

AERO MODELLER

MARCH
Vol. IV
Monthly

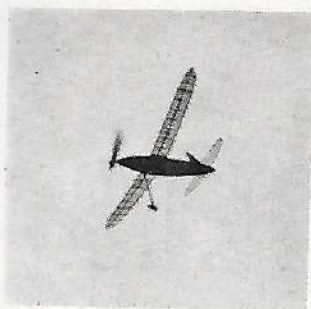
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Full Size **SCALE PLANS** of the 'SPARROWHAWK'
● A 31 inch **SPAN DURATION' PLANE**

Designed by J. Van Hattum



"THE SPARROWHAWK"

Balsa	$\frac{1}{4}$ in. square	3 ft. long	5 off
"	$\frac{1}{4}$ in. \times $\frac{1}{8}$ in.	"	2 "
"	2 in. \times $\frac{1}{8}$ in.	1 ft. long	1 "
"	2 in. \times $\frac{1}{16}$ in.	3 ft. long	1 "
"	12 in. \times $1\frac{1}{2}$ in. \times $1\frac{1}{8}$ in.	Aircscrew	1 "
Block	$1\frac{1}{2}$ in. \times 2 in. \times $\frac{3}{4}$ in.		
Three-ply	$\frac{1}{8}$ in.	4 in. \times 4 in.	1 "
"	$\frac{1}{16}$ in.	4 in. \times 4 in.	1 "
Bamboo	approx. $\frac{1}{2}$ in. wide	12 in. long	3 "
Jap. tissue	White or coloured	—	2 sheets
Rubber	Motor: 10 strands		
	$\frac{1}{16}$ in.	7 yd.	—
Piano wire	16 gauge	5 in.	1 off
" "	18 gauge	12 in.	1 "

Sundries: Cellulose glue, mounting paste, razor blades, laundry clips, sandpaper (0 and 00), dope, thread, paper, ruler and pencil—also indiarubber!—and strong table to work on.

Begin by carefully studying the drawings, until you are sure that every detail is quite clear. Read the text through a couple of times, referring to the drawings, and get familiar with the sequence and methods of construction. Many a good job has been spoilt because someone started right off without studying the plans. Also see to it that all materials are on hand and all the tools complete before building is started; there is nothing so annoying than having to hold up a job that is shaping well just because one forgot to get an important piece of material.

The Fuselage.

Pin the plan on a flat board. Take two of the $\frac{1}{4}$ in. square balsa spars, place them along the upper and lower curve of the fuselage side, and cut them approximately to the right length. The illustration shows how the assembly is done by means of small blocks of scrap wood, pinned or nailed to the board. Start by putting in just a few, and adding on where needed. It doesn't require many. Next, place small bits of greaseproof paper under all the places where the struts will have to be glued to the longerons. This prevents the joints becoming stuck to the wood. Now, when the longerons follow the side view perfectly, you can start cutting the vertical struts and fitting them in place. First try the fit and cut the struts a little too large. Never pass one which is too small and does not take up a sliding fit, nor one that is too long and forces the longerons apart. When the struts are ready, dip the ends in cellulose glue and drop a little glue on the longeron as well. Fit the strut in place and leave undisturbed to dry. (A better method, but it takes more time: cover the ends of the struts and the longeron with a thin film of glue and leave to dry. When dry apply glue once more and fit the strut in place. This gives a better joint.) When all the struts have been put in their proper places, cut the nose and tail pieces from $\frac{1}{8}$ in. balsa sheet. Note that the grain runs vertically. This is not sound from a carpenter's point of view, as one should never glue grains at right angles. However, if the grain ran horizontally the wood would split after a bad shock. And balsa absorbs so much glue that we are justified in adopting this method.

When one side is finished, leave it to dry thoroughly. Some glues dry more quickly than others, but all like to be given time. Therefore a few hours' rest is advisable. (Meanwhile one can start on the ribs). When making the second side, take great care to get it exactly

like the first, or the fuselage will be twisted. Now for the assembly.

Take the two sides and run a little glue on the four corners of the bulkheads 4 and 5, as well as on the four horizontal struts, which have been measured up from the plan-view. Leave to dry, and then glue the struts all on one side. They will tend to fall over, but one should just hold them more or less vertical until the glue has set and become tough. Then apply glue to the four remaining ends, and the corresponding point so on the other side. Again hold the job in place. When the glue has set so that there is no more danger of the struts becoming detached, place the fuselage in the normal position on the board and start trueing up. Place a drawing office set-square against the sides to see that they stand perfectly vertically. Also check the plan to see that one side is not ahead of the other. Next stretch a couple of elastic bands over the sides, fastened to the board by means of pins. This will hold the sides in place. Do not tighten the bands too much or they will cause the whole job to collapse. Don't force—persuade.

