portion is the front or foremost part of the propeller.

THE ELEVATOR.

The framework and supporting bracket for attachment to the motor rod are constructed throughout of steel wire. A plan with all dimensions marked is shown in Plate N, Fig. 1. About No. 20 gauge wire should be used. The method of construction is very similar to that of the main planes, but the ends of the wire ribs are soldered to the outer framework, the join of which is also soldered. First solder the outer framework in the form of a ring, then knock a number of small nails into a flat piece of wood of the shape and size of the plane and pull the wire ring over them. Solder on the ribs. The camber given to the ribs should be but slight.

The two ends are bent up similarly to the two main planes, and the frame is covered with fabric in precisely the same way, but the stitching in this case can be done close up to the wire framework. The manner in which the bracket holding the elevator is arranged is shown in Plate N, Fig. 2, and Fig. 8. A piece of steel piano wire (gauge 18), 5" long, is bent as in Fig. 2A; F B and K L are sewn to the leading and trailing edges of the elevator, B A K, being in a line with the central rib; another piece of wire of similar gauge, of the dimensions shown in Fig. 2B, is bent as illustrated, the portion C D being bound to the central rib, shown in Fig I. with florists' wire and soldered. The portion P O X lies along the top of the motor rod, being held in place by two pieces of copper wire twisted round it and the rod. The angle of the elevator is altered by bending O C backwards or forwards. It is usually best to bind and solder B F and K L to the wire frame before putting on the silk.

COMPLETING THE MOTOR ROD.

To complete the motor rod we must put on hooks to carry the rubber motor and winding-up gear and also the protector.

There are two ways of winding up the rubber motors. In one case each motor is wound up separately from the propeller end, the motor hook at the front being fixed and the propeller rotated. If this method be adopted then the fixed hook simply takes the form of a piece of 20-gauge steel wire bent as shown in Fig. 5, Plate N, and bound to the nose of the motor rod. A useful winder is shown in Fig. 3. In the other and, in many respects, better method both rubber motors are wound up at the same time (Frontispiece, Fig. 3), the propellers being held stationary. This method throws no undue strains on the motor rod, and is much quicker; but above a certain power the effort required is considerable, and the winder must be a good one or the cogs will rip. Plate IV, Fig. 3, shows an ordinary egg-beater converted into a double winder. It is very useful for small motors, but will not wind up a double motor each containing eight strands of $\frac{3}{16}''$ strip rubber to 1,000 turns, a more powerful one like that shown in the Frontispiece, Fig. 3, being necessary. Sometimes both methods of winding-up are used, a double egg-beater winder to begin with, finishing with a single winder from the propeller end. The manner in which the double winding is carried out from the front can be understood from Plate N, Fig. 6. The protector is merely a loop of wire, some 4" long, bent as shown in Fig. 4, and bound round the nose of the motor rod. The same binding can be used for both the motor hooks, or motor hook bearings, and the protector; it is advisable for the latter to be soldered to a tin cap (fitting over the nose) as well.

THE RUBBER MOTORS.

To get the most satisfactory results particular attention must be paid to the rubber motor. Only the very best rubber is of any use for model aeroplane work ; the rubber must be new—last year's stuff is not worth having. Procure a sample and test whether a piece will stretch to at least seven times its own length without fracture, and if it will not stand this test do not buy it ; make this a condition of purchase. After you have been flying your model, never leave the rubber on the machine. It should be kept in an airtight tin in a cool place. It is best to use strip rubber and not that of square section, $\frac{1}{4}''$ strip being the best for general use. Six strands to each propeller should suffice to fly the model we are considering, but you may require seven or even eight ; begin with six and if this be insufficient, increase it. The more rubber you are compelled to use, the more inefficient your model.

Do not tie knots in the rubber ; when you want either to join rubber or tie loops in it, let the ends overlap for about an inch and get someone to hold the rubber between the finger and thumb of both hands and pull the double layer hard ; then you must tie in the middle with a piece of strong thread whilst it is stretched hard. Do this before the rubber is lubricated, as it is almost impossible to do it afterwards without washing the rubber. The length of the strands should be such that you have to stretch them about $\frac{1}{2}''$ to get them over the hooks. Each of the steel hooks must be covered with a short piece of rubber valve tubing. The normal stretch on the rubber should make it just taut ; no more. Take care that every strand, as far as possible, is stretched to the same extent, and always have exactly the same amount of rubber on both motors. When adding a single strand, make a loop in both ends, pulled and tied with thread as described above.

