BEING ABLE to carve a good propeller is what makes a 'rubber modeller' and you will need a good assembly to let it work properly. Ready-made fully machined propeller assemblies are commercially available...far better make it yourself and take a pride in it's successful construction!

No special tools are necessary to make a propeller, it can all be done with a sharp knife and sandpaper. The first thing is to choose a block of wood. For an Open Rubber model this is preferably as light as you can find. It is often cheaper to buy the 12in. long off-cuts found for sale in most model shops. You may find one of large enough cross-section to make the whole propeller, otherwise, buy two, this is better than buying an 18in. length as the grain of the wood can often be arranged more usefully if two pieces are joined together.

Normally a block of balsa will not be of consistent density across its section and you will have one soft trailing edge and one soft leading edge which makes the propeller impossible to balance and worse, causes unequal flexing in the two blades. By joining two pieces together, the densities can be balanced out to give similar blades (Fig. 1).

This arrangement will give more evenly matched blades and using the harder wood at the trailing edge will stiffen the thinner part of the blade section and reduce the weight of the thicker leading edge.

If using two pieces of block, they should be assembled as in Fig. 2. Having got a block, mark it out as shown on the plan. Take care with the marking out as the accuracy of the propeller depends on it. I like to use a fine ball-pen for marking and when carving is complete, the lines should still be visible, thus confirming accuracy.

Carve out the marked block shape and then start forming the blades by carving away the back of the block (Fig. 3). Carve blades only to within about 1½in. of the middle of the propeller at this stage. Carve the underside of the blades flat and use coarse sandpaper in a circular motion to reduce the bumps and form a little under-camber. Now curve away the top leaving the blades about ½in. thick and you should now have something beginning to look like a propeller (Fig. 4).

The next thing to do is make a template for the propeller blade sections. The pattern shown on the plan enables all parts of the blade to be checked (Fig. 5). Now make a pattern for the propeller blades and being very careful to get it in the same position on each side, mark the outline of the blade shape on the back of the block (Fig. 6), the blades may now be carved to shape. Using the template, the underside of the blades are sanded to their final shape (Fig. 7). Use the template frequently until the

The final steps to getting this novice's Open Rubber model into the air — explained in detail by Bob Wells

Part 2

BO-JESS

Aeromodeller
The propeller blades should now rest on the triangles. It may be found that the leading edge of one blade does not touch and the trailing edge of the other is clear of the triangle or both trailing edges clear, then something is wrong. Either the block was the wrong size, the marking out incorrect, the triangles have the wrong angle, or the triangles are at the wrong distance from the centre. If on checking you find that it was one or both of the first two then there is nothing you can do about it! It means that you now have a propeller of different pitch to that intended. Make fresh triangles until they fit the propeller and then find out what pitch you have carved. The calculation is easy (Fig. 11). If the pitch is between 28 and 34 inches then it will be suitable, if not ideal. Outside these limits, it is too small or too large.

Having got the propeller to sit nicely on the jig you can now glue the brass tube in position. Use epoxy and if you have had to make the hole a bit big, use pieces of balsa or dust as a filler. Put it all back on the jig until dry, then file the brass tube flush with theply facings. Now you can finish the blades. Blend the underneath into the hub, not making the blades too thin near the middle, when satisfied with the back of the blades, finish the top.

Mark the radius at 1 in. intervals along the blades, beat done with very soft pencil on the back of the blades (Fig. 12). Now using the section template frequently, carve and sand the tops of the blades until the template fits at every point (Fig. 13). Leave the leading edge about $\frac{1}{16}$ in. thick and the trailing edge about $\frac{1}{32}$ in. at this stage.

When the template fits the blades at every station, you have done all you can to shape the propeller. Use flour paper to finish sanding smooth and round off the leading edges. Give the whole propeller two coats of thickish dope, 60% dope, 40% thinners, and then tissue cover. This is most easily done with lightweight Modelspan using dope as the adhesive. Cut out four pieces of tissue. Cover the back of the blades first. Lay the tissue on the blade and give a very generous coat of dope all over, then 'mould' the tissue onto the blade (use fingers - messy but effective). If it does not adhere first go, apply more dope and work in with fingers until it does. While working the tissue onto the blade, turn the overlap over the edges (Fig. 14). When the dope is dry, trim off the surplus leaving the tissue stuck on the leading and trailing edges. Cover the tops of the blades similarly so that the tissue finishes overlapping and double covers the edges.

