RHI ROTOREVI

When MFA launched the budget-beating Sport 500 onto the British market two years ago some alleged that it was troublesome to build and even more of a problem to fly. Not true said a lot of newcomers to the hobby who were just grateful someone had given them a cheap admission ticket.
We asked Phil Cranford to take a look at MFA's latest offering, a Collective version of the 500. As a novice pilot and an experienced Engineering Designer he was uniquely qualified to report on MFA's buildability and novice appeal. He found it scored on both counts.

...THE PRICE IS STILL RIGHT

I was glad to be asked to review this particular model recently introduced to the market by MFA as an uprated version of their successful fixed pitch model.

As a relative newcomer to the world of model helicopters I realise the importance of simplicity, ruggedness and, perhaps most important of all, economy when raw pilots are involved. And beginners will be very much concerned with this kit as it is they who MFA are aiming at.

On opening the box my immediate impression was how well the kit was laid out. A minor detail some might say, but surely first sight of the contents should inspire the modeller's confidence, not knock it for six.

The main box contains the woodwork, canopy, tailboom etc. In a small inner box there are five sub assemblies individually packaged, a control pack, a screw and nut pack, a chassis pack, a transmission pack and the main and tail rotor pack. I could already see this heli going together in my head. But the manual should be more informative than my thoughts, I told myself. So abide to rule number one I told myself and read the instructions first. Informative they were.

The next thing which struck me was the amount of aluminium components used instead of the plastic moulded variety, particularly when compared to my Kalt Cyclone.

Some parts were machined from solid whilst some were fabricated from sheet material. On the whole most of the components

had a 'functional' look about them rather than being aesthetically pleasing.

I was also a little surprised to see so much wood in the kit. My initial thought on this was that I thought that model heli's were all high-tech machines utilising state-of-the-art materials, and here we are with half a tree in the box! Having taken the blinkers off myself I then thought well, when it boils down to it, wood is strong, readily available and easy to work with not to mention cheap! So why not?

I have already commented on the lack of plastic components in the kit, but in some cases plastic was used whereas ali or steel may have been more suitable. However, I'm sure MFA have done their homework with regard to material choice, for there are other factors to be considered other than choosing the best, i.e, cost, availability, machinability etc.

I got the impression that MFA have made this product 'in-house' and therefore utilised their existing plant/machinery and manufacturing techniques. This may be at the expense of aesthetics, but is definitely an advantage when it comes to economy, quality control and availability of spares.

NEW MFA SPORT 500 Collective

One of the early MFA kits, which can now be uprated with the Collective conversion kit.

INITIAL NOTES IN MANUAL

The manual starts by giving some useful information, such as additional equipment/tools required to get the model airborn, and advises which engine to use. This is an MFA Blue Bird .46 AAC which apparently was the engine used to carry out the development work on the model. Priced at £55 you can't really go wrong. The manual, however, does state that most makes of .40-.46 engines can be used.

I opted for an Enya .50 which I already had at my disposal. A little over the top maybe? This proved easy to fit and it became apparent that virtually any engine could be used since there was ample space and the modeller was left to drill the fixing holes.

Another note stipulated that Locktite should be used on all screws and nuts except nylocs and the engine propnut (however, the propnut did actually come undone on one of the initial startups, so I replaced the star washer which collapsed with a spring washer which seemed to do the trick).

I liked the many useful notes throughout the manual which will be very helpful to any beginner. MFA have listed points which would possibly be ignored by more 'up-market' manufacturers.

ASSEMBLY

The assembly of the model can be broken down into four basic sections:

Steps 1 to 8; Mainframe/Powertrain

The mainframe consists solely of one 3mm aluminium plate which has several shapes punched out of it and some 90 degree bends

The first thing I did was to spend a few minutes deburring this as all of the edges were sharp. Next you have to fit the aluminium undercarriage legs to the chassis, sandwiching four spacers. No washers were supplied with the screws and nuts, which I feel is very poor when you bear in mind that steel screws on ali does a bit of damage.

This oversight continued throughout the stages so I purchased some M2, 3 and 4 plain washers and used these wherever possible.

The ali skids are then fitted to to the steel leg joiners and these to the legs. Ensure you fit the skids in this manner as if the leg joiners are fitted to the legs first and you try to slide the skids through them they get badly scored.

