A double dose of Schluter's Magic on test

We decided to follow Nigel Ashwood's introduction to the Schluter Magic with this "two-hander" from Noel Cross and David Beckinsale.

First off we have Noel Cross with a description of some of the design philosophy of the machine followed by a blow-by-blow account of construction from David Beckinsale.

Nigel's introduction was published in the August/September 1989 issue of MHW.

So, over to Noel for the first Act:—

The Schluter Magic is the latest brain-child from Dieter Schluter. The model is aimed at the sports and FAI type flyer. The machine incorporates many new ideas thus giving the machine high performance and reliability for a very reasonable price.

Starting at the tail end we find a completely new tail rotor, gearbox assembly. The tail blade holders now incorporate a single ballrace plus one thrust race assembly giving very smooth tail rotor control without any bearing lock up when using heavy T/R blades. The tail rotor hub is now of the tetering type, which also incorporates a rubber damper. Using this system plus the new ballraced pitch change assembly gives this machine accurate and smooth tail rotor control. The gearbox housing is now in four parts: two parts for the gearbox and two others are moulded clamps which attach around the tailboom. The gearbox is bolted to these clamps using four M3 bolts. The thinking behind this is when the tail gearbox is mounted in a fuselage the gearbox is simply bolted via the four bolts to a plywood plate mounted across the tail boom, giving a very strong fixing point for the whole gearbox assembly. The tailboom now utilises a brass tube tail drive guide so stopping any whirling of the drive wire. Using this method gives the drive wire a longer life and so increases the reliability of the system and hopefully making sure you won't have to learn autorotations the hard way.

Main Mechanics

Engines these days are designed to produce their max BHP at high RPM — 15,000 to 17,000 is typical. The Magic is designed around this type of engine. By using a 10:1 gear ratio the engine can turn a large rotor dia. (in the Magic's case) 1490mm at around 1,600 RPM. The way Schluter has arranged the gearing is quite unusual. Instead of using the more usual drive pinion and main gear Schluter has doubled up on this system so now you have the clutch pinion gear driving a larger gear which drives a smaller gear via a shaft to an internally driven main gear. If you didn't follow that have a look at the photo — it will explain it a lot better. The tail drive gear is a separate moulding that is bolted to the main gear so if you manage to strip the gear you only replace this gear and not the main gear as well. All these gears are supported by hefty ballraces, mounted in two aluminium bearing holders. One of these supports the whole length of the side frames, the other about a quarter the length. When this lot is bolted to the side frames you end up with a structure that is extremely rigid — almost crash proof (someone will prove me wrong).

Moving on to the starter system this is where Schluter has made the biggest improvement. Instead of the start shaft being constantly driven, it is now separate from the clutch. It will only engage when downward pressue is applied from the starter. Once the engine has started, the starter is removed and the start shaft disengages. The system uses a slot in the centre of the fan, which engages with two pins on the start shaft. Disengagement is ensured by a spring which pushes the start shaft out of the fan, once the engine has been started. using this method means less engine vibration is transmitted to the airframe, thus reducing fuel foaming etc, and more power is transmitted to the main shaft, instead of the starter shaft asorbing some of that power. The clutch is also totally new. The clutch assembly now uses a tapered collet for correct alignment first time — so no more out of line cooling fans or clutches. This whole assembly is superbly made and seems bomb proof.

Servo & Radio Trays

For a long time now, people have asked when will Schluter replace the wooden servo tray. This was never a problem with me, as I like to do a bit of wood bashing occasionally, but for

The SCHLUTER Magic

those who don't, Schluter has now introduced some new plastic servo trays. These are very lightweight, once again, well made, and allow for a very neat servo-radio installation. Schluter still uses a wooden back plate to support the canopy. This item requires the minimal of finishing, e.g. sanding and painting — thus giving a quick build canopy/servo support systems.

Rotor Head

The rotor head used is the System 88 which uses a plastic rotor head, collective pitch is applied via a rising/falling swash plate, the swash plate being controlled by three tilting servos. I won't dwell on the head and servo tilting assembly as Martin Briggs described this system in the first issue of *Model Helicopter World*.

