A VERY NICE HELICOPTER

A Review of Jim Morley's Scale Agusta 109 by Roger Moore (not the 007 variety) of Tennessee.

The Agusta 109 is the latest scale edition to the Morley line. The kit contains a polyester glass fuselage, mechanics, and an impressive retracting undercarriage. The model accepts .40 to .45 engines and a 7 channel heliradio.

Most „High-Tech" helicopters contain ten or eleven ball bearings in the tail box assembly alone; the Morley, however, has only eleven ball bearings in the entire machine. How does Morley do it? Obviously bronze bushings are used in lieu of ball bearings, which doesn't compromise performance at all. A reduction in the number of ball bearings is conducive to less overall model weight. which is why a .40 to .45 can handle the load well.

Instructions

The instructions in any kit play an important role in the construction process. For the most part the instructions are adequate for the Agusta. It would prove valuable, however, if more detailed information on rotor head set-up could be provided as well as photographs of the model in various stages of construction. Detailing bolt length at each step of the construction could also prove helpful.

Building the Mechanics

Rather than a step by step account of the assembly of the mechanics, a brief description of the works and building highlights is provided herein. The mechanics consist of an aluminum stamping that mounts the engine; speed reduction via a set of timing pulleys to the clutch pinion shaft which drives the main bevel gear enclosed in a wet gear box. A sleeve is used to connect the gearbox to the main rotor shaft and is supported by an 8 mm. ball bearing in the gear box and a sintered bronze bushing on the main shaft. The tail drive is taken off the opposite end of the clutch pinion shaft.

The engine is mounted on nylon rails with flywheel, fan, timing pulley, and V-groove starter pulley. A shroud directs air over the cylinder head to cool the engine while fresh air is drawn through an opening in the models floor. The gearbox went together with no problem. The engine mounting rails required milling to obtain a flat surface on which to sit the engine. Milling .010 inches off both rails proved to be adequate. Both rails had a ridge of approximately .007 inches each which made engine mounting an inaccurate proposition. If a milling machine is not available, the mounts can be filed flat in a vice, using the top of the jaws as a guide, being careful not to squeeze them. When the engine was mounted per the instructions the rails were too wide for the chassis mounting holes, necessitating having to elongate them. The flywheel required drilling to fit the engine shaft using a quarter inch drill in a drill press only. (Don't drill it by hand). The flywheel assembly was balanced in the „High Point" balancer and was very close. All that was needed to correct the imbalance was to rotate the flywheel in the fan. The flywheel assembly was then fitted to the engine and checked for run-out. Run-out of the unit was .002 to .003 inches all over. The assembly was then installed in the chassis. Everything went per the instructions until the clutch pulley and clutch bell were installed. Axial play in the pulley was .070 inches (over a sixteenth of an inch). All that was necessary to correct this was a couple of washers. Be sure to lube the washers with a small amount of moly grease.

This is the first model I have ever built which required assembly of the swashplate. It is made entirely of glass filled nylon moldings and twelve steel balls. There is a top plate, center plate, bottom plate, ball cages and center ball. These pieces sandwich together around the center ball with the steel balls acting as a bearing. While this assembly went smoothly I made a few interesting discoveries. The main shaft, clutch pinion shaft and pushrod hardware were American standard sizes! I thought this was a little out of place considering the large amount of metric nuts and bolts. The pushrods are 256 threaded rod, which is great because I have lots of these in my spare parts bin; also, the Agusta comes with lots of extra ball links because some don't fit the balls or the pushrods as well as others because the holes in the ball links were molded off center.

The rotor head was next on the list of mechanical things to do. I skipped around a little bit, saving the fuselage for later. The rotor head consists of a flat plate with axle stubs molded over it. Bearings are then pushed over the stubs followed by nylon caps with two steel plates, top and bottom, all bolted together. The flybar carrier is bolted directly on top of the head with two cap screws. The pictures illustrate the general bits and pieces that make up the rest of the head including the „Bell" mixers. This head looks very similar in general to the one produced by „Aerospatiale" for their helicopters. The head is very light and very strong and while it doesn't contain thrust bearings, it shouldn't need them because of the light weight of the rotor blades. Morley's kits usually come with a Hiller only head, but in the Agusta the mixer pack is provided as standard. In my particular kit the flybar paddles were cracked, which made it necessary to replace them. I didn't especially like the manner in which the paddles attached to the flybar, Morley uses a brass collar in the end of the paddle to clamp on a dimple ground into the flybar. I didn't have another set of paddles to fit the Agusta, so I replaced the stock flybar and paddles with parts from another brand of helicopter.