Next comes the clutch assembly which is of the centrifugal type. Method of operation is two half moon shaped steel shoes which pivot independently and drive the lined ali clutch bell. Dissengagement occurs when the force exerted by two horseshoe shaped springs overcomes the centrifugal force which falls as the engine speed decreases. The shoes are assembled with the springs into the toothed pulley which is driven from the engine.

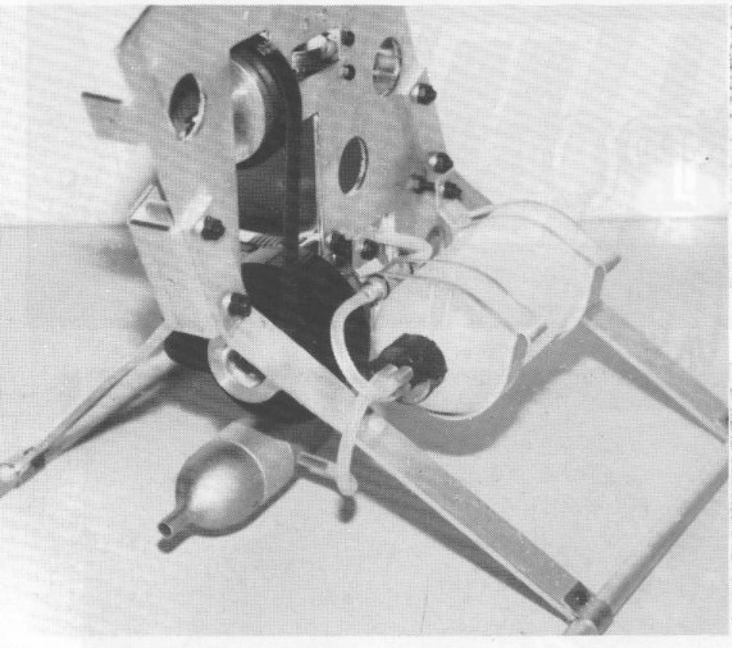
This pulley is a moulded plastic item which I had my doubts about even before I started to assemble the clutch, and in fact it did take me three attempts to obtain satisfactory operation. This was due to the plastic distorting as the shoes were screwed to it.

I feel that a component as important as this should be rather more substantial/rigid. After all the clutch must be the hardest working assembly of any heli. It did actually prove to be a problem on the initial test flight (this is an understatement, as you will learn later).

The clutch lining is then glued into the ali clutch bell. Now the clutch could be fitted to the main gear shaft, which is a steel shaft of 5mm diameter with a bevel gear half way down its length which in turn drives the head.

Slide an M5 washer down the shaft to the back face of the bevel gear said the instructions. Great, but there was no washer in the kit, so I fitted a standard M5 plain washer which seemed fine.

Then an ali bearing block is slid down the shaft. All of the components which →



Fuel tank in position

This assy consists of a new type shaft (A.R.1), a different bevel gear (A.R.2) and the clutch itself along with some shims and a circlip. The bevel gear is screwed to the clutch, a shim is slid down the shaft to the circlip (already fitted) followed by the gear/clutch, the lower and upper bearing blocks (these are the blocks used for the std. build). Fit this to the chassis using the upper set of slotted holes for the lower bearing block (the lower set are used when no auto clutch is fitted).

Don't tighten yet until the second shim is slid down the shaft followed by the mast collar. This line of components are then all pulled up together as the mast collar is fixed securely to the mainshaft with an M3 grub-screw. This is to eliminate any unwanted end float which would constantly alter the mesh between the two bevel gears which could accelerate wear. Now the two bearing blocks can be securely fitted whilst setting the mesh of the gears (there must be some play between the gears but should be kept to a minimum).

With regards to setting the mesh of the gears there is a very important piece of information missing from the instructions. They should tell you that there is rather a lot of end float in the horizontally mounted gear shaft which is inherent. When you adjust the two gears for mesh the position of the horizontal gear could be anywhere within approx 2mm. Therefore, the mesh could alter dramatically if the correct method of assembly is not used. So what I did was to push the horizontal shaft as far as possible to the right before adjusting the mesh.

This worked perfectly as due to the nature of bevel gears, if allowed to (i.e. aren't constrained) they will try to force themselves apart from each other. But because the end float is eliminated by moving the shaft to the right you are in effect allowing the main shaft bevel gear to constrain the gear shaft bevel gear.