After the sides have been thus connected, fit the struts of the other bulkheads, upper and lower at the same time. Measure the length from the plan view. Finally, fit the balsa nose and tail pieces. Now look carefully along the fuselage to see if it is straight. If the job has been carried out properly, all the struts should be parallel. In the case where it is badly twisted, the only thing to do is to cut out the offending strut or struts and correct the misake by refitting them properly.

The Wing.

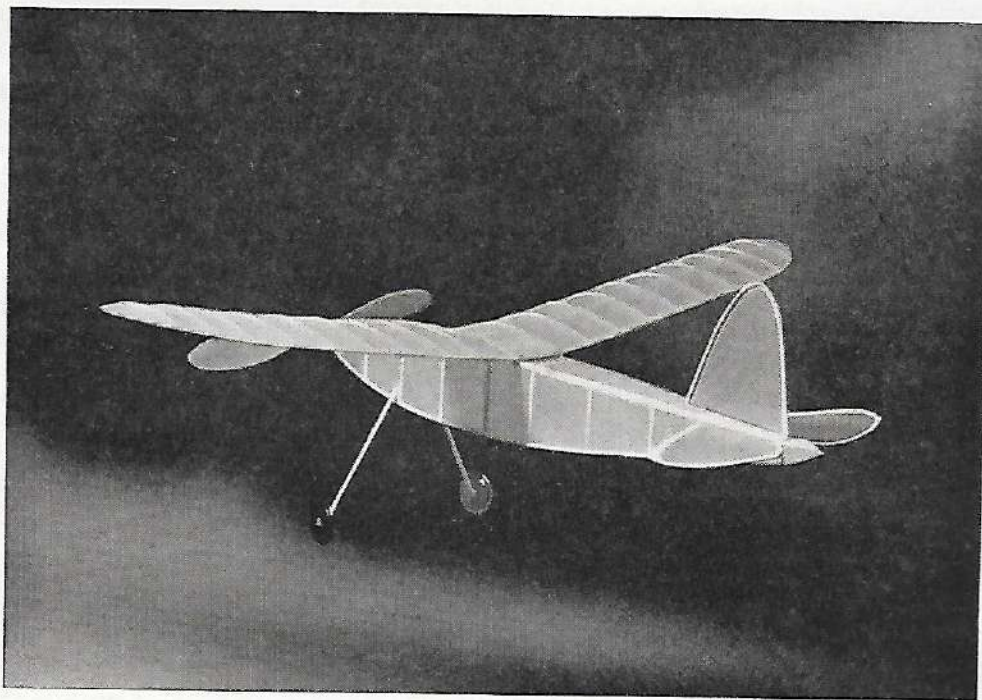
Begin by making two templates of $\frac{1}{16}$ in. three-ply and of the form shown for the ribs 1—7. Take care over this job, as the shape of the actual ribs will depend upon the accuracy with which this is done. Cut out the templates and finish with sandpaper. Then trace twelve ribs on the $\frac{1}{16}$ in. balsa, grouping them in such a way that the material is used most efficiently. Two ribs are made of $\frac{1}{8}$ in. balsa. Cut out the ribs, taking care to keep beyond the outline. Finish the lower surface straight by means of sandpaper and clamp them together, the two templates on the outside. By stretching a strip of sandpaper over a block of wood and nailing it to the sides we can make a very useful tool for sanding down flat surfaces. With this the curved upper surface of the ribs is brought to exact similarity to the template. Before the ribs are taken apart we mark the place where the

(Continued on page 249).

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INSTRUCTIONS FOR BUILDING THE "SPARROWHAWK"

main spar is to be placed, and where we shall have to cut a slot. This slot is made by carefully "sawing" into the wood with a razor blade and picking out the small rectangle with the tip of an ordinary penknife. The slots in the ribs must be of such a size that the spar fits just nicely. It must not be too large, so that the ribs sit loosely on the spar, nor must it be necessary to force the spar in the slot. Therefore cut the slot a shade too small and increase the width by sandpapering or slicing off thin strips, after fitting on a sample length of spar. When all these fourteen ribs are ready (and no not forget that two of them are $\frac{1}{8}$ in. thick—see drawing!) make the ribs Nos. 8, 9 and 10. It is unnecessary to make templates for these, as only two of each are needed. Draw them carefully on paper and transfer this to the balsa sheet by means of carbon paper. Note the attitude of the ribs. They are placed at a twist towards the tip of the wing, and this twist must not be neglected.

Now we take the $\frac{1}{4}$ in. \times $\frac{1}{8}$ in. spar. This is longer than necessary, so we measure off about 32 in. and cut this length in halves. First we must make the centre, which incorporates the dihedral. From the lower surface of the spar we cut off a small triangle, so that when the spar rests on the base of this triangle the outer portions are swept up at a slope of one in seven. To joint the two halves we glue a triangular piece of balsa on top and thin strips against the sides. Take great care to get the right dihedral of one in seven, and check to see that both sides are the same. Next take the sandpaper block and carefully taper the spar so that the height is gradually reduced from $\frac{1}{4}$ in. at rib 1 to $\frac{1}{8}$ in. at rib in the tip. This saves some weight, and, moreover, it is logical, as the spar need not be of the same strength at the tip as at the centre.