In Flight (Part I)

"Well", I hear you say, "What does it fly like?" All I can say is it's a very smooth machine with good forward flight characteristics. Aerobatics are a dream, with plenty of control power left to get you out of trouble, the hover is very stable, with cyclic and tail controls being nicely balanced. The settings I used on the model are as follows:

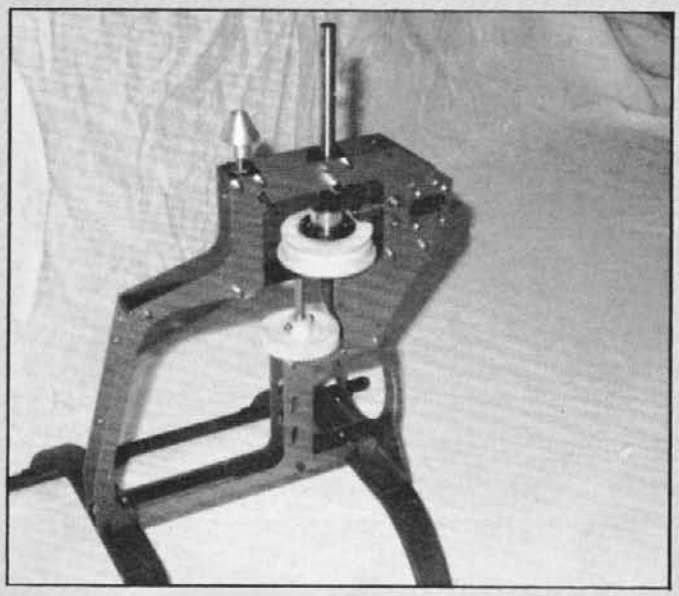
Low throttle and auto –4.5
Hover +4·5
High throttle +9 to 10
Auto high-pitch +13
Cyclic servo throw — at servo ball link — each way 8.5mm to 9mm.

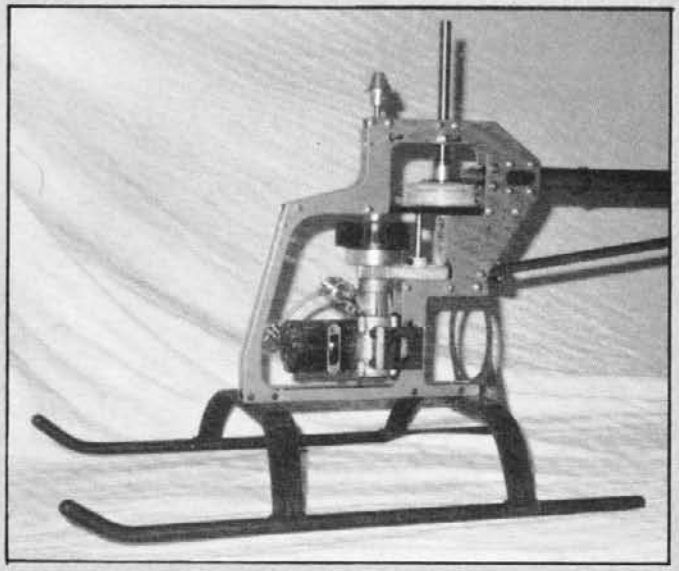
There are a couple of optional extras available. For those who do pirouettes in a hurricane there are 20 to 20 tail gears available, part no. S319. Also a tail drive auto unit part no. S2833.

