HELI-PAD

by JOHN GRIFFITHS & NIGEL BRACKLEY

AUTOROTATION appears to be uppermost in the minds of most helicopter enthusiasts these days, so a summary of the developments in this area would seem to be worthwhile.

What is Autorotation

When a helicopter flies, energy is supplied to the lifting rotors from the engine, and, in the event of engine failure, it is possible to use gravitational energy to produce rotor lift providing the helicopter has sufficient height available. As soon as possible after engine failure, the lifting rotors are put into negative pitch and forward cyclic control applied. As the helicopter starts to descend the air passing over the rotors causes an increase in rotor speed. The rotors are now autorotating and producing lift in the same manner as those of an autogyro. Providing cyclic control is kept forward it is possible to fly down to the ground using lateral cyclic control for direction, i.e. banking to turn — tail control is unnecessary.

The basic difference between ascending under power and descending without, is that when under power we are using energy to make a revolving wing with a positive attack angle produce lift and, when the rotors are autorotating, we are using the same revolving wing now with a negative attack angle, to produce lift and so slow the descent.

Using autorotation, the rate of descent is slowed considerably, providing some forward speed is maintained, but is usually still too fast to carry out a reasonable landing.

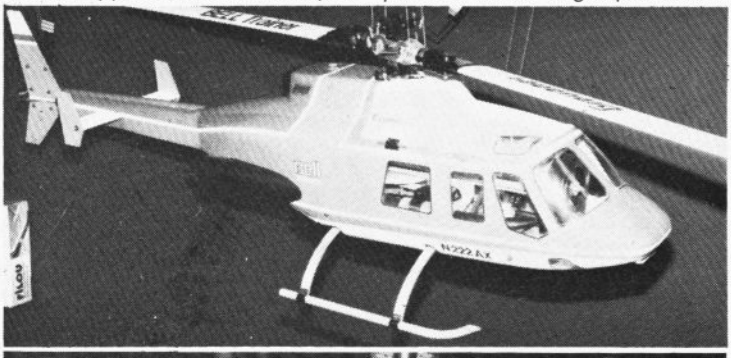
However, during descent the rotor can develop fairly high speeds thus storing energy which we can use near the ground.

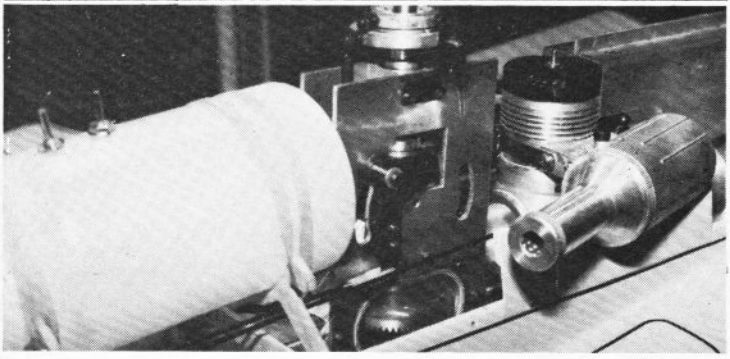
This is accomplished by putting the rotors into positive pitch with reverse cyclic and utilizing the stored energy of the rotor to provide temporary lift. The helicopter can, in fact, hover for a very short period until the main rotors slow down, so the point at which this procedure is carried out is extremely critical. Ideally, rear cyclic should be applied between 10-15 ft from the ground to lose forward speed with positive pitch added smoothly between the 5 ft to zero level.

The manoeuvre just outlined summarises the flying procedure but it requires practice, like anything else, to complete smoothly without mishap. Slight variations might be required on different machines.

Autorotation — how

To get a helicopter to autorotate efficiently it is necessary to reduce all drag on the lifting rotors in the





Above left: aerobatic version of the Bell 222 from Graupner.
Left: the *Cheyenne* from Schlüter. Autorotation fitted as standard.

form of energy absorbing mechanical areas such as geartrain etc. to a minimum. Also, as there is no power from the engine, there is no torque to compensate for, so the tail rotor is also unnecessary drag!