Basically all I'm trying to say is that if this end float isn't dealt with, no matter how well you set the mesh, the gears will move apart from each other which wouldn't become immediately apparent but rapid wear would probably result. That's probably about as clear as mud unless you've got this particular model in front of you.

The last instruction regarding the assembly of the auto clutch says oil the bronze drag bearing in the upper bearing block along with the shims and grease the gears. But it would be easier to oil these items beforehand - a minor detail but none the less helpful. In fact that is one very slight criticism I have about the manual, the instructions are not always given in the ideal order.

utilised bearings already had them pressed in by MFA. (This is a good idea as if you do not have facilities such as a fly press then it is easy to make a mess of the bearing housing if the bearing goes in out of square).

Then the clutch assy is slid on followed by the clutch bell which is retained on the shaft by a split pin. This sub-assy is then set aside, while I reflected that the use of a split pin to drive the mainshaft is very poor.

Next comes fitting the engine to the engine plate, but first the flywheel, fan, toothed pulley and the vee belt starting pulley are fitted to the engine's propshaft. As mentioned I ended up using a spring washer instead of the star washer supplied.

The engine is then placed onto the ali engine plate, its fixing holes marked out and drilled for M3 screws. A gap of 3mm must exist between the back of the engine plate and the flywheel - this ensures correct positioning of the toothed pulley on the main gear shaft that it is to drive. The two piece plastic fan duct is also fitted to the engine plate; this may require some trimming to clear the throttle arm and/or cylinder head. I would like to emphasise again how versatile this design is with regards to engine choice, as so many models are limited to two or three types of engine.

These two sub assemblies are then fitted to the chassis. First the gear shaft/clutch, with the toothed drive belt hooked over the pulley. The engine assy is then bolted to the chassis ensuring that the belt is as near as possible to right angles with the correct tension (the tension is not too critical as toothed belts are very forgiving) before tightening. Belt is better slack than tight.

The next step was to fit the main shaft and here I elected to fit the autorotation clutch which is an optional extra from MFA (priced at £19.95, part no.768). This comes complete with its own set of instructions for both building it into a new model or converting a standard build. Note that the auto clutch is only available for the collective model.

Beginner's Note: An autorotation clutch is used as a means to disengage the head from the drive train in the event of your engine stopping for one reason or another. It allows the head to carry on rotating due to the inertia in the rotating mass of the head and if you're clever you can let the heli descend at the correct angle and speed using cyclic and pitch inputs (or so they tell me!). But to the likes of you and I, the auto clutch would only be used to allow the heli to sink to terra firma reasonably gracefully from quite a low hover. So it's up to the individual to decide whether or not one is necessary. It really depends on your type of flying. Even if you don't use this facility initially, the day will come when you may be glad you have got it.

Next the fuel tanks clips are fitted to chassis on the opposite side to the engine and sticky backed tape put on them to stop the tank rubbing (there was no foam in my kit). The fuel tank is then assembled. This consists of a thin plastic bottle with a self-sealing screw on top. Three brass tubes are then pushed through the cap, one is feed, one is the pressure tapping and the other the filling port.

These are very tight, but again they are self-sealing with no messy leaks so common in other models. The tank is then held in the tank clips with elastic bands to make a very neat and visible unit, so there's no excuse for running out of fuel in mid flight! Even the silicon tube is supplied.

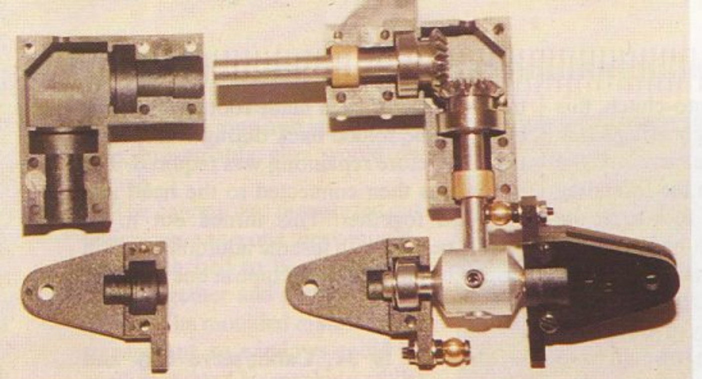
Steps 9 to 14, Tail boom/tail rotor gearbox

The boom is made from thin-wall ali tube and is fixed to the chassis with two M4 screws. The trouble is that if the screws are tightened to anything more than finger tight the tube will crush. This would only be a cosmetic fault as the front section of the boom isn't functional.

