H ELI-PAD

By Jack Barnard

THREE YEARS of patient work by Italian modellers Vincenzo Mastroianni and Pietro Frillici has resulted in the successful completion of a scale Vertol CH-47 *Chinook* twin rotor helicopter. Vincenzo handled all the mechanical aspects of the construction, while Pietro was responsible for the installation of the five function radio equipment and the general setting up of the machine. Powered by a 2 b.h.p. glow engine, the *Chinook* has a flying weight of 8Kg. (17.6lb.), and features a welded strip steel structure.

Matters Mechanical

The single rear-induction .60 engine is positioned forward of centre with its crankshaft vertical. A toothed belt drives a centrifugal clutch, which engages at 3000 rpm and therefore produces a very smooth start at the rotors. A 2:1 reduction is incorporated in the belt drive, while the bevel gearing at the top of clutch shaft reduces the drive speed by a further 2:1.

Power is transmitted to the front and rear rotor heads by two independent tubular steel drive shafts. At the rotor heads bevel gears are again used to alter the drive direction and reduce the speed to the rotors' maximum of 1500 rpm. By splitting the drive at the clutch shaft the rotors are made to operate in different directions, one clockwise, the other anticlockwise.

Each two bladed rotor is 130cm. in diameter with blades being made up from laminated beech and having a semi-symmetrical section. These rotors can develop a tip speed of 500 k.p.h. and put a 200 pound strain on the rotor hubs. The blades must therefore be carefully matched and balanced both statically and dynamically, and are attached to heads that are comparatively massive. Aluminium reinforcements are bonded to the rotor blade roots and two ¼in. bolts are used to secure the blade to the two beams on the rotor head.

Basic fuselage construction is from 10 x 1 mm. steel strip welded together. Six 6cm. airwheels are used on the undercarriage, four in two pairs on the front legs and the remaining two on separate legs at the rear. The fuselage shell is produced from fibreglass, the two halves being fixed to the frame and each other by a combination of screws and latches.

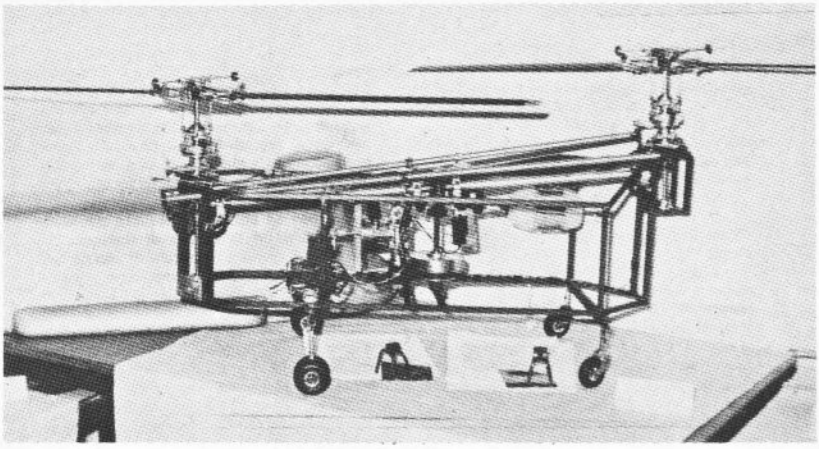
Control systems

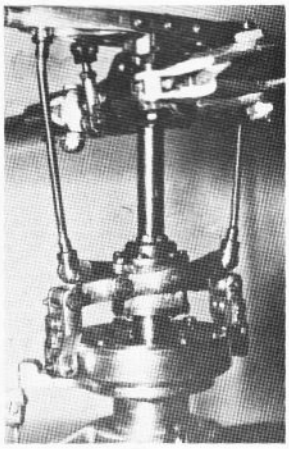
Aluminium tubing supported by ball races connects the collective pitch and longitudinal cyclic (pitch) controls of each rotor. Lift from the rotors must be balanced otherwise the helicopter might start pitching uncontrollably. Rotor pitch angle may be altered from zero to eight degrees.

The throttle is operated by its own servo, while the transverse cyclic (roll) function is independently controlled on the front and rear rotors. Tilting both rotors using the transverse cyclics in concert results in a rolling effect, while a yaw movement may be obtained by using the cyclics in opposition.

Although this particular model has been scratch built

Below and below right; this R/C scale Vertol CH-47 Chinook by two Italian enthusiasts took three years to complete — see text.