The easiest way to solve the problem mechanically is to install a one-way bearing between the drive gear (or gearbox) and the main shaft. These bearings are similar to a roller bearing, but the roller holders are so designed that in one direction the bearing revolves freely around the shaft and in the opposite direction the rollers clench the shaft and lock.

If this bearing is inserted in the main drive gear (i.e. **Schluter** *Heliboy* or similar) or in a fitment between the gearbox and main shaft (i.e. **Schluter** gearbox or similar systems), when the shaft is driven the bearing locks, thus turning the rotors; if the engine fails the bearing unlocks, allowing the main rotor to revolve freely.

A good point to note here is that even if you are not ready to try and fly autorotation in its true sense, the facility may be of help, for, if your engine fails when flying a model not having this facility, the main rotor stops almost immediately due to mechanical drag, but, with an autorotation bearing fitted you can get away with far less damage, due to a possible slight increase in lift generated by the free running rotor, even in the hover. It is possible to practise engine failure and go into autorotation by throttling back to a low idle, you should not, however, apply power too quickly to recover, as sudden "snatching" of the bearing on the main shaft can cause damage.

Lockheed 286L from Kavan, above, features a flybar-less rigid rotor type head.

Autorotation — availability

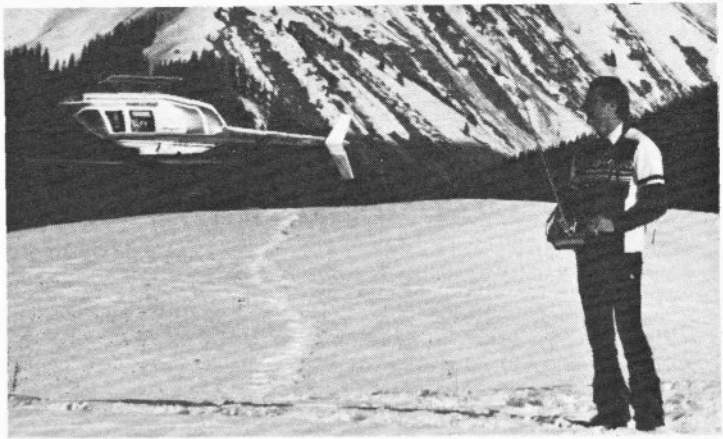
We expect that most manufacturers will be marketing autorotation accessories for their kits this year. **Schluter** expect to have an add-on unit for the *Heliboy* mechanics available in April (announced at Nuremburg) which consists of a modified main gear with a one-way ratchet installed.

Kavan also (information also gained at Nuremburg) has an

accessory kit for the *Jetranger* mechanics, soon to be available, which uses the one-way bearing system.

Revolution Helicopters have had the one-way bearing system available for their *Commander* since early 1979.

Many of the specialist helicopter shops have their own kits available for the more popular makes.



Manfred Heid Turns Everything Upside Down

Further to our report on Nuremburg in the April column regarding the inverted flying of a *Jetranger,* the photo here proves the pudding!

Although Mr **Kavan** was not giving away any secrets we think we know how it is done and at the time of writing this article we have a *Heliboy* set up and ready to try. Unfortunately, because of press deadlines, we won't be able to give you the results this month, but we can outline the way we have modified it.

Firstly, collective pitch movement has been changed to give −5 deg to +5 deg. At zero throttle and trim the blades are set at −2 deg. Servo reversers have been installed on the collective, fore/aft and tail servos and these can be switched in by an extra channel during flight. When the servo reversers are activated fore/aft and tail become reversed in action, so normal control stick movement is maintained when the chopper is inverted. This also applies to the collective pitch servo except that the pitch range will now be +2 deg to −5 deg (i.e. normal pitch movement in reverse).

The idea is to pull up into a nice easy loop and when inverted level out switching in the servo reversers and continuing to fly inverted as you would normally.

We are told that the helicopter should be more stable inverted than the normal way up!

Well, next month we will either be able to show you some interesting inverted flying shots or, some nice crash photos! If the engine cuts while inverted, it will be interesting to try rolling out under autorotation. — Yuk!!!