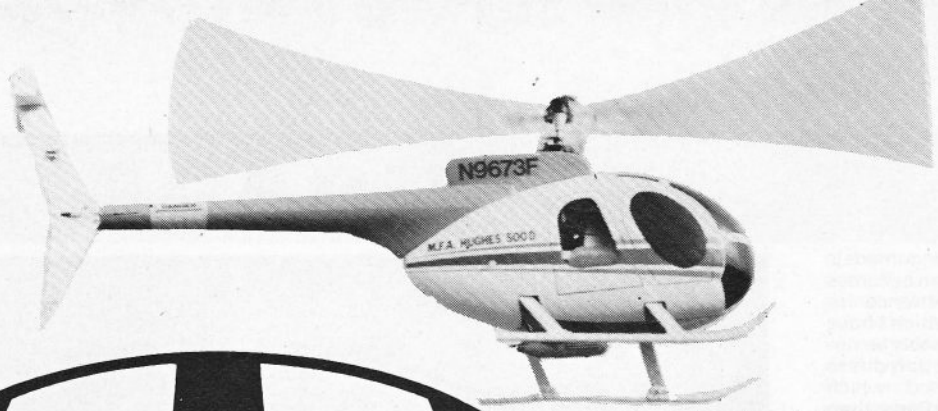



# HELI-PAD

*by John Heaton*

BLADE TOPICS can be split into several categories; their construction and section, covering or finish, retention to the rotor head and balancing. Many newcomers are worried by the dangerous looking piece of machinery that flails around on top of a chopper and perhaps imagine that some sort of special materials or techniques are required to assemble and operate this element of the model successfully. To dispel some of these fears that may be discouraging potential helicopter enthusiasts I thought that this month a return to basics might be appreciated.

## Construction

Most blades these days are of a fairly standard laminated construction, hardwood for the front of the blade and lighter wood for the trailing edge, the whole blade being machined to the proper uniform aerofoil shape after the woods were joined. In the beginning, all blades had trailing edges made of balsa wood to coax the C of G of the blade towards the centre of the pressure or point where the greatest lift is found, at which the feathering hinge (collective pitch pivot) is usually placed, chordwise that is **(Figs. 1 and 2)**. Recently quite a few manufacturers are using a hardwood trailing edge, giving a less than ideal C of G placement, but absolutely no problems in service. It gives the machine a steadier feel, probably because the overall blade is heavier, masking the bit of blade instability caused by a mismatched blade C of G and centre of pressure. The larger the blades the more important the alignment of centres becomes. Small light machines, i.e. the *Zenith* and *Baron 20,* are perfectly OK with solid blades, the blade stiffness resisting blade torsional loads.

If you try the same thing on a large machine, as I did on a *Jet Ranger* many years ago, the wildly flailing tip path has to be seen to be believed.

An aerofoil's centre of lift moves with the changing angle of attack. This move is smaller with symmetrical section blades than with lifting section blades and this is the reason why full size craft have symmetrical section blades. Their lifting efficiency is very poor but on the merit side they are not feeding large forces down the linkages, which with a manually controlled system, i.e. no hydraulic assistance, would probably snatch the stick from the pilot's hands. With our models of course we have very strong power controls in the form of comparatively huge servos. Recently full size designs are beginning to incorporate more efficient blade sections (probably after having studied our models). Overall weight of the blades is not important, all commercial blades are roughly comparable in weight. This only applies to the normal system that employs a flybar to stabilise and slow down response.

With a flybar-less system the blade tips have to be weighted to increase the gyroscopic stability; the heavier the weight the better the characteristics. It is however, dangerous ground, obviously a model with ½lb. of lead in each blade tip is many times more dangerous than one with a standard wooden items. A small amount of tip weight, say one or two ounces, can be helpful with a flybar system, you get steadier flying and better autorotation. With any weighted system, however, it is very important to fly at low rpm for safety.

I believe there is considerable scope for new and different construction methods. I can visualise a glassfibre blade with a mirror finish, moulded-in blade reinforcement, a solid leading edge, hollow trailing edge and ready weight matched which would fly like a dream. The trouble is they would cost about £100. A pair of standard wooden blades costing around a tenner fly like a dream anyway.

## Finish or covering

We can have bare wood, paint or varnish, fablon type material, heat shrink tube, heat shrink film, or possibly even glass fibre like that used on glider wings.