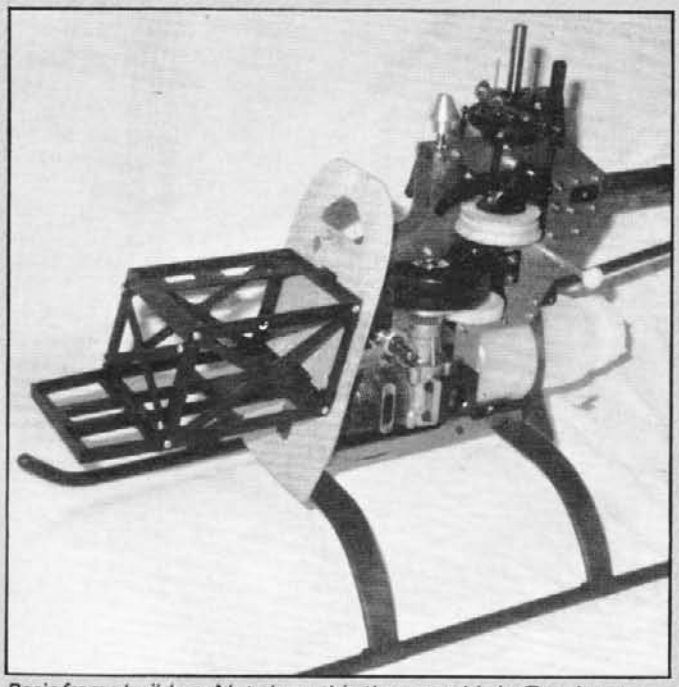
Next we have a detailed building review by Dave Beckinsale who gets down to the nitty-gritty of things:—

One of the nice things about running your own flying display business is that you get to build and fly some of the latest types of radio controlled helicopter. The latest of which for me is the Schluter Magic, it was supplied by Amerang.

The Magic is designed to take a 10cc motor, I used a Webra. It has the System 88 rotor head, however it is a little bit more than an uprated Scout 60. The main difference is the new, two stage drive gear system. I will go into this in more detail later.







Basic frame build up. Note how thin the assembly is. Gear layout can be clearly seen here with conventional spur primary stage followed by the internal second stage and the crownwheel to provide the tail drive.

First Impressions

If you have built any of the other Schluter helicopters then you will know what to expect. Upon opening the box I gazed down on the usual, neatly laid out numbered packages. Two building plan sheets (printed on both sides), a yellow sheet of safety instructions printed in four languages and a comprehensive booklet of building instructions. There were actually three of these, so you could have a go building it in French and German as well as English if you want to.

There are two boxes to the kit, the other box contains the two halves of the canopy. This is similar in shape to the Scout 60 although it has been moulded in such a way that it will fit over the silencer.

The side frames, tail fin and the tail boom are anodised a metallic red, which I thought looked very good. There is also a separate packet containing a set of Allen keys, a large tube of grease and a tiny tube of Loctite.

Now I shall go on to the building. I shall go through each stage, and point out any problems or easy methods of building that I came across. If you haven't got one of these kits then this may be a bit boring for you, but if you have then I hope that this will help you. Remember, DO NOT open any bag other than those involved with the stage you are working on. I have built several Schluters before and by sticking to this rule I have never come unstuck.

One small tip which will apply to any kit, if you open a bag that contains grub screws, put all the grub screws into their appropriate position so you don't loose them.

Assembly

Stage 1 is the assembly of the side frames and the bearing strip. The bearing strip supports the drive system and the starter shaft. It is one of the parts that you won't find on previous Schluters.

Assembling the side frames is pretty straightforward, I found it easiest to do up all the nuts freehand and use a flat surface to align everything when they needed only a couple of turns to tighten them completely. The tail boom sockets are assembled at this stage, there are two, semi-circular cut outs in the top and bottom at one end of the

plastic assemblies. These have to be positioned so they are facing forward. This enables you to check the tail rotor drive shaft is tight after the helicopter has been assembled.

The bearing strip is also aligned on a flat surface and then placed into the side frames.

It takes a little time to align everything properly but it is worth it if you want things to run properly.