LUBRICATING THE RUBBER.

You would naturally think that lubricating the rubber meant oiling or greasing it. On the contrary, no oil, grease, vaseline, petrol, ether, benzoline, etc., must be allowed to come in contact with it. Castor oil, however, is said not to injure it. Pure glycerine, soft soap and soda (or salicylic acid) make a good lubricant, in the proportion of 3 or 4 oz. of water, 1 oz. of glycerine, ½ oz. of soft soap, and ½ oz. of common washing soda. Mix well and boil for some time, then allow the mixture to cool and place it for a day or two in a well-corked bottle. If it solidifies like thick treacle, it is too thick and a little more water must be added and the mixture reboiled. To get the best results the lubricant must be fairly liquid. On no account filter or strain the mixture, and always shake well before using. Apply it with a brush or with the fingers, rubbing it well in when the rubber is new.

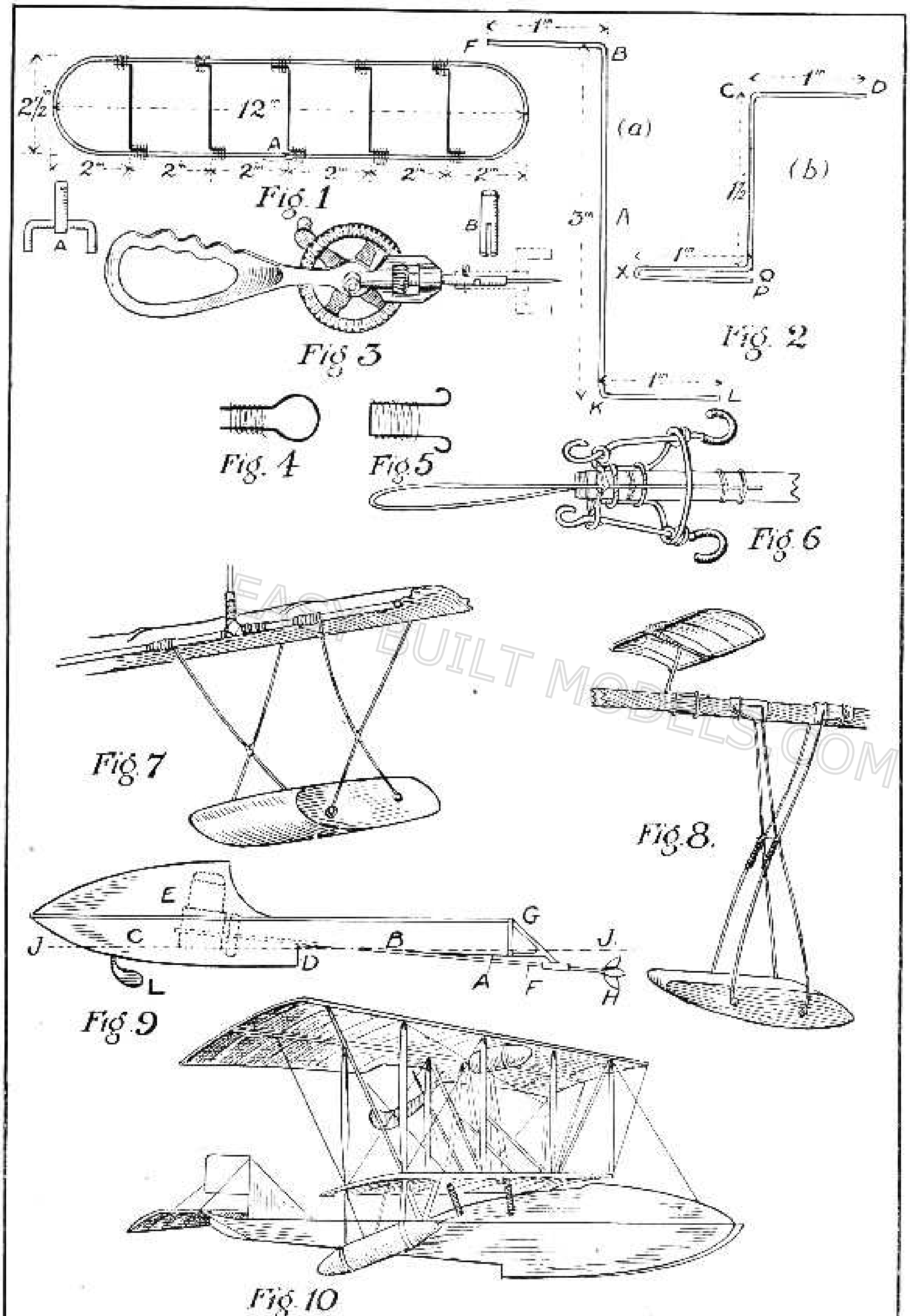
Lubricating the rubber doubles or even trebles the results you can derive from it. The motors on the machine described, if well lubricated, can be given 1,000 turns, but generally 600 or 700 should be the limit, or the rubber will soon be done for. Flight durations of thirty to forty seconds at least should be obtained.