*Bare wood* — they're not ideal as they quickly get grubby and are not as smooth finished hence efficient as the covered items. However, if you are itching to fly — go ahead, bolt them on bare and go flying.

*Paint or varnish finish* — Kalt blades come ready varnished and nine times out of ten matched weight-wise as well. I think the reason why they use a hardwood trailing edge is to make it easier to varnish (balsa is a 'hairy' wood and therefore time consuming to prepare for varnishing). The coating looks like an epoxy and is very durable. Other blades which come in bare wood could be primed, sanded and sprayed in the normal way and you could go to the trouble of getting a perfect paint finish, balancing with paint as well, ending up with a really fine set of blades. Of course, few are going to spend hours and hours and pounds and pounds on paint for such a degree of perfection.

*Fablon-type* — this has been the standard covering for a number of years, only recently being superseded by heat shrink tube. With this covering you need to paint a small area at each end of the blade, which would otherwise be left exposed, stick the material on to the blade with the overlap on the bottom facing away from the airflow (i.e. start on the underside of the t.e., fold the material forwards over the top and then back under the blade to the t.e.) and that is that. Easy to write about but very difficult to do without getting creases. You have to work a bit at a time rubbing well down with the fingers as you go. **(Fig. 3)**.

*Heat Shrink Tube* — the latest time saving innovation, you just insert the blade into a length of heat shrink tube, wave it in front of an electric fire, heat gun or what have you


Graupner's *Helimax 40*, distributed by Ripmax, is one of the latest neat and compact sports helicopter. Use of a single tail boom support strut, starter cone and asymmetric tailplane are notable points.

and, hey presto, a perfect drum tight covering skin. My own method is to rub on black felt tip pen on each exposed blade end, shrink tube on the full length of the blade and then cut away the surfaces from each end with a scalpel to produce a neat blade in about two minutes. Be careful to heat each side a bit at a time, as with balsa wood trailing edges uneven shrinkage can distort the edges.

*Heat shrink film* — if you have mastered the art it is a good and cheap method, probably the most economic.

*Resin and glass-fibre cloth* — I have read about this in glider articles but have not tried it, it sounds as though it could possibly be the best method. Any comments from experienced readers?

## Retention

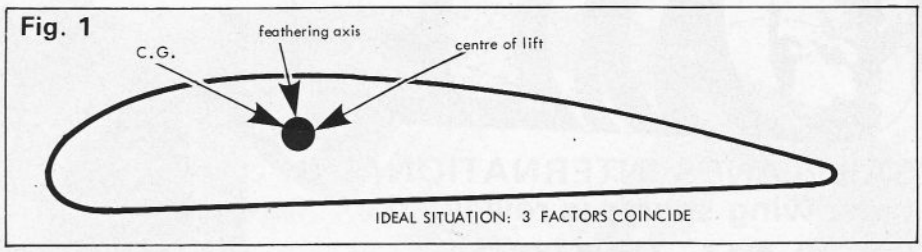
There has been a change of thought over the last few years. Originally all the blades were rigidly fixed, three bolts on a *212* and a tongue and bolt affair on a Kavan *Jet Ranger*. These days almost without exception blades are hinged with a single bolt and allowed to fly free, held in position (in lead and lag) purely by centrifugal force. I feel that flight performance is at its smoothest if the blades are very loose but in practice find it a nuisance when starting up, etc. so I tighten them up just enough to stop them swinging about. You can get to a stage where if you tighten them up securely in an incorrect position the centrifugal force is not powerful enough to straighten them out, with resultant high vibration.

