KIT REVIEW

No. 94 By D. F. Cardy

MORLEY Mark 2c
R/C Helicopter

THE Morley Mk 2c helicopter is broadly based on the Bell 47G, or Westland Sioux helicopter and has a pedigree going back to 1973 when the model in its 2b form won the competition for homebuilt machines at the Sywell Show. Since that time, the somewhat frail and touchy prototype has been refined to produce a very attractive machine which is also robust and practical. Many of the transmission parts have remained unchanged in this time which points to the soundness of the original design.

A letter to Jim Morley enclosing £1.50 brings a large plan giving the general arrangement of the Mk 2c, a model in the medium size range with its rotor diameter of 47 in. and overall length of about 59 in. The design suits engines from .35 to .45 cu in capacity and normally uses only cyclic pitch control, but a recent development includes sketches and parts for a rotor head giving full collective pitch control. The plan is liberally detailed with sketches and notes which give the latest modifications and includes the necessary information to make many of the parts from scratch. However, most modellers will prefer to obtain the various sets of parts which are available and which considerably shorten the building time. These parts comprise fine nylon mouldings, many of them glass filled, and metal components in various stages of manufacture ranging from the basic alloy plate for the engine mount to the fully machined and assembled main and tail rotor gear boxes already grease-packed for 10 to 20 hours' running time. The modeller is, therefore, expected to find readily available materials like plywood for the cabin, piano wire for the tailboom, tube for the skids and nuts and bolts, etc. Whilst all turned parts are available, operations like hack-sawing, drilling and tapping are required and, therefore, Jim describes the model as being a model engineering project only suitable for competent modellers.

Having already built a Morley 2b and having subsequently transformed it into a Mk 2c in easy stages, my experience suggested that in building the review model I should concentrate on weight saving.

Space does not allow a complete description of the construction process and so I have concentrated on those areas which are of major interest or where some extra attention to detail is required.

The heart of any helicopter is the engine and it is really essential to obtain this before starting construction. On the 2c, the space around the engine can be a bit crowded with carburettor, fan, fan duct, undercarriage, silencer and needle valve all competing for the same space. Ignoring the advantage that a rear induction engine would give in this respect, I selected the front induction Austro-Webra Speed 40RC.

The engine is fan cooled, power being transmitted to the main gearbox by toothed belt and pulleys providing a reduction ratio of 14:32. A centrifugal clutch is fitted at the gearbox end and power passes upwards to the main rotor via 4:1 reduction bevel gearing and rearwards to the tail rotor via a piano wire drive and 1:1 bevel gearing.

Construction

The transmission system is built around a 'U' shape chassis in 12 s.w.g. alloy which comes preformed and drilled. The base of the 'U' was not quite flat where the gearbox fitted and it was necessary to correct this by filing in order to avoid gearbox distortion. The engine mounting plate bolts directly to the chassis and care needs to be taken when marking this out to make sure that the gearbox and engine shafts are at the design centre distance so that the toothed belt runs correctly.

The engine crankshaft is fitted with a steel flywheel, nylon centrifugal fan and toothed pulley, the assembly being secured by a prop. nut. It was necessary here to bore out the inside of the flywheel to give clearance over the Webra drive plate and front bearing. I also modified the toothed pulley to enable an aluminium spinner nut to be fitted because this suited my electric starter better than the moulded extension to the engine pulley, which was really designed for cord starting. The fan duct was fabricated from 20 swg aluminium sheet and leaving 1-2 mm clearance around the fan periphery to allow for fan expansion when running.

The centrifugal clutch has two trailing shoes which are made from a mild steel turned blank and these expand to engage an alloy clutch housing which is lined internally with the friction material provided. Construction presents no real problems provided care is taken during drilling to ensure alignment of the screw holes about which the shoes pivot.

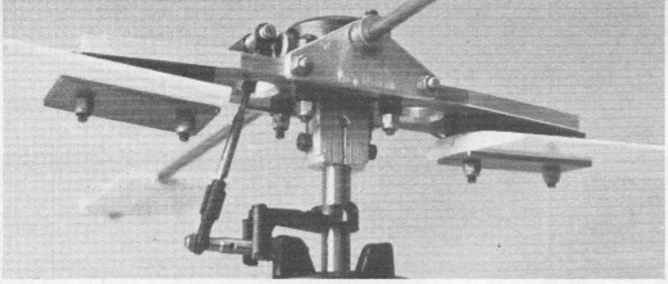
I decided to use ½ in. × ¼ in. light alloy for the undercart legs and aluminium tubing for the skids, this material being available from model engineering suppliers. The skids were shaped using a small pipe bender (friendly plumbers are known to possess these) and the undercarriage legs using a vice with a round bar as a former and plenty of brute force. The undercarriage legs and the skids were joined using metal straps and only a small part of the fan duct had to be removed to make way for the undercarriage fixing. The resulting combination was very much lighter than its steel counterpart on my first 2c.

