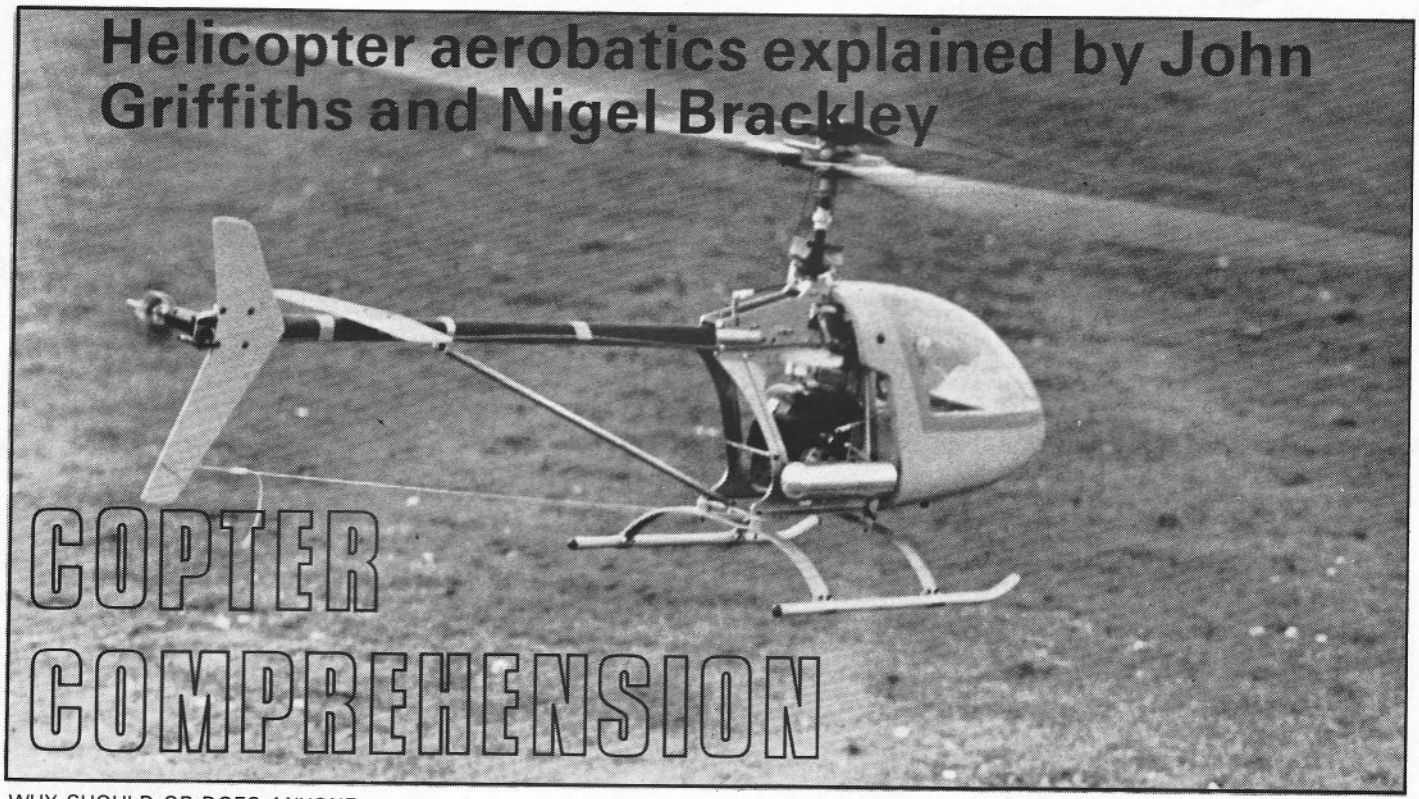
Helicopter aerobatics explained by John Griffiths and Nigel Brackley



COPTER COMPREHENSION

WHY SHOULD OR DOES ANYONE want to perform aerobatics with a helicopter? Well why does anyone want to climb Mount Everest? Quite simply because both present challenges and many people thrive on challenges, some find that unless fresh challenges keep on cropping up even something as exciting as just flying an R/C helicopter starts to become a bore. As well as being a challenge, flying aerobatics is fun and demands, and can be used to demonstrate, a high level of skill!