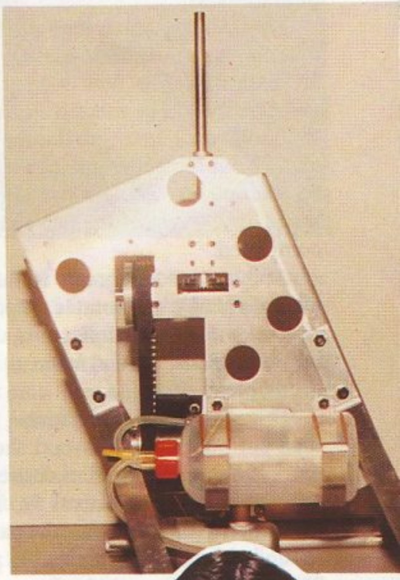
At this stage the anti-rotation bracket and the two tail drive wire supports are fitted (loosely). Then the front drive coupling is connected to the drive shaft just behind the clutch bell. Flats are then filed on both ends of the 14 swg. drive wire for the grub screws in the drive couplings to locate on. This drive wire is then fed through the loose drive supports and secured to the drive coupling.

I was a little concerned about these drive wire supports due to the metal to metal contact possibly generating "noise" i.e. interference to the receiver. I would liked to have seen some non metallic bushes used instead e.g. PTFE. I elected to leave the supports as standard for the meantime, for if any problems were encountered during test flights, it would be a simple modification to make.

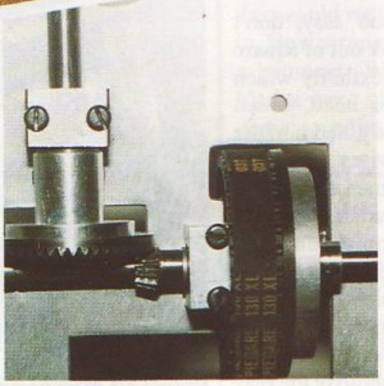
Next came the tail rotor gearbox. Any moulding flash was trimmed off the reinforced nylon gearbox cases before commencing. The two gear shafts were 5mm dia. hollow components with a bevel gear pressed on one end. I noticed here that shavings of metal had been left behind as the gears had been pressed on, so this was removed as swarf is the last thing you want floating →

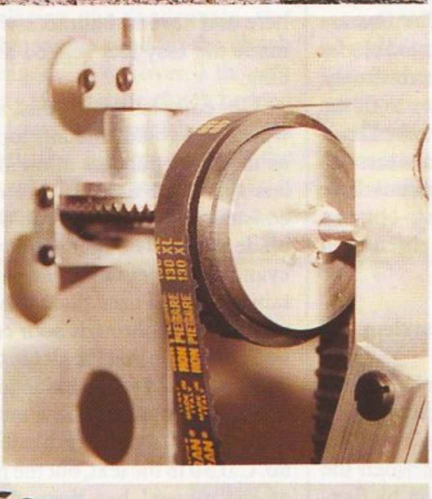


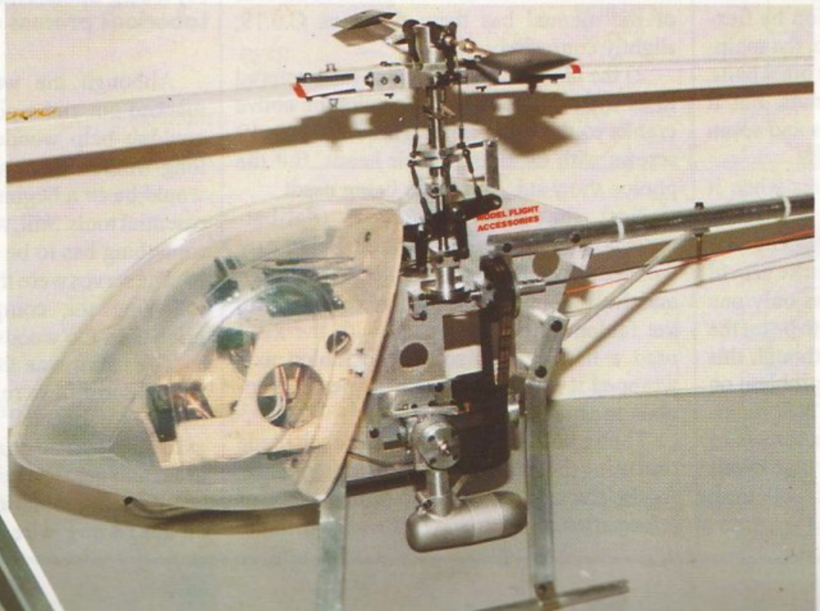
Above: Impressive and robust tai rotor assembly.
Left: the completed kit, before and during flight test.