Above; the 'works' of the Chinook. Above right; close-up shot of one of the Chinook's swash-plates and collective pitch rotor heads.

by two individuals possessing considerable engineering skills, it does open the way for further twin rotor choppers. Who knows, the day of the R/C "Flying Banana" may be upon us.

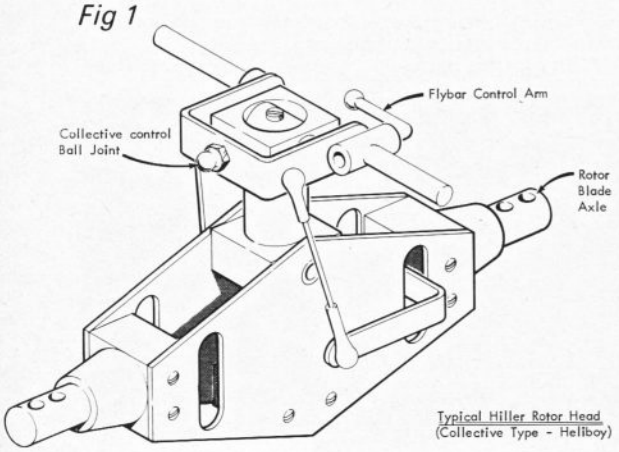
Beginners' Corner

In our last issue we discussed the basic controls of the model helicopter i.e. engine speed, tail rotor and cyclic pitch. You will no doubt remember that our imaginary model was fitted with a 'fixed pitch' main rotor i.e. the angle of attack of the main rotor blades to the airflow remained constant until varied by use of the cyclic pitch control.

Collective Pitch

A further control, known as collective pitch, is more popular with experienced R/C helicopter pilots as it produces a faster reaction to changes in engine power. The mechanics of the 'collective pitch' rotor head are, however, rather complicated and it may be thought inadvisable to use it on a training model — one good reason being that it is much more expensive to replace than the fixed pitch head!

Fig 1



Typical Hiller Rotor Head (Collective Type - Heliboy)

The collective pitch head (Fig. 1.) is fitted with variable pitch rotor blades, i.e. their angle of attack is adjustable in flight. The control arms which provide the pitch change are connected to the engine control servo in such a way that an increase in power automatically gives an increase in angle of attack, i.e. the combination of engine power and rotor blade angle controls the amount of vertical lift.

We have really only briefly discussed the control system and in future issues of 'Beginners' Corner' we will take a much closer look at the individual parts of the R/C helicopter.

I did it my way . . .

Mr Michael J. Sheppard sent in the following amusing story of his own introduction to R/C helicopters.

Becoming interested in R/C helicopters I went to the South of England one weekend to meet a chap who was very well known as a model chopper pilot. His advice on radio, engine and model was listened to with interest, and excitement. The exhibition flights I saw made me aware how much work was involved.

A firm order was placed with a model shop for a particular chopper kit and engine. Nailbiting delays followed, why doesn't it come? It was at this time that my particular selection had ceased to be imported. Phone calls followed by more waiting. Weeks came and went and time was a-wasting. Look at the classified ads at the back of the modelling magazines. Anything second hand? Here's one, 'helicopter with motor immaculate, never flown.' (A very common advert.) A phone call followed by a car trip — this time to the north of England. Thank goodness I own a large estate car. Big model choppers take up a lot of space. My dream is getting closer, or so I thought at the time. Take my new beast apart, not too much at a time, in case it ends up with more spares than intended when it eventually goes back together again. Its obvious from inspection of the parts that a lot of thought and investment has gone into these designs.

The intricacies of cyclic pitch, collective pitch, a new fuel other than diesel, glow plugs and differential throw on the servos had to be mastered and understood

along with linear and rotary servo output, advantages and disadvantages.

I re-read everything that had been accumulated to date about all the equipment now assembled, and hopefully put in its right place. Softly, softly, creep away from home and family to some secret place. At this stage my mind remains blank; when and where did the first attempt at flight take place? It was, I remember, totally unsuccessful and rather expensive. My hands and brain could recall nothing from my life's experience of any practical use in this fight between man and machine.

These secret disappearing acts, followed by reserved, sly, frustrated and expensively painful comings and goings went on for a very long time. No doubt about it, the words of wisdom given those months before were proving to be justified. Give up and settle for second best. Fixed wing. So easy, so simple, all the help available I could possibly need. Many, many times this seemed to be the easy way out.