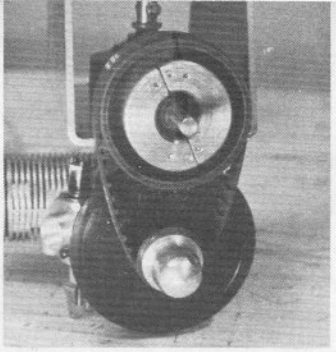
The tail rotor assembly is straightforward, all the parts being provided except the piano wire linkage. The pitch control rod is made from 14 s.w.g. wire which is flattened at one end and drilled through to take a split pin. There was a minor problem when it was found that the control rod would not pass through the hole in the tail rotor drive shaft. This was solved by stripping the gearbox and opening out the hole with a drill.

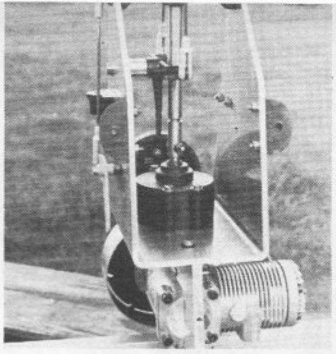
The main rotor featured on the plan is of the flapping blade variety and this type is advised for inexperienced helicopter pilots. However, a sketch is included for a teetering type head for 'experts' and since I had already built a flapping blade head I decided to build the alternative design. The design is simple involving only a small amount of bench work before the assembly can be screwed together. Cyclic pitch control is obtained with the almost universally adopted 'Hiller ' system, miniature ball races being used to minimise friction on the feathering axis. The rotor blades are flat bottom section with a hardwood leading edge and standard balsa trailing edge, each blade being attached to the rotor head with two 6 BA bolts. The plan gives quite detailed instructions about blade and rotor balancing, an operation which is critical if smooth flight is to be obtained.

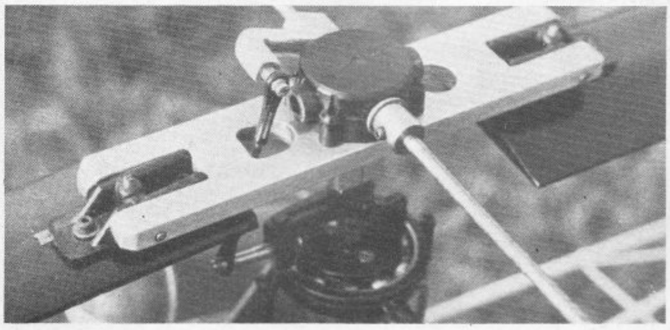
The construction of the cabin is from ply and allows the canopy to be removed to service and adjust the radio, the radio and servo tray being styled to represent the pilot's console. An average modeller would have no difficulty here although there are minor dimensional discrepancies on the plan. Provided part P4 is glued to the bottom face of P3, not the underside, the vacuum formed canopy fits very well . A pair of cabin doors may be added if required – I think it is worth it just to keep oil out of the radio gear.

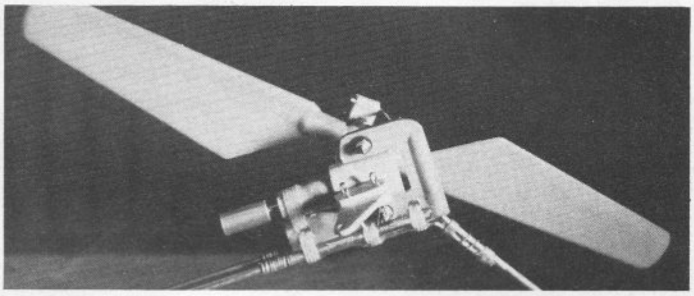
The tailboom needs to be left until at least