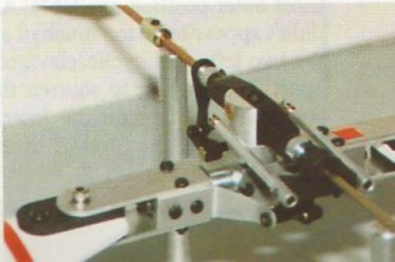


Right: bevel gear which stripped during flight test. Centre: the troublesome clutch area.
Below: mechanics featuring a Super Tigre engine, later changed. Far right: reviewer and MFA. Bottom right: balancing blades.









around in any gearbox. These two shafts were referred to as part numbers in the text as H.9, whereas, the photo of the parts, layout in the rear of the manual refered to them as part numbers H.91 (the correct one).

A ballrace and oilite bearing are then slid down each shaft. (oilite is a sintered oil - impregnated bronze material which is made up from 90 per cent copper and 10 per cent tin, having approximately 30 per cent porosity which allows the oil to be retained. This makes for a self lubricating bearing with high side loading capabilities). These two shafts are then sandwiched between the two gearbox halves with plenty of grease on the gears. This felt very smooth running and I was suitably impressed with its operation, ruggedness and simplicity along with the wise choice of materials.

The tail rotor hub is then assembled as per diagram with the plastic blade holders which are ballraced. The hub is then fitted to the gearbox itself. The manual doesn't say what shaft to fit the hub to, but it is the one furthest away from the bellcrank bracket which can be seen clearly enough in the photo in the manual. The rest of the tail gearbox is then completed.

At this stage add grease to the pitch yoke which is plastic and rotates at speed whilst in contact with two ali collets. Again, the manual states this at the end when all the building is complete.

The vertical and horizontal tail fins are then cut out of the plywood sheet which is marked very well. Paint as desired and fit the tail gearbox to the vertical fin. The fins are then fitted to the boom and the painted blades to the holders, being allowed to pivot freely. The text says to use M3 x 8 screws to fit the gearbox to the fin, but they need to be 12mm long. The tail drive wire is then connected to the rear drive coupling and the two tail drive wire supports adjusted up or down to obtain a straight line with the drive wire. Tighten them in this position.

Steps 15 to 26, Head/Control system.

Start with the swashplate which is a two part ball-raced ali pre-assembled item. An O-ring is placed into the internal groove of the swashplate which acts as a guide when the swashplate is tilted in any direction by flexing, but remaining in contact with, the mainshaft. (The instructions say fit nine brass balls, nine M2x12 screws and eight nuts, but it should say nine balls, eight screws and seven nuts).

There were a few discrepencies when it came to assembling the three bellcranks which control cyclic and elevator. The text says to use the inner hole on the centre arm of all three bellcranks, but there was only one hole in each arm which happened to be on the most outer position available. Although this didn't appear to be too much of a problem on the two left-right cyclic/elevator bellcranks, apart from having to shorten the screws to stop them fouling on the lower mainshaft bearing block, the fore/aft cyclic bellcrank needed modifying.

Because I had fitted the auto-clutch, this raised the position of the lower bearing block which fouled on the centre arm of the bellcrank. So I had to shorten the offending arm by 9mm and drill a hole in it to fit the brass ball to. If the auto clutch had not been used this problem would not have occured.

The individual instructions which came with the auto clutch did actually give advance warning of the modification that would have to be made to the bellcrank in question, but this proved to be inaccurate and unclear at that particular stage of the assembly. Although this was a rather minor fault, I feel that such problems should be ironed out before marketing takes place.

The linkages were then assembled by using the given assy lengths and using the scale drawings of the bent ones as a template, a nice touch. The swashplate was then slid down the mainshaft and the relevant linkages connected. The ballinks were rather tight to clip over the brass balls, but better that than any chance of them unclipping in mid flight.