Firstly of all, don't ever attempt any form of aerobatics until flying the helicopter normally in the hover and through all transitional stages into and out of circuit flying are fully mastered. The model is quite likely to end up in odd situations where it may present an unusual profile during aerobatic manoeuvres and the pilot's ability to react correctly is vital!

Is it aerobatic?

A fairly easy question to answer these days, most manufacturers will claim aerobatic potential if they are confident that it exists! Basic essentials for helicopter aerobatics can be summed up as a rotor system with sufficient power to pull the helicopter through the manoeuvre with a rotor head sufficiently stiff to persuade the body of the machine to follow. Speed is a must, for with speed comes the inertia necessary to complete the loop or roll once started. The type of soft teeter head that is good for learning to fly on is not suitable for aerobatics, good positive control response is necessary, and collective pitch is nearly always essential.

By and large most modern aerobatic models are responsive enough without being twitchy, they need no modification to enable them to perform aerobatics, having said that many models can benefit from lightening of the servo paddles — not by reduction in area but either using different materials or by fretting out the paddles and filling in the gaps with lighter material. Many scale models are not capable of aerobatics.

A good power to weight ratio is needed to produce the forward speed, 7½-8 lb weight with a good Schneurle port 0.50cu. in. motor is reasonable, tuned pipes are not necessary unless noise reduction of the 'quiet' type pipe is felt to be an advantage. Currently rotor speeds are being kept down as it is a fact that the dependability of the mechanics is reduced as the rotor speed goes up.

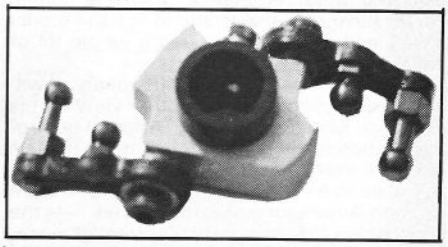
Will it or won't it?

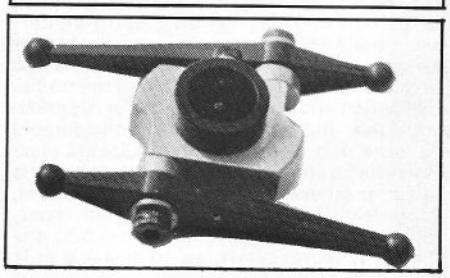
The only way to really find out if the model you suppose to be aerobatic is, and if you can 'cut the mustard' as a pilot of aerobatic choppers, is to go out and try; make it a loop first. In case you aren't sure what a loop is — are you reading the right article for you? Before trying any aerobatics, check out everything fully in the hover and circuits, make sure you have plenty of fuel on board and try flying round at altitude, this high altitude flying is an essential step towards aerobatics, the model looks surprisingly different at 3-400ft. Now try steep climbs and dives, and when ready start the fateful first run-in into the wind from a good height in a shallow dive. When the model reaches a position level with you, feed in backward cyclic. As the model is flying at high speed, instead of tipping back and stopping forward flight, it should go right round a loop. It if shows any sign of flagging before reaching the top of the loop, return to level forward flight as outlined below and try again with more forward speed.

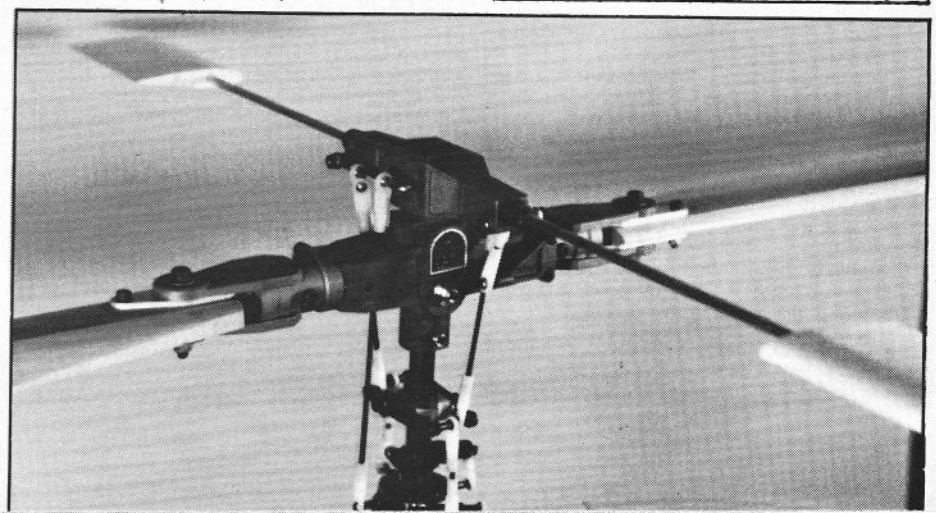
Two things can go wrong — only two? Well not exactly, but the following two are the most likely! The chopper may stick at the inverted point — don't panic, recognise the situation fast and roll out by applying full sideways cyclic. Second situation is with the model flying vertically pointing upwards. Don't allow the model to tumble out of the sky, turn the attempted loop into a stall turn rapidly turning with torque by use of tail rotor control.