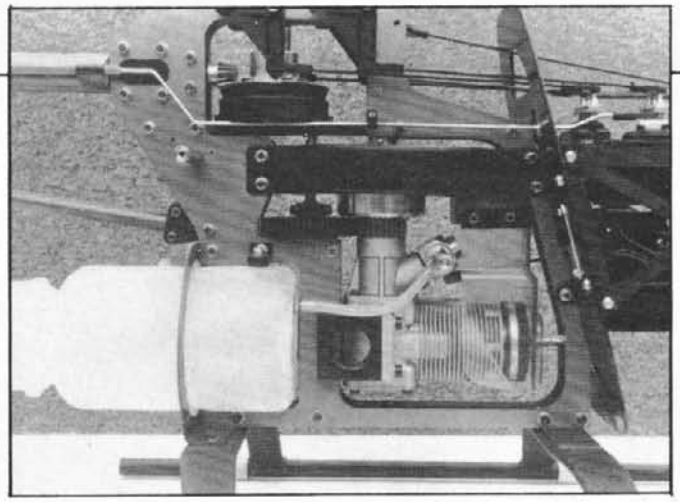
The landing gear has now to be added to the side frames. This requires a little bit of model engineering, i.e. the drilling of two holes in the rear leg so that the fuel tank holder can be bolted in place. I wonder how many of you who fly Shuttles and Concept 30's can remember how to do this! Once this is done the legs are bolted to the main frame, the bolts are done up from underneath, into a threaded block, Loctite is used. I liked this method as it meant that if the undercarriage works loose it is far easier to do up, no more fiddling to try and get an Allen key under the fuel tank. The last part of this stage is to add the fuel tank retainer. If you have any nuts and bolts left now you have missed something, so go back and check.

We now come to the part of the helicopter that sets it apart from all the previous Schluters, the drive system and the starter shaft. These are both mounted around the bearing strip.

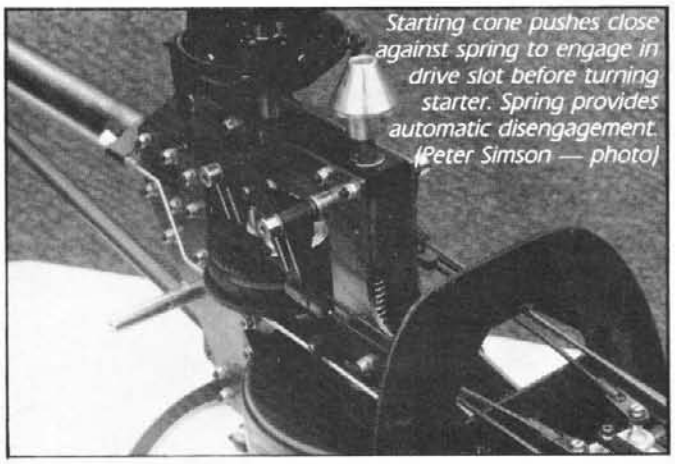
The drive system in the Magic is really very similar to the Heim helicopters. In the early marks of Schluter the rotor and tail were driven, via a clutch by one main drive wheel. The Magic on the other hand, has two drive wheels and works as follows. The engine sits on its back and drives a gear wheel, a shaft from the gear wheel goes into a bell with internal gearing. This bell drives both the main rotor and the tail rotor. The clutch and clutch bell are fitted to the engine, thus eliminating the need for the usual type of starter shaft.

Assembly of the starter shaft and main drive is fairly straightforward, the only complaint here was that one of the drive shafts was in a separate bag and not in bag 3.

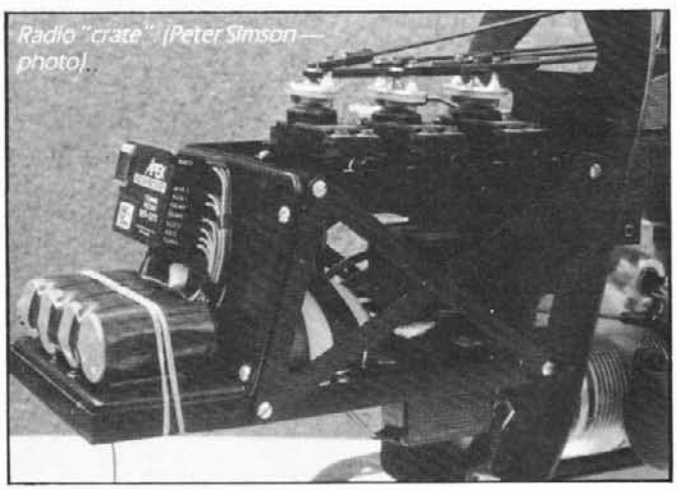
The starter shaft is spring loaded. It is necessary to set the tension of the spring to get it to work properly, it didn't tell you by how much to set it but I compressed it by about 8mm