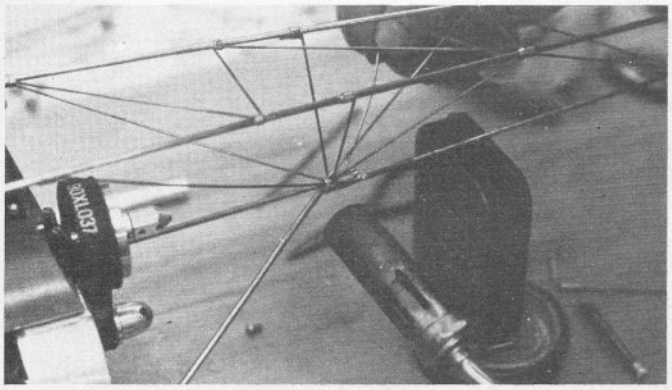


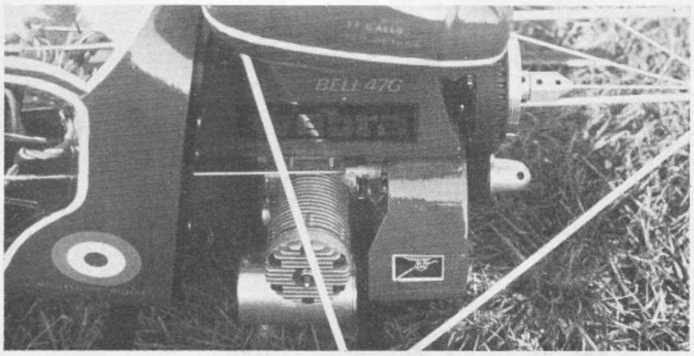












Top left: main rotor 'Teeter Head' of the review model. Top centre: transmission detail showing back of nylon fan, toothed belt drive and trailing shoe clutch. Top right: chassis, gearbox and mast assembly, note sleeve at top of lateral cyclic control linkage. Centre left: alternative 'Flapping Blade' rotor head. Centre right: tailrotor fixing, note extra binding in front of mounting bracket. Bottom left: making the final joint in the tail boom. Bottom right: the power house, Austro-Webra Speed 40 with Kavan carb.

the undercarriage has been completed, I left it till last so that it didn't get in the way during other operations. On my first Mk 2c I used 8 s.w.g. wire for the main longerons and decided for this model to take Jim Morley's advice and use 10 s.w.g. in order to lighten the tail and reduce the amount of nose ballasting required. The boom is of triangular section and made completely from piano wire, bound and soldered together. The top can be made first, flat on the plan, but then after that it is necessary to make a few simple formers or jigs to support the third or lower longeron relative to the top whilst the side bracing is bent to shape. There is no doubt that this whole exercise requires care and patience but the result is well worth while. A propane or butane torch is useful during the soldering process – a 50W electric iron is no use at all – and use Bakers Fluid as a flux. Flying experience with the first model led me to add extra binding just in front of the rear rotor bracket and a stiffening wire at the rear.

The final operation is to make the tailplane and to fit the piano wire drive to the tail rotor. Here I found that one of the couplings provided ran out of true quite badly and so I made a replacement. A 6 oz. square type fuel tank fits quite nicely on the R.H. side of the chassis.

The radio installation follows the usual practice and care taken at this stage is adequately repaid.

Finishing

All that remains is to paint the model. To do this I stripped it down and gave all the metal parts a coat of chromate primer followed by one coat of enamel, using a red and white scheme.

An opportunity was taken to run in the engine on the bench and here I found that it was necessary to replace the standard carburettor with a Kavan carb in order to give smoother mid range control.

After assembly the transfers were added. When properly balanced the all up weight turned out at 7 lb. 2 oz. – a saving of 12 oz. on the previous model. Construction had taken around 120 hours total.

Flying

The engine is started by applying the electric starter direct to the crankshaft. It is almost impossible to choke the engine because the air inlet is inaccessible inside the fan duct, however, priming can be carried out by temporarily pressurising the fuel tank by squeezing it or by blowing down the vent pipe.

The maiden flight in hover took place in my back garden (I have interested and tolerant neighbours) and immediately the effect of the lower weight was noticeable. Take off occurred at about one-third throttle and so I landed, reduced blade pitch and tried again. This time it was much better and all that was necessary was to cut down the tail rotor sensitivity by adding an extension to the tail rotor bell crank.

The next day there was a light breeze and rain was threatening. After a few flights in hover just to get the feel of it, to set the teeter head damping and settle the engine, the throttle was opened and forward cyclic fed in. Off she went with no trouble at all, control was much more positive with the teetering head than with the flapping head and I landed quite safely after a minute or so. The only trouble experienced was that one of the skids had vibrated loose in its metal straps and this was later traced to a slight unbalance of the tailrotor which was easy to correct. By now the cold and wet had become too unpleasant and so I was forced to pack up and go home to savour the experience.

Conclusions

The Morley 2c is an enjoyable model both to build and to fly and one which creates a great deal of interest because of its authentic appearance. The plan and parts represent very good value for money and I can personally vouch for the longevity of the transmission system having used an identical one for nearly two years with no signs of wear. The only failures I have experienced have occurred as a result of crash damage and here it takes a real prang to damage any of the mouldings. Spare parts are readily available and repairs quite easy since one tends to know every nut and bolt having built the model more or less from scratch. Due to the continued development which has taken place there are a number of dimensional discrepancies between the general arrangement and the detailed drawings of the parts provided, but this is only a minor matter.

Could the average modeller make the 2c without any previous model engineering experience? Perhaps the most important thing to realise is that helicopters can be dangerous and therefore if you are one of those modellers who cuts corners in order to get flying as quickly as possible this model is not for you. On the other hand if you get satisfaction from building accurately and are accustomed to making a neat job of engine and radio installations then have a go but get some drilling, tapping and filing practice in first!

Are machine tools needed? A lathe is useful but not essential and most of us have friends with one or with access to one and who would be prepared to do the odd job like turning out a flywheel. A bench drill or a power drill in a stand would be much more useful than a lathe but again, not essential.

Price, complete set of parts and plan £55.08 including VAT from: J. B. Morley, 403 Woodham Lane, Weybridge, Surrey.