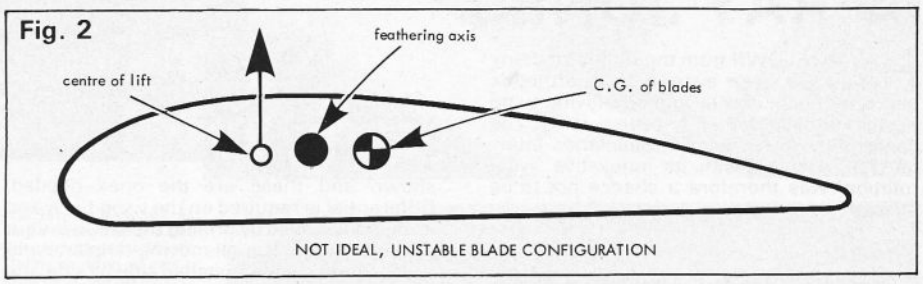
All the models I can think of have some sort of blade reinforcement at the root, plastic on the Hirobo, metal on the Kalt and wood on the Graupner, *Star Ranger,* Kavan, etc. 505 *Falcons* have no reinforcement, the blades being rigidly fixed with two bolts, however, most people remove the inner fixing bolt and let the blades fly free with no reinforcement. Be warned that it is possible to get up enough rpm to throw a blade but at reasonable revs there are few problems. Similarly with the old style *Baron* trainer, the advantages of free swinging blades are the possibility of saving the blades in a crash and ease of transport. Incidentally whilst both blades are folded up for transport, I always pop off the control links to save straining the control system.

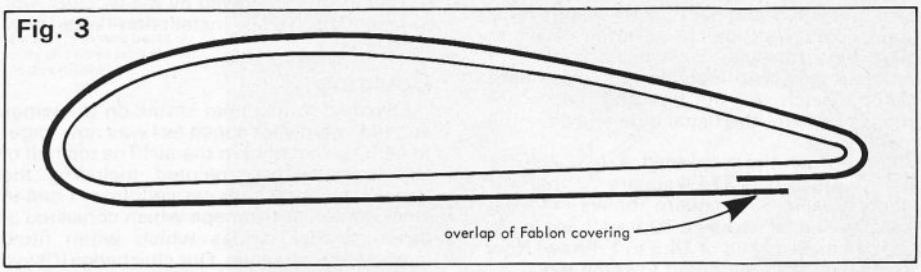
## Balancing

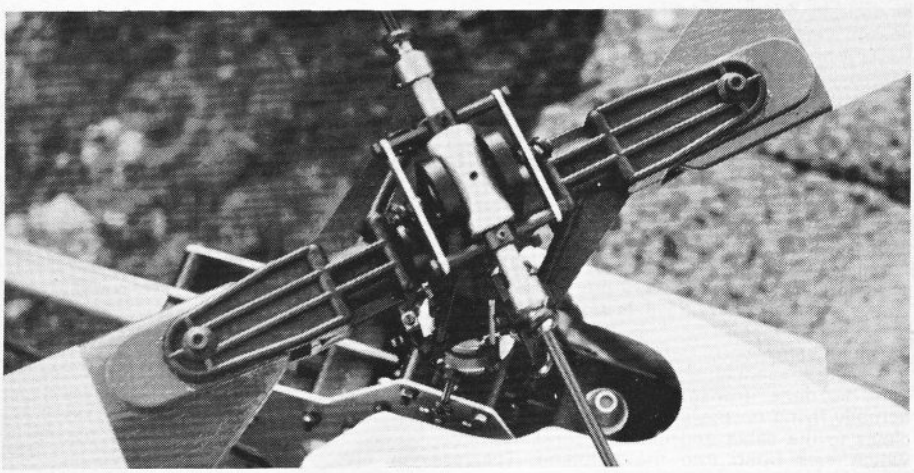
This used to be the bogey or talking point about helicopters, however things have eased considerably. All I do is to complete the head and fit the covered blades attached in the straight out position. Rest the head by the fly bar rods on two metal one gallon cans and whichever blade points skyward is the one to attach a piece of coloured tape to. In one process you have balanced the blade and coloured it for tracing. If a smallish piece of coloured tape is insufficient to make the head balance level then take a larger piece of the same colour fablon and fix it at about the middle span of the blades. This is all I do and find it adequate for me. If you want to go to the trouble of ensuring the C of G of each blade is individually correct it can only be better but again it is a case of diminishing returns and I don't bother.

If your completed model has a vibration problem the usual trouble spots are, blades out of balance, bent mainshaft, out of balance flybar system, blade holder axles bent (not very common these days) blades tightened up too much therefore not flying out straight, static or running tracking out, one of the head components bent (not very common), or of course it could be a combination of every one.



Above: close up of the *Helimax 40* rotor head reveals its wood reinforced rotor blade roots.

Single blade retaining bolts are very evident on the *Jet Ranger* shown below.

Below: glass fibre cloth and metal strip reinforcement to the blade roots are visible on this machine.