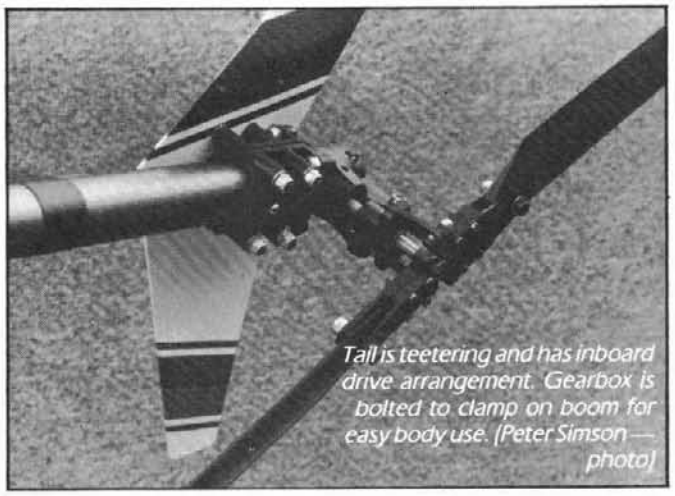
With motor in place and cooling shroud fitted it looks like this. Kinked tail pitch rod is an odd touch. Noel obviously subscribes to the Dave Day school of fuel filtering. (Peter Simson — photo).



Starting cone pushes close against spring to engage in drive slot before turning starter. Spring provides automatic disengagement. (Peter Simson — photo)



Radio "crate". (Peter Simson — photo).



Tail is teetering and has inboard drive arrangement. Gearbox is bolted to clamp on boom for easy body use. (Peter Simson — photo)

on the shaft, this I found works perfectly.

The second stage of the drive system is quickly assembled, the auto-rotation unit was in a separate bag so look in the box before you ring to complain. *PLEASE NOTE it is essential to grease well the internal toothed gear, if you do not it will quickly wear out. I also grease mine after every few hours of use.* The later kits will carry this instruction although the earlier kits do not.

When all this is done it is time to assemble the tail rotor drive system. I deviated from the instructions here slightly by filling a flat on the tail rotor driven shaft at the end that takes the bevel gear. I don't like doing things that are not on the instructions when I am reviewing a model but I know from experience with other Schluters that it is necessary. If you file a flat on this part then you will not get any trouble, if you don't then the bevel gear may work loose. Then you find out how good you are at doing pirouettes.

It is now time to fit your engine, I used a Webra 61 with a TN carb. First of all it is necessary to fit the clutch, clutch bell and fan hub to the engine. The kit is supplied with spacer sleeves and split taper collets of 8 and 9.5mm, you have to fit whichever is appropriate for your engine. To fit the clutch bell you have to remove the prop driver, then you slide on the clutch bell. After having fitted the right spacer sleeves and collets you then put on the clutch and fan. I found that when I tightened up the propeller nut the clutch was rubbing on the bottom of the clutch bell. To fix this I undid the fan and clutch, laid them on the bench with the clutch on top of the fan hub and hit the centre of the clutch. It is best to cover the clutch with some wood. This did the trick as I was then able to tighten up the propeller nut as tight as possible. The clutch and fan are already assembled, it probably is only fitted loosely and is left to the builder to fine tune it.

Once the fan and clutch are fitted the engine is fitted to the helicopter. It is necessary to ensure that the starter shaft will disengage from the fan housing freely. This I did by rotating the engine with shaft engaged and making sure that the shaft

would spring up at all points throughout the rotation. Once this is done it is necessary to check that there is no slop in the rest of the system, it is a lot easier than having to align the old style starter shaft system.