Learning, learning, ever learning, those two or three seconds of airborne flight followed by that rich expensive bang when mother earth leaps up just in the wrong place. Then one day the machine actually stays in one place in the air for just a few fleeting seconds, followed by a hard landing. Going home with the machine still intact and to all intents ready for another flight is a feeling that words are incapable of describing. Radio failure, mechanical failure, pilot error and inexperience all add up to an extension of the long hard frustrating episode. Imprinted in my mind vividly with minute detail is one particular incident — my first really successful, reasonably controlled flight. The totally demoralizing and shattering effect to one's person when a main rotor blade gives up in mid-flight, followed by the now inbuilt rule (when in trouble open the throttle). The vivid pictures of the receiver battery, then a servo, flying out the side of the machine with the heart stopping realisation that the engine cannot now be shut down is something I truly would not wish on even my worst enemy. The fuselage by this time was attempting to fly in two halves, held together by the tail rotor drive shaft. From the machine came the last vital piece, the fuel tank, how I wished — even possibly prayed that Mother Earth would now leap up again and save the inevitable landing. Nature is cruel, Mother Earth just sat there serene and unmoveable. She may even have laughed a little.

At about this time I changed my mode over to throttle right. Helping my son in building and setting up his radio in line with the local club practice, created difficulties for me. So a new helicopter model and different radio mode were ahead of me.

This new box of tricks went together very easily, the previous experience gained in engine and radio installation was of tremendous benefit. No real fear now of modifications to the framework or the previous long painstaking tasks of balancing main and tail rotor blades. Some time was now spent sitting in a chair in the workshop with the model on the floor before me. Practising motor and swash plate controls, to familiarize myself with the new radio set up. This was followed by many short frequent sessions in the garden with the motor running: at last I pronounced myself ready for the real test.

Truly, one day very secretly the machine was taken out of the house to my now established flying site — a field directly behind my home which incidentally is a very long way from being flat. This new machine flew first time out 10 ft. to 15 ft. up and came home again in one piece, all ready to go again. More and more times this happened, crashes and damage due to inexperience becoming less and less.

The feeling of achievement and excitement was, well, almost painful. My being able to now hold my own inquests fairly accurately why things went wrong. But more important, what to do next time to put this right. Practice and practice, the previous fear of anything more than just a very gentle breeze gave way to a positive delight in going out in a wind. The wind I found can be of practical benefit. Although it creates lift and gusts can upset things near the ground, the directional control facility more than compensates for any disadvantages. I found I could fly in higher wind strengths than my son was prepared to fly his fixed wing in. To be able to press the model against the wind without having to fight that nasty unco-operative little propeller on the back end of the model is very useful. What a blessing it would be if we could dispense with that mechanical contrivance. Some day of course we will fly twin rotor machines.

Slowly but surely the tail rotor became less unmanageable. The main steering being done by the swash plate. Take off without bothering too much about the tail of the machine swinging about, experience having taught that it almost certainly will swing back more or less into its intended place. Each landing becoming better and better. I well remember a visitor to the area calling on me one day and saying in the course of conversation that a chopper is landed from just one inch and not from a few feet. Simple, yes, it had not previously sunk into my brain. Getting down to the one inch height was not done in one go. A series of lowering movements later to be smoothed into one continuous flowing manoeuvre. It calls for a lot of stick juggling.

My memory recalls many individual incidents. Each contributing to my standing now as a novice model helicopter pilot, the time I aimed at a patch of cow manure as a landing marker and actually hit it dead on. The substance was really in the fan. Lesson learned, don't aim at fresh pancakes. Times when careful pre-flight checks revealed a fault that would have been deadly in the air. Having spectators turn away from watching a non productive event never helped. Changing over to a special chopper fuel and finding it was no longer possible to use the clouds of smoke as a wind sock. I really did miss it. It was pleasant however to be able to see the model properly at last. The first time I saw the model flying towards me, and the resultant work, my first circle, both the deliberate one and many of the accidental ones. It says a lot for the model that some of these were without incident. The first low level banking turn and see the rotor blades tips touch the ground. If you have never seen a helicopter cartwheel on its rotor blades, then you really should. It's most spectacular. I do recommend however that you pick someone else's model rather than your own. The lesson learned from that incident was — don't let the machine sink in a low level turn. That is what throttle and collective pitch are for.

It is hoped that the many people I have met during this difficult time can now be called friends. That many will forgive me for their time I used, possibly even wasted in talking about my problems.