Spar and ribs being ready, we now fit the ribs temporarily, to see if the front and rear ends run parallel. Do not glue yet. Place a straight-edge or good ruler along the noses and tails of the ribs. If some do not toe the line there must be a mistake somewhere. Either some ribs are too short or all the others too long; or the spar may be slightly bent in plan view. Correct these faults and glue the ribs in place. Take one of the remaining $\frac{1}{8}$ in. square spars and sand it to a half-round section, as shown in the sketches. Cut off the noses of the ribs and obtain the proper dihedral in the leading edge by gently bending it in steam. Then cover all the places marked for the ribs with glue; also the noses of the ribs. Leave to dry and apply glue again. Place the leading edge in position, holding it there by means of rubber bands. The same applies to the trailing edge. Take care to get the right triangular section, with a sharp edge. The next job is to make the tip outlines. Split the bamboo in halves, and repeat this until you have two thin spars about $\frac{3}{32}$ in. square, or a little more. As we shall make the tail surfaces in the same way, it is best to manufacture a small store of these, say six or seven, to allow for breakages. Place the small spar flat and start scraping it with a razor blade or piece of broken glass. Do this carefully, otherwise the wood will break. After reducing the section to about $\frac{1}{16}$ in. round, it is finished with fine sandpaper. Now bend it very gently in steam, holding it with the hands and not with pliers, as these crunch the wood. Take time over this job, and follow the exact curve given in the drawing. It is particularly important that both tips shall be exactly the

same shape. The same applies to the tail-plane. See to it that the tip is well connected to the leading edge, main-spar and trailing edge. The wing skeleton is now finished, and all we have to do is to bend four hooks of 18 gauge piano wire, to be glued against the inside of the centre ribs, as shown.

The Tail Surfaces.

We already know how to make the bamboo framework. After they have been bent in steam, point the ends and press them lightly into the wood at the places indicated on the drawing. Note the fact that the tail-plane makes a negative angle with the horizontal datum, in the sense that the leading edge is placed lower than the trailing edge. Glue the ends well, so that the tail surfaces are strongly connected to the fuselage.

The Nose and Tail-Pieces.

These are fully explained in the sketches. Take care to have the airscrew shaft running lightly. A length of brass tube, well glued in the nose-piece, serves as a bearing. The loop which is to take the airscrew drive must be well soldered to the shaft. The motor hook on the tail-piece must not be able to turn, and the short prong must therefore be well soldered to the wire and bedded into the three-ply as shown. In this connection one should check the offset at the front end of the fuselage, which is given in the side-view. The nose-piece must be placed so that the shaft points downward at a slight angle.

The Undercarriage.

This consists of two cantilever bamboo legs which slide in paper tubes glued to the fuselage. The sketches show clearly how bulkhead No. 3 is made to take the tubes, while two short $\frac{1}{8}$ in. square struts carry the landing loads to the lower corners of bulkhead No. 2. First make the bamboo legs. Again we cut a length of bamboo and scrape it down until we obtain approximately the right section, after which we continue with sandpaper. Next cut a strip of ordinary writing paper and wrap it one-and-a-half times round the top of the leg. Cover about two inches with mounting paste and wrap this carefully round the top. Do not use too much paste, as this will run out of the seams and the tube will get stuck to the leg. After the paper has been given plenty of time to dry, remove the tube, to see if it is not in any way defective. Always keep tube and leg together, and do not interchange. Slide the tube on again and cover the outside well with cellulose glue and leave to dry. Also apply glue to the bulkhead where the tube will be fitted. Next cover tube and bulkhead well with glue and place the former in position so that it rests against the lower longeron while the lower ends of the legs are about 8 in. apart. The distance between the tops of the tubes, 2 in., serves as a check. Hold the tubes in place by means of laundry clips. Do not touch or remove legs until the tubes are thoroughly fixed to the fuselage.

The wheels and axles need little explanation. The wheels are kept in place either by gluing on a couple of cup-washers or merely a little blob of glue. In the latter case just glue the wheel on to axle and when dry cut it free. See to it that the axle cannot swivel on the leg.

(Continued on page 251).

INSTRUCTIONS FOR BUILDING THE "SPARROWHAWK"

The Airscrew.

Carving an airscrew is not an easy job, and the whole process cannot be explained in this description. The best method is to cut the block first according to the plan view, then shape the side view, after which one cuts away the superfluous wood, keeping strictly to the sections and angles shown. If this is the first effort, however, it may be wiser to obtain a ready-made airscrew from a good store. The diameter is 12 in. and the pitch 18 in. Material: Hard or medium balsa.