The propeller then only needs a couple of coats of 30/70 dope/thinners to finish. A check can now be made on the static balance. Hold a piece of wire horizontally, slip the propeller on it and give it a spin. When the propeller comes to a halt, it should do so gradually without running back. It does not necessarily stop horizontally, but if one blade runs back and settles at the bottom, it is obviously heavier. Try giving the lighter blade a few more coats of dope. If this will not balance the propeller then don't worry, it is not that important unless the blades are wildly different, which is unlikely.

**Propeller Assembly**

There are many ways of making a free-wheeling propeller assembly. The one shown on the plan is neat, reliable and does not rely on soldering to make it work. The soldering shown on the assembly for the motor is necessary to prevent the hook on the motor 'climbing' up the shaft, if you can't get on with soldering, thread binding and epoxy may be substituted.

The most usual fault on a freewheeling assembly is that when the motor is run down, the tensioning turns are such as to pull the shaft back and jam the propeller against the turned over end of the shaft. This prevents the propeller freewheeling on
the shaft as it tends to turn the shaft and wind-up the motor backwards. This does for a while but the motor soon becomes too tight and everything stops, followed by the model diving into the ground!

This is usually overcome by soldering a washer to the shaft between the propeller and the thrust bearing (Fig. 15) so that no matter how hard the motor hook is pulled back, the propeller always has a little movement backwards and forwards on the shaft. The soldering of this washer must be very good, as it takes quite a force. It must be done as the shaft is being bent. This either means bending the propeller end of the shaft over last or that the pliers are inserted at 'A', an undesirable gap will result. Alternatively this end can be bent first which means bending the motor hook last with the noseblock in place. This usually results in either a long length of shaft extending behind the noseblock or damaging the noseblock as you try and bend the hook close to it.

On the assembly shown on the plan, a brass wheel collet (sold in most model shops) is used instead of the soldered washer. This means that the motor hook can be bent first, the shaft inserted through the noseblock, the thrust race, brass collet and propeller slipped onto the shaft in that order, then the end of the shaft bent over. With the collet screw loose, the shaft can be pulled forward as far as it will go, the end bent over and then the shaft pushed back. The collet position can then be adjusted and the screw tightened.

You now have a working propeller assembly. Points worth noting are to leave the noseblock rough until all the wire bending is finished, then shape and sand it. Make the nose plug last after everything else is finished. It is nice if the shaft is straight through the noseblock, but it doesn’t matter if it is not. The model will certainly want some side or down-thrust during trimming so if the shaft is obviously not straight, make sure that you position the assembly on the model so that the shaft points to the right or downwards.

When you have got it all right way round, mark the nose assembly in some way so that you can’t put it in the wrong way round. I print 'TOP' on mine in large letters. Alternatively cut a corner off the nose plug and glue it inside the nose of the model. (Fig. 16).

The freewheel clutch shown is again simple, the only point worth making is that it is easier to make the tube/wire assembly before fixing to the propeller. If one blade is still lighter than the other, fix it to the light one!

The propeller is taken off the rubber motor for winding so it is necessary to make another hook for the rubber motor. That shown on the plan is the one I have been using for years. The rubber motor end is in the shape of an 'S' (a backward 'S'), the other end fits on the winder and when wound, on the propeller assembly. The 'S' hook is the best way found so far of preventing a wound motor from creeping round the shaft. The next best is a bobbin or even two bobbins.

If you try bending the hook shown, make sure it is bent exactly as shown or else it will all spring open in use. The main point to watch is that the ring in front will fit both the propeller assembly hook and your winder hook. It should fit the propeller assembly snugly, but don’t make it too small for the winder! (I use a 12swg hook on the winder).