One improvement to the mounting of the engine is the engine mounting blocks. These are far superior to the older types, instead of two bent metal plates the engine is fixed to two threaded metal blocks. There are four holes drilled in each block in order to accommodate a wide variety of engine types.

Tail End

Installing the the tail boom was straightforward, I expect that you will find it necessary to slacken the bolts that hold the tail rotor drive system in place.

The horizontal stabilisers are fitted now, I found it rather difficult to screw the plastic stabiliser onto the threaded stud. This was easily remedied by placing the stud into a hand drill, pushing the stabiliser onto the stud and at the same time gently turning the drill. You will then feel it bite very quickly. Don't turn the drill more than two turns at once though or you may damage the stabiliser.

Now the tail boom is in place we now have something that is beginning to look like a helicopter.

The tail rotor gearbox is now assembled and fitted onto the tail boom. There are some changes to the gearbox, the end that connects to the tail drive is more or less the same as before, but the tail rotor shaft has been changed with respect to the pitch change mechanism. It comes pre-assembled, all you have to do is fix on the blade holders and blades. However the pitch change unit is now the same as the Heim. For those of you who are not familiar with this I had better describe it. Before the tail pitch was changed by a thin metal rod, this slid through the centre of the tail shaft. It worked very well but I found that it was easily bent if you were careless and banged it on anything whilst moving the helicopter. The new system has a pitch slide movement that goes over the tail rotor shaft, it works like the swash plate which slides up and down the rotor shaft.

The fully assembled gearbox is now attached to the vertical stabiliser, then once the tail drive wire has been attached, the whole unit is fitted to the tail boom. Here the instructions tell you to do up the grub screw one full turn after you feel it touch on the tail rotor wire. I would strongly advise you not to do it that way, I did on an earlier one and stripped the thread on the grub screw. The best way to do it is to start at the tail, feed the tail wire into the gear box, with the flat on the wire facing the same side as the grub screw. Once the wire is in position slowly tighten up the grub screw whilst at the same time gently twisting the tail wire from side to side. Eventually you will feel the two edges of the flat on the wire tapping against the grub screw, you will then know that the grub screw is nearly tight and more importantly, that the tail wire is being held properly by the grub screw. That's what they actually mean in the instructions I think, perhaps the translator got a little lost here.

When you have done up the tail wire at the gearbox end in this fashion you will be able to do the wire up at the front end more easily, you will also know that the grub screw is located on the flats at both ends.

The swashplate is controlled by four pushrods, which are connected by bellcranks to the servos. I will describe this in more detail when I talk about setting up.

Assembling the swashplate is again straightforward, the hardest thing I found was finding drawing 11a on the plan. The collective pitch compensator is also put together now and the two units are slid onto the rotor shaft.

One thing I should mention is when assembling the swashplate, the swashplate ball is held in place by a steel ring. This must not be done up too tightly or the swashplate will be unable to pivot on the ball.

The swashplate is steadied by a plastic holder, which is fixed behind the rotor shaft. To fit it in place I had to slacken off the bolts of the top rotor shaft bearing to allow the swashplate holder to slide easily into place.

The swashplate is then connected to the bellcranks with the plastic ball links. These are provided with plastic spacers so that they can all be set easily to the same length. It must be remembered that Schluter ball links are designed to be fitted with the word Schluter facing the outside.

Noel Cross and model. (Peter Simson — photo)

Plumbing

The fuel tank is the next item to be fitted. I would strongly advise that you position the fuel filler pipe and the pressure pipe not in front of the fuel tank plate, as they say on the plan, but put to the rear of it. Then if you want to take out the fuel tank for any reason, all you have to do is undo the tank retaining bolt and slide it out. If you do it their way you will have a hell of a job getting the tank out.

The feed pipe can be fitted where they say on the plan. The best way to fit this is as follows. Connect the uncut fuel tubing, onto the feed pipe and then dangle it into the bottom of the tank until you can get the pipe through the hole that you have drilled. Decide how much fuel pipe you need and take it out, trim the fuel tubing to length, fit the clunk and then put the feed pipe back in place. I found that the length of the clunk pipe should be approximately 95mm, but check first.