Before putting the rubber away for a time wash it in warm soda and water.

TUNING UP—FLYING THE MODEL.

The exact position of the elevator and main plane along the motor rod must be determined by experiments, but to begin with, place the elevator 1" from the nose of the motor rod and the main planes in such a position that the centre of gravity of the whole machine (rubber included) comes very slightly behind the leading edge of the top plane. In other words, the machine, if the finger be placed underneath the motor rod, at a point just behind a vertical line through the leading edge of the top plane, balances about that point, both laterally and longitudinally. Take care that both the elevator and main planes are horizontal and parallel to one another, that the bracing wires are taut, and the main planes free from all twist or warp. Try the machine first on a calm day. I have omitted to state that the main planes must be fixed to the motor rod in such a manner that the leading edge is very slightly lower than the trailing one, that is to say, the planes have a very slight negative angle of incidence, when the motor rod is horizontal. The elevator must have

Plate N. MODEL SEAPLANE.



1. Plan of elevator. 2. (a) and (b) Fixing bracket for elevator (OX and PX are in a horizontal plane and are shown as in diagram for clearness). 3. Winder and drill. 4. Protector. 5. Fixed rubber hook. 6. Twin winding gear and protector. 7. How rear floats are attached to lower main plane. 8. Wire struts for front float, elevator and wire bracket. 9. Hydroplane fitted with a joggle or step; E, engine; F, marine propeller shaft; H, propeller; G, bracket supporting propeller shaft; J, line of designed flotation when model is on the water; D, juggle or step; L, rudder; C B, hull. 10. Elevation of Flying Boat.

a positive angle of incidence, *i.e.*, its leading edge must be higher than its trailing one. The machine is strong enough to fly from a small pond and come to earth without damage. Avoid a pond with trees round it or near it, because the model, if well made, will fly high. Begin by gliding the model over land, a lawn or grass field being best. Choose a sheltered spot and, grasping the motor-rod lightly well forward with the thumb and first finger of the left hand and the centre of the crosspiece behind, with the thumb and fingers of the right hand launch it forwards and slightly downwards. On no account launch it up into the air. The left hand should be released momentarily before the right and drawn sharply down. If the model soar into the air and then the nose dive, the model is over-elevated, *i.e.*, the angle at which the elevator is set must be reduced. If the model dig its nose straightway into the ground, the angle of incidence must be increased; it may also be necessary to alter the position of the main planes along the motor-rod. When good steady glides have been secured, the model may be tried in free flight. Wind up both motors to about 500 turns and launch the model as before. If it switchback soaring up and down, it is over-elevated; if it come nose first to the ground, it is under-elevated.

To fly the model off water, wind up 600 times, place the model gently on the surface (taking care not to dip the floats right under) and just release the propellers, the model being held in both hands by the crosspiece and propellers. Launch it facing the breeze; it should rise quickly, but if it does not, slightly increase the angle of the floats. If the flight is low and not of very long duration, it shows you are under-powered and you must put on more rubber, one strand on each motor. Do not push the model off nor dab the floats on the water. Against a good breeze it should quit the water within a few feet. If it upsets be very careful how you pull it out of the water. Always take with you a reel of strong thread with a weight tied securely at one end, and throw it over the model and haul it gently in.

When you go model-flying provide yourself with a small repair outfit, such as wire, thread, mendine, a piece of tube, wire cutters, a little varnish, a small brush, a small screwdriver, and a needle and cotton, etc.