If you have not tried it before, you may have difficulty getting the neoprene tube on the hook. If you do, don’t be tempted to try thin rubber tubing; it wears through too quickly. The trick is to hold the hook in a vice by the winding loop, smear all the wire with soap and keep the neoprene softened with a match flame. Not enough to turn it black and melt it, just enough to soften it; it will go on fairly easily.

If you don’t get on with bending the hook try an alternative (Fig. 17). If you have now arrived at a suitable hook, just need a motor peg and rubber motor. Use a decent size of motor peg, 3/16 in. or 1/4 in. diameter thick walled aluminium tube or rod is about right and have it long enough to extend about 1/8 in. each side of the fuselage.

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When it is the right length, put it in the model, wind on about 100 turns, hook on the propeller, make sure the freewheel clutch is engaged and let it unwind. When the propeller stops the motor should be tight enough so that the noseblock is held positively in place yet the propeller can knock out of place on landing to prevent it being broken. Test this by knocking the end of one propeller blade, gently at first, and see if the noseblock goes out of the fuselage. It should do. If not, remove the motor with less tensioning turns. When happy with the motor, put the wings and tail on and see where the model balances. Anywhere between 3/4 in. and 4 in. back from the wing leading edge will be satisfactory. If the balance point is outside these limits, either the propeller or the tailplane must be excessively overweight. Short of replacing the offending unit with a new one, the only thing to do is add ballast at tail or in the noseblock, wherever appropriate.

Having got the balance point right and made sure that the motor and tail line-up both on plan view and from the front you are now ready to start test flying.

Hold into wind and make sure the propeller freewheels smoothly; the slightest breeze should turn it. Hand-gliding with a freewheel propeller will always seem a bit strange but try to pretend the propeller isn’t there. Get the model to glide smoothly with a slight turn to the right adding packing under (Continued on page 253)
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the tail for the glide and add a trim-tab to the fin to get the right turn if necessary. Built as shown, both our models so far have needed about an ⅛ in. packing under the tailplane trailing edge and quite a large trim tab.

When adding packing under the tail, make sure that the tailplane still locates properly. If you need as much as an ⅛ in. packing, it will be necessary to shape it exactly as the top of the fuselage. (Fig. 19). The trim tab should be braced to the fin so that it never moves. Make the trim tab fairly large, high enough to cover two ribs and about ½ in. wide (Fig. 20), set it at 45°. If adjustment is needed, reduce or increase the size of the tab. The glide can only be seen from about 50 feet up, so wind on about 100 or 150 turns, put in about ½ in. right thrust (left side of noseblock) and launch the model gently. If it stalls under power, keep adding side-thrust until it doesn’t. If it turns too tight to the right remove the side-thrust. Stay with low turns until you have got it to climb until the motor runs out and can see the glide properly. The glide should complete a circle in about 20-30 seconds and obviously be flattish. Adjust the trim tab size to get the right circle and alter the packing under the tail as necessary to get the glide flat.

When happy with the glide try a bit more power, work up in stages of about 100 turns and at each stage check any power stall with more side-thrust. At about 400 turns, the model should start to climb fairly fast and steep. If at this stage the model stalls under power, it may be that some down-thrust is needed. If the climb circle is quite tight and the model stalls because it is trying to go too vertical then try down-thrust. If the model seems to be ‘leaning’ left when it stalls continue with more side-thrust. Should the model tend to start off in a good climb then suddenly dip the right wing and swoop low, you probably need more washout on the left tip.

Try again with the same number of turns but immediately before launching twist some washout into the tip — quite viciously so the tissue crinkles. If this cures the trouble, the warp will need to be steamed in. Do not try to do this on the field, take it home and do it. However, carry on trimming, just remember to twist the warp in before launching each time! While trimming the climb, keep an eye on the glide. A freewheeling propeller can affect the glide trim if a lot of side-thrust is used, so the glide turn may change as trimming proceeds.

At about 800 turns, the motor run should be about 75 seconds. If less then try a less powerful motor but if more than this and the model climbs steadily you could be onto a winner . . .