The kit also contains a remote glowplug connection, this is fitted at this stage. A little bit of soldering is required here. The completed unit is fixed to the fuel tank plate. For those of you who would rather not use this remote connection it is possible to reach the glowplug with a long plug clip. However that would mean having to either struggle to get the clip on every time or putting the canopy on and off each time you start the helicopter.

The fan housing has to be fitted now, this part is the same as on the previous models and only has to be cut to size. This is only a case of cutting to length, if you use a Webra 61 there will be no need to do any more trimming. There is a clear plastic fan housing extension provided, in fact the superglue I had would not stick the extension to the fan housing. I de-

cided to leave it for the first few flights and see if the engine needed it, since the flight tests I have decided that for my engine the extension is not necessary. Please note that I am not recommending that you don't fit it, only that it wasn't necessary in my case. [This was before the Summer of '89! — J.D.]

Now we come to the rotor head. This is the same as on the Scout 60, the blade holders and the main rotor hub are made of plastic rather than the metal of previous designs. The rotor head comes with a choice of flybar paddles, the standard thin paddles that you find on the Champion and the Helistar and a pair of thick profile paddles. The thicker paddles will give a more stable response and should be well suited for the learning stage, the thin paddles will result in a more lively helicopter and should be saved for when you are more advanced. That's the theory anyway, if I get the chance I shall try the thicker paddles but for now I shall be using the lightweight paddles.

The rotor head has to be assembled — one piece of advice here. The blade control levers are fixed to the blade holders by screwing them into two little threaded blocks which fit inside the completed blade holder. It is best to fit the fixing bolts in them temporarily when joining together the two halves of the blade holder. This way they will be located in the right place, I didn't do this and found it necessary to undo one blade holder to reposition the blocks.

When fitting the flybar paddles I always make sure that each paddle is done up by at least six full turns, however many turns you decide upon make sure that it is the same for both sides, that way you will ensure that everything balances properly. As I said before, I used the thin paddles and set the flybar up with the weights right up against the paddles. If I used the thicker paddles I would still have the weights as far out as possible.

We now move on to the next new feature on the Magic, the front cabin structure. In the past this has been made out of wood and many people recently have wished that Schluter could update this part and make it out of plastic, like all the other leading manufacturers. Well now they have! There is still one piece of wood left, this is the cabin former over which the canopy is fitted. The plastic frames have all the cut outs for the servos, I would suggest that you drill the fixing holes for the throttle servo, which fits into the lower frame before you screw everything together. If you don't it gets a bit fiddly doing it when everything is done up.

David Beckinsale and model.

The wooden cabin former has to be fuelproofed, once I had painted this I deviated from the order of assembly and covered the blades and cut out the canopy whilst I waited for the paint to dry.

I am not going into great detail about covering the blades, that could take up a whole review. I would suggest that if you are new to the sport you buy Schluter's book on helicopters as this tells you exactly how to do this. It's also a useful reference book.

The canopy fits together easily if you follow the instructions. I found that Loctite Superglue 3 worked best. Once the canopy is joined together don't paint it until you have assembled the front cabin structure. With the cabin structure in place, slide the canopy into position and mark the position of the canopy holder. When you have found the right place to drill the hole you can then do this and the canopy will be ready for painting.

When I had done all that I assembled the cabin structure and moved on to the next stage which is the installation of the servos and the assembly of the mixer. The mixer is the final part of the System 88 rotor head, as mentioned earlier the collective pitch is altered by sliding the swashplate up and down the rotor shaft. The swashplate is supported by four bellcranks, of which one pair operates the pitch of the nose up and down and the other pair operates the roll. Together all four work to increase or decrease the pitch. One servo works the roll, one the pitch and one works to tilt all three to work the collective. These three servos are mounted together in the mixer.

Installing the servos in the mixer is simple, it is all drawn out in great detail on one of the plans. However the plan does not give the lengths of the pushrods, the lengths of these can be found on the back of the instruction booklet in the list of parts.