The head mixer and flybar were then assembled and all went together smoothly. The flybar is then balanced independently of the main rotor by moving a counter balance weight to the desired position.

The rotor hub is then tackled. This is of the damped flapping type and involves most of the components that would be used if the collective conversion kit was being used on the fixed pitch model. I must say this looks the most professional part of the complete kit. There seemed to be a wise choice of materials here and several ballraces were used which made the assy feel rugged and smooth running.

On completion of this sub assy, don't worry if the blade mounts look out of square as the teeter rubbers allow flexibility which lets the head flap. The rotor head, which constrains the flybar, has to be glued into the blade joiner. The manual advises the use of cyano-glue or epoxy; I had some Locktite retainer 638 so I used that instead. If you place an M3 screw through both components you will guarantee that the slot in the rotor head is exactly square to the blade joiner.

I'll just point out a few errors that existed in the text: 1) the plastic blade cranks are part no. C.0.30 in the text, but the photo in the rear of the manual has them down as C.0.19; slightly confusing.

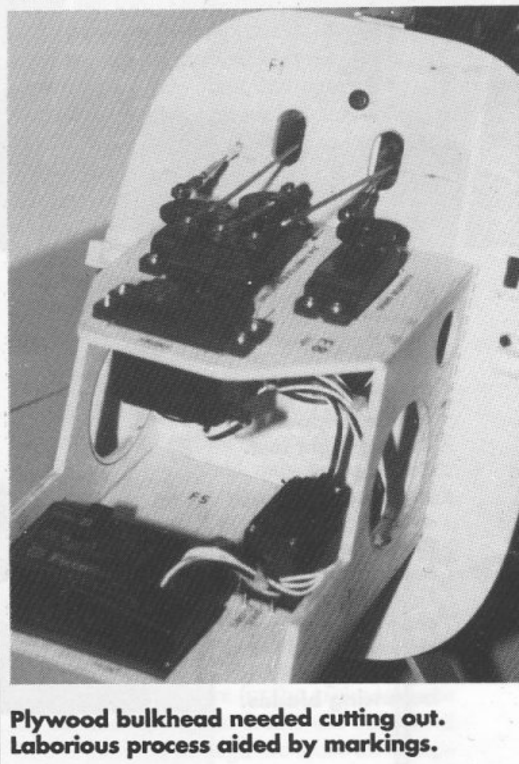
2) the blade crank pivot pins (also refered to as C.0.30!) are used to connect the above cranks to the pitch arms. These are M3x19 screws with no slots in their heads. But the photos show std. capscrews being used!

Next the semi-symmetrical (flat-bottomed) blades had to be covered. Being bare wood, the root had to be painted to fuelproof and the remaining lengths were covered with the fablon material supplied with the kit. I used a hairdryer to soften the fablon as I wrapped it around the blade as per instructions to obtain a superb finish.

Then a hole had to be drilled in each blade root using the reinforcing pieces as templates. Again, the manual came up with a piece of information too late, and that was to trim the trailing edge of each blade root to allow the blades to be folded back during transportation. Therefore repainting was required. The flybar was then connected to the head and balanced together. This turned out to be almost perfect with just the addition of a thin strip of brightly coloured tape at one blade tip to aid tracking.

Steps 27 to 31, Cabin/servo tray and Canopy

The remaining woodwork was cut out to make up the cabin which consisted of four separate wooden sheets. The woodwork involved drilling holes, from 2mm dia up to 55mm dia, cutting out various shapes and glueing the pieces together. This took me about two hours but I had such facilities as a bandsaw and pillar drill. Surprisingly I enjoyed this part of the build and ended up with a remarkably strong assembly having used rapid-setting Araldite to glue the pieces together. This also acted as a shell to protect the electronics in the event of the ground leaping up at the heli as we all know happens too often!



Plywood bulkhead needed cutting out. Laborious process aided by markings.

Although the woodwork was superbly marked out and a good assembly resulted, I couldn't help wondering how difficult and long-winded this particular part of the kit would be to a beginner who only had a few essential tools. Still, with a product this cheap, something has to be sacrificed.