Covering the Model.

This is not a very easy job, but with care it can be carried out satisfactorily. We begin with the fuselage. Cut two strips for the sides, having a width about $1\frac{1}{2}$ in. greater than the greatest height of the fuselage. Take the length in the direction of the strong grain in the paper. Fasten one end of the strip to the nose by means of dope, cellulose glue or mounting paste. The latter is recommended because it is possible to remove the covering more easily in case the job turns out badly or the model must be re-covered later. Leave to dry and then fix strip to the rear of the fuselage, stretching well. After drying, apply paste or glue to the sides and wrap the paper round the longerons, stretching lightly. After every side is covered it should be doped. During the doping the paper will become wrinkled and loose and the job may look like a failure. Leave it to dry, however, and it will finish up taut. Two coats of acetate dope are given to the fuselage.

We cover the lower halves of the wing first. Attach the covering to the inside of the centre ribs. When dry, pull and attach the paper to the tip where it meets the main-spar. Then work round the tip, still stretching but gradually less so as one approaches rib 10. Cut the paper so that it overlaps the leading and trailing edges by about $\frac{1}{4}$ in., and, stretching slightly, wrap it round these. The top is covered in very much the same way, but the covering must be serrated to follow the curve of the rib inner ribs (see sketch). Apply dope to each lower and upper half after covering. Cover the centre-section with separate pieces of paper. While the dope on the right-hand half of the wing is still wet, twist the framework so that the trailing edge is raised $\frac{1}{8}$ in. Hold in position until dry.

Covering the tail-surfaces is fully explained in the appropriate drawing. Do not tighten the covering along the chord, as this will deform the shape of the outlines. The paper must not be doped, as it would tighten too much in the heat. It must be damped slightly and allowed to dry, when it will tighten sufficiently. The drawback of this method is that the covering will not stand rain. However, flying in rain is no fun at the best of times.

The Motor.

The motor consists of ten strands $\frac{1}{8}$ in. wide elastic of a total length of 18 ft. (six yards). The length of the motor is therefore 4 in. longer than the distance between the hooks. This motor will take 550 turns

safely, when stretched during winding. If, however, one stretches the rubber to five times the normal length, the number of safe turns can be increased to 650. As this is a simple model, no rubber-tensioning device is incorporated, but the maker can adopt any existing system which has proved reliable. In that case the motor can be arranged in eight strands, which gives us a maximum number of turns—fully stretched—of 750. "Entwining" or "plaiting" the motor is a good method. The weight of the model without motor is 1.65 oz. The motor weighs 0.65 oz. Total weight, 2.3 oz.

Area, 0.725 sq. ft. Loading, 3.2 oz./sq. ft.

Flying the Model.

Full details about testing a model can be found in the various articles which have appeared in this paper. In this particular case we first check over the model thoroughly and correct any faults, particularly those which affect the alignment. Check rigging angle, dihedral, rigging angle of tail-plane, fin and down-thrust, and position of centre of gravity. Lubricate motor and fix wing to fuselage by means of strong rubber bands. Also fix nose-piece so that it will not drop out during flight. Test the model from the ground on about 150 turns. It should run along and just life into the air. If it fails to rise, give the motor more turns. If it still does not rise, bend up the trailing edge of the tail-plane. It is assumed that the wing is placed in the right position with regard to the centre of gravity. If, however, the angle of the tail-plane conforms to that given in the drawing, we must move the wing forward about $\frac{1}{4}$ in. If this does not improve matters, move it forward again, until the model takes off properly.

It is also possible that the model climbs too steeply after the start, drops the nose and dives back to the ground. In that case bend the trailing edge of the tail-plane down a little, but see to it that it still has a negative rigging angle. If the model still "stalls," move the wing back about $\frac{1}{8}$ in., and so on until it flies without following an undulating path. Now give the motor about 200 turns and try again. Possibly one of these difficulties will crop up again. Correct them and increase the number of turns. It will now be noticed that the model shows a tendency to turn to the left. This is caused by the turning couple of the airscrew and can be corrected—as we have done—by decreasing the angle of incidence of the starboard wing. If the model turns away too steeply after the start on full turns, this twist should be slightly increased. Do not use too much washout, however, as it will affect the glide.

Now we must turn our attention to the glide. Possibly the climb and power flight are perfect, but the glide is either too steep or stalled. If the glide is too steep we must either shift the wing forward or bend up the trailing edge. But in order to keep the good characteristics when the motor is running we must slightly increase the down-thrust of the airscrew. Inversely, when the model undulates in the glide the wing must be pushed back, or the trailing edge of the tail-plane depressed, while the down-thrust must be decreased.

Before building this model, study the plan very carefully, and also read the announcement on page 227