The setting up of the head can be done easily and quickly by following the diagram on the plan. Using the jig provided the middle range value comes out at 2.5 degrees. I did feel that it should be 3.5 degrees but I decided to wait and see what would happen when I flew it.

Once the servos were installed the gyro, battery and receiver are fitted so as to balance the helicopter correctly. I had to mount all three as far forward as possible, without the canopy on the helicopter was very slightly tail heavy, with the canopy fitted the helicopter balanced slightly nose down.

Final Setting Up

The set up of the model that I used is as follows:

Bellcrank movement to swashplate = 7mm either side of centre.

Full throttle pitch = 9 degrees

Low throttle pitch = –4 degrees

Mid throttle pitch = 3.5 degrees

Tail rotor pitch at mid throttle = 8 degrees approximately.

A simpler way to get the tail rotor set up approximately is to fold the tail blade down so that it is running parallel to the tail boom (with the tail rotor unit running vertical), the tip of the tail blade should then be set to be about 2cm from the tail boom.

These settings I arrived at after the test flights.

Building time was 20 hours.

In Flight (Part II)

This is the part I like best. By the way hands up all of you who are reading this part first, if you have then you won't know that the Magic has a special sort of starter shaft. So take a hundred lines and go back and start at the beginning!

The way to start the engine is first push the starter shaft down and locate the pins in the top of the cooling fan. Second push the starter onto the shaft and spin the engine, provided you did connect the glowplug the engine will soon fire and you can remove the starter.

I didn't find it any easier than starting an engine with the old style starting shaft, but it wasn't any harder either. The main be-

nefit is that the shaft only rotates when it is needed and so eliminates a source of vibration.

The take off was rather a non event really, I was feeling a bit nervous, however it was a beautiful day so I increased the collective and took off into a hover. It appeared, and felt, to be a very stable machine, but certainly not a docile one. I mean by that it was rock solid in the hover, but it also felt as if it could be very lively if I wanted it to be. I then landed it as I had to adjust the tracking a little, I also had to increase the mid range pitch to that which I have detailed above. I tried to start it again but my 2 volt battery had had enough, it was just as well really because just after I had put everything away it started "....ing" down, isn't out climate lovely!

The next day was quite windy, even for Cornwall, with the wind blowing betweeen 15 and 25 mph. We had to take pictures though so I started it up and took off. The Magic handled the wind really well, its only response to the gusts was to rise up. It coped with the wind at all angles, from nose in, tail in and side on to the wind. It wasn't much fun standing out in that weather so I landed it and we went home.

Day 3 arrived and the weather was lovely again, no wind and no rain. This time I could do a more objective test of the flight characteristics. The tail rotor response was good; slow and fast pirouettes looked very good. The pitch and roll responses were good, in forward flight the helicopter had a smooth feel to it. Operation of the collective pitch did not induce any tendency for the nose to pitch up or down. I have done one auto-rotation with it, but being a coward I shall do no more until I have some fibreglass blades on it, I like the margin of error that you are given with glass blades.

I have also tried the model with a set of Sitar blades that were meant for the Champion, these are about an inch shorter than the Magic blades. With these on the engine coped a little better and it seemed to fly a little better too.

I have tried the helicopter with both sets of paddles, the thin profile paddles I used with the flybar weights, the thicker profile paddles I used without. To be honest I couldn't tell the difference, I think though that with the weights and the thick paddles the helicopter would be far more docile.

In forward flight the Magic will go very fast and as I expected it is suitably aerobatic.

To summarise then I am very impressed with the Magic, it is an excellent flying machine.

I do have two criticisms, one of which has already been taken care of. Firstly the instructions should have told you to grease the internal toothed gear to prevent premature wear, this has now been done though. Secondly I think that they could have supplied a larger tube of Loctite in the kit. If you are like me you will not be under generous in the application of Loctite and I ran out very quickly.

Once again though it is a very good flying machine and if you have one or are thinking of getting one then I hope you enjoy flying it as much as I do.□