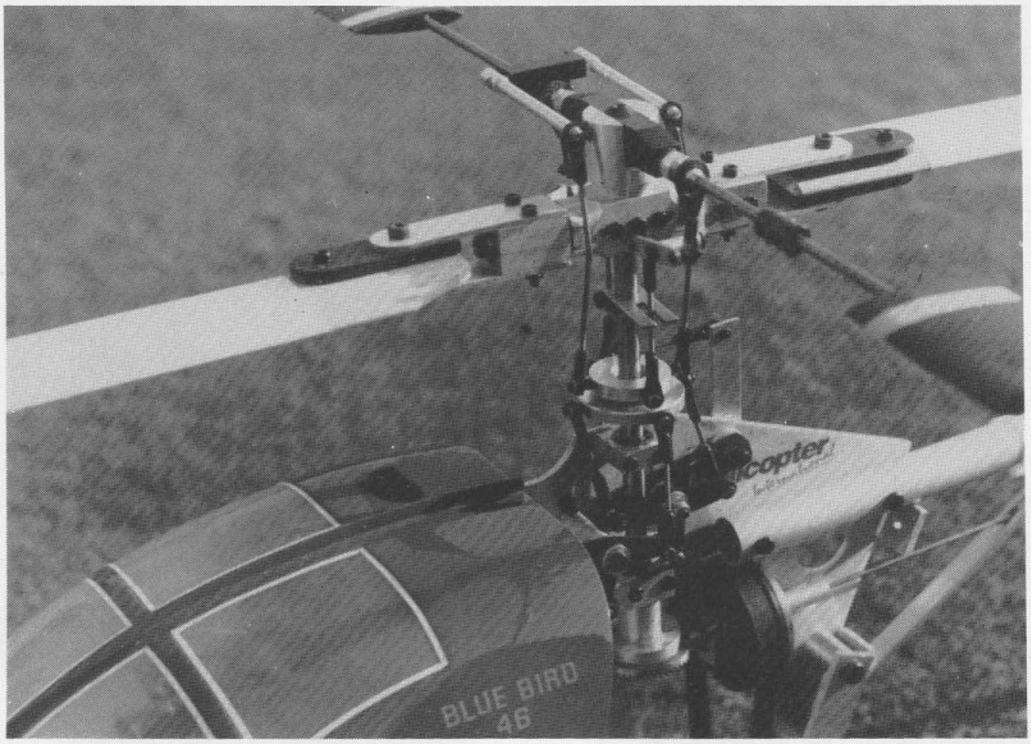
The servos were then screwed to the cabin, following the comprehensive instructions printed on the woodwork itself.

The cabin was then fitted to the chassis with three M4 screws, and the remaining linkages connected up. The battery pack, gyro and receiver can then be installed in the usual manner. The tail pitch control cable can be fitted after soldering the two threaded ends on the 18 swg wire which slides in a PTFE tube. If a soldering iron is not available, presumably glue would do the job.

The canopy was then sorted out which came as a one piece moulding which had to be cut in two, glued together and painted as required. The moulded material was transparent, so windows could be easily obtained by masking whilst painting.

On completion of the canopy, I felt that it was rather flimsy around its rear area and could do with a frame around its circumference to stiffen it up. The canopy did actually vibrate badly, so I placed sticky backed foam around the inside of it to locate on the wooden cabin.

To complete the assy, the rotor assy was fitted to the mainshaft and the final linkages connected up. I elected to use an M3 nyloc nut instead of the standard one supplied to hold the head on due to the importance of this fixing.



The build is completed by setting the pitch to -1 degree at low throttle and +7 or 8 degrees at high throttle using the neat wooden pitch gauge supplied in the kit.