Either case of failure to loop can be the result of lack of speed, or maybe the chopper is just not aerobatic! Head response can be improved, either fit harder damping rubbers to cut down teeter, this particular fault is frequently indicated by the nose high stall

Above: Kalt 'Baron 50' Aerobatic built by RCM&E Editor, Bill Burkinshaw for Kit Review, typical of modern aerobatic R/C helicopters. Below: two swashplate mixers mentioned in the text. Bottom: this Kalt rotor head incorporates such a mixer.







situation. Control movement increases don't always produce the required effect, the aforementioned paddle lightening exercise should be tried. Whatever modification is tried, full and careful hover tests should be conducted before trying the aerobatic manoeuvre. It may well be found that stiffening up the head can have unwanted side effects such as 'nodding' if the rotor rpm is *too* slow.

A recently developed device called a Swashplate Mixer can help — this little gadget is best described as an Automatic Mechanical Rate Switch. The normal swashplate drive to the rotors via the paddles is augmented by a connection from the rotor blades to the swashplate which goes through a 2:1 reduction. This system puts R/C servo power straight into the rotor blade and certainly does increase response.

Finally a decrease in main rotor pitch may be the answer, pitch angle cannot be stated, if in doubt follow the manufacturer's advice, they are usually right!

If the model will loop, experience has shown that it will usually roll. Although the roll is easier to perform, for the helicopter anyway, orientation can be a real problem. Headings can change during the roll and the model may well end up a good distance away in an unusual attitude. Speed of entry is again critical and must be obtained from a shallow dive. Once experience is gained it may be found that the shallow dive is unnecessary but for the moment — do it! Commence the entry dive into wind, down wind rolls use miles or airspace, and put the nose up before pushing the stick over to the side for the roll. *Neutralise* the stick fore and aft, as the roll starts otherwise it will become a barrel roll with the possibility of the model falling out of the sky in the inverted phase of the roll. On no account use forward stick pressure during the inverted phase in an attempt to keep the nose up, this action will probably stop the model dead with predictable results!

Inverted

The talk of 1980, inverted helicopter flying, has become less of a party trick during the last 12 months. Surprisingly the helicopter feels more stable when hovering inverted, perhaps the result of the fuselage being out of the downwash of the main rotors. Requirements for inverted flying are mainly on the control system side, both pitch control servo senses (main and tail rotor) need to be reversed. A single switch in the transmitter does this. Some of the latest helicopter R/C systems have such a switch fitted. The main rotor blade pitch needs to be set up to run to negative as well, although not as much negative as positive is needed.

In practice the model is taken up to altitude, a roll is commenced during which the switch is thrown and the model reaches the inverted state, and continues to fly with all controls operating as normal but now inverted. Return to normal flight is the exact opposite. Of course, what happens in between is up to the pilot but believe you me, the chopper looks really weird when flying in an inverted banked turn!

The implications of the inverted capability on aerobatic flight are, to say the least, interesting, by manipulation of the switch such things as square loops immediately become a possibillity, even use of the switch during rolls to maintain altitude, whilst the inverted phase is gone through. This latest capability has certainly given R/C helicopter pilot plenty of food for thought, we should see the advent of some pretty spectacular aerobatics during the next couple of years.

Conclusions

A properly maintained well set up helicopter is an absolute must for aerobatics, as is basic total mastery of the model. Most difficult aspect of aerobatics is the human one of orientation and practice and experience are the only ways that this can be come to terms with. Acrobatics are not the be-all and end-all of helicopter flying, but an interesting and challenging area well worth exploring.

Below: Slough Radio Control Models Kalt Baron inverted, not to be undertaken lightheartedly, orientation is a problem.