ON COMPLETION

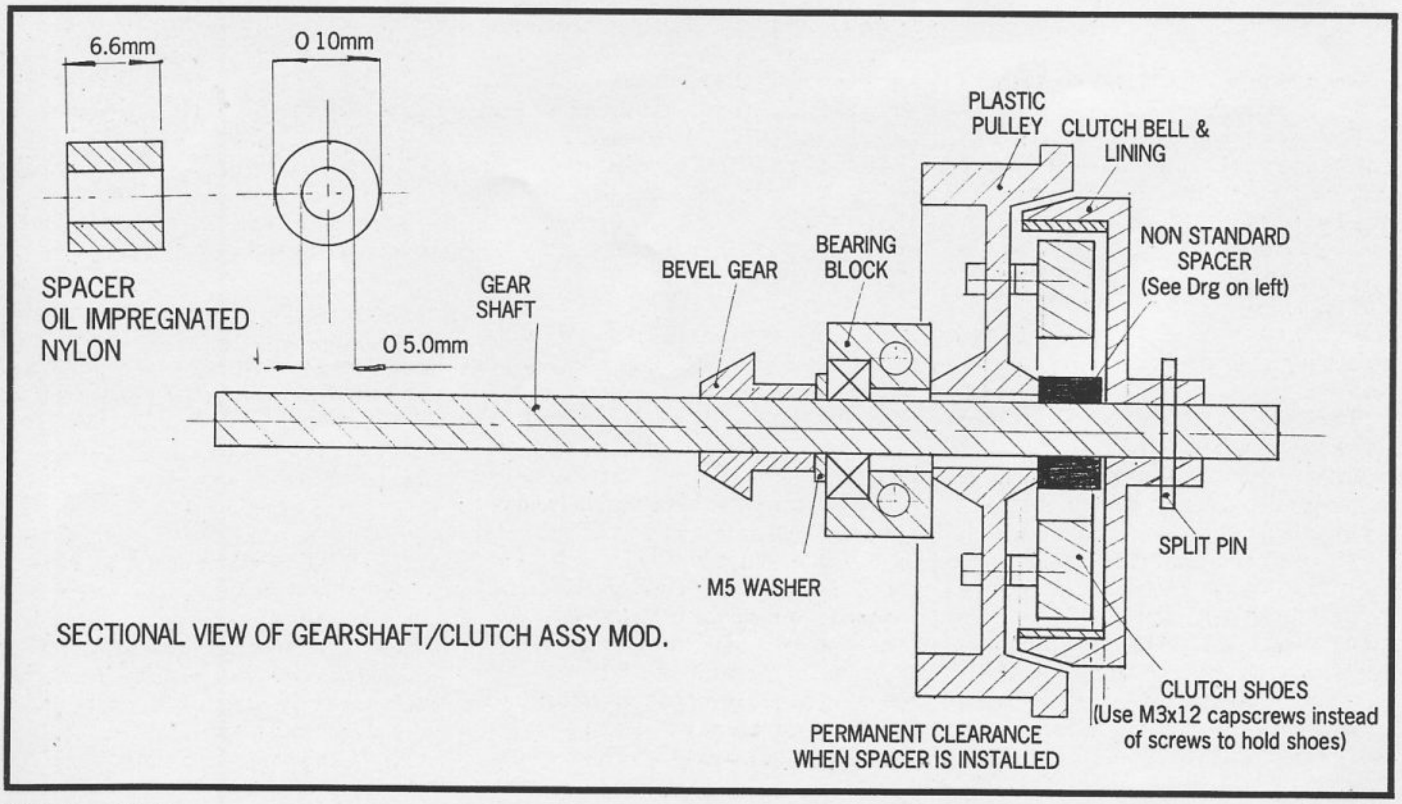
Arriving at this stage took approximately 12 hours. Another couple of hours could be added to this if certain tools weren't at your disposal. Also I haven't painted the wooden bulkhead yet. I propose to hand paint this, so a little time should be allowed for here. However, considerable time had to be spent to get the thing airworthy on top of the basic building.

GETTING DOWN TO THE NITTY GRITTY

After sorting out the bellcrank problems previously mentioned, it was time for the initial 'test hops'. On first start up the starting pulley came adrift, so a spring washer was then fitted replacing the inadequate star washer. With the engine fired up the clutch was trying to engage at tickover. I thought this would rectify itself as the clutch bedded in. How wrong I was, but more about that in a moment. With the blades spinning the blades were checked for tracking. When it came to adjusting the linkages to raise or lower the pitch of one of the blades, it became apparent that the 56mm link had to be lengthened to reduce the pitch, and vice-versa, due to the configuration of the blade cranks. I realised this only after adjusting the pitch the wrong way, putting the blades further out of track.

Within a few minutes of running the clutch seized. As far as I could tell this was because of a design fault - the plastic pulley which houses the clutch shoes is allowed to float up and down the gearshaft to such an extent that the flat face of the steel shoes can come into contact with the flat face of the ali clutch bell.

I rectified this fault by making a spacer out of oil impregnated nylon, a bearing →



SECTIONAL VIEW OF GEARSHAFT/CLUTCH ASSY MOD.