The Morley tail box uses a standard miter gear set, with the input and output shafts running in a combination of ball bearings and bronze bushings. A good quality moly grease should be used to lubricate the gears since they aren't hardened. The rotor hub comes in two halves which encase two large ball bearings with each blade holder screwed to the inner race. The blade holders, along with the tail blades were a little rough, so use a file or sharp knife to smooth them up. Most models use a nut and bolt to secure the blades to the holder, but cotter pins are used instead. I found the tail rotor to be slightly out of balance when I checked it on the „High Point" balancer, only a drop of cyano was needed to correct this. The pitch change unit is the standard wheel collar and flat plate type which finally has really big set screws in the wheel collars that don't strip as easily as the usual tiny screws. Be careful to check that the blades are pitched the same. Mine weren't and I had to cut a little off one ball link to correct this. Please remember to file flats for the tail rotor hub and input coupler. Tail drive is accomplished with sixteenth piano wire and two large nylon hexagon ball drivers and nylon sockets. These should give no trouble at all. I used a special dry teflon lubricant, called „Fluoro Glide" to lube the drive wire and socket assemblies.

Fuselage Construction

The Agusta fuselage is an excellent piece of mold work. Panel lines and door latches are neatly molded in the surface, with these details providing a guide for the modeller to cut out windows and the retract doors and openings. The only problem I had was fitting the top hatch to the body; mine didn't fit well. This presented only a small problem that a little resin and baby powder cured. After the window openings were cut I fitted the plastic windows, and plastic tail piece. Its important to fit the tail tube exactly per the instructions to have proper tail blade clearance. This model has a really clean tail installation with the tail pushrod cleverly hidden by the tail cone. The horizontal stabilizer wires were glued in with „Stablit", and given a slight bend to hold the stabs in place. I used „Stablit" to join the tail section to the body, and used the before mentioned baby powder resin mix to fill the gap between same. I cut the retract doors, and then built the retracts. Make a photocopy of the retract assembly drawing to use as a drill guide after the bulkheads are sanded to fit the fuselage. I played with the main gear for

a while to make sure it worked to my satisfaction.

The side windows are removable for flying, while the front windows are held in place with little plastic tabs cut from excess plastic and the windshield wipers. The wiper arms are glued to the front windows, and with the instrument shroud in place this completes the front of the fuz. The side and top windows are installed after the paint work is complete.

Retracts

After the bulkheads are in place and the retracts installed, then you will have to install the retract servo and linkages. If only one retract servo is used make sure the rear mounted idler arm is mounted as low to the floor as possible and still permit operation. The front mounted servo should lay down on the floor so the pushrod to the rear is as low to the floor as possible. The rear linkage will now clear the mechanics and still operate both sets of gears. I suppose some of you have guessed that I didn't use one retract servo. You're right! I guess I'm just lazy, but it was too easy to use two servos, and while I'm on the subject of retract servos Ed Brannan of „Hobby Radio" kindly made up a „Y" cord with a seperate battery to power the servos. Using a seperate power source insures that if for some reason the retract servo should be stalled it won't kill my receiver power.

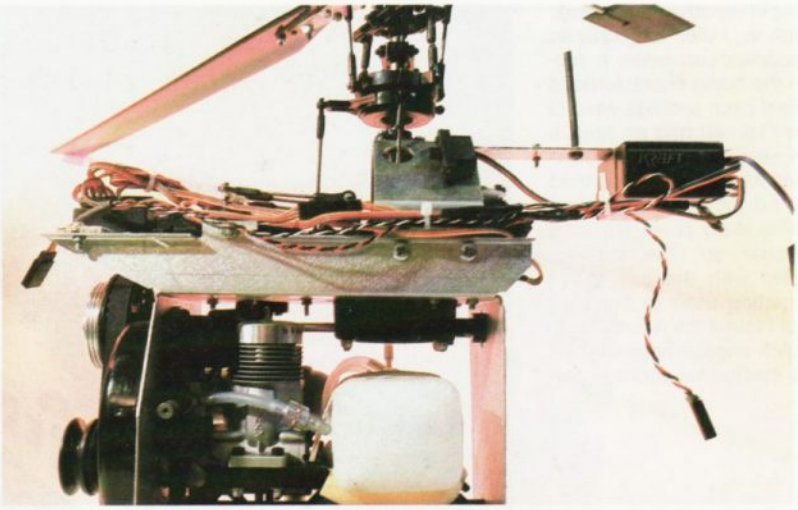
Pictures don't do the retracts justice as far as portraying just how they work. I hope this description will be adequate: with the gear up in the body, as the gear comes down it will open the doors, and as soon as the gear is far enough down, the door snaps back into place by rubber band power. That was pretty easy to do, but the big trick here is to make the doors open, then pull the gear up and close the doors. The door pivots have cam followers molded in so that as the gear cycles upward a cam swings the door open, the gears move inside the body and the rubberbands close the door to complete the cycle. The retracts work better than my explanation I assure you.

Servo Installation

Information on the servo installation is rather sketchy and there are many choices available to the builder. My only suggestion is to plan carefully. If the installation is a good one, it will result in a nice tight control system. There is also a choice to be made as to where the tail rotor servo should be mounted; fore or aft. I chose the aft mounting because it offered a straight shot to the tail rotor. My gyro is mounted in an unusual position, but it works.

Rotor Head set-up

This rotor head is different from the ones I usually fly and not a lot of information is given on set-up in the instructions. I'm not an expert on the Morley rotor system so the suggestions given here are my own. I set all the mixing levers horizontal at half stick. This should give a nice linear feel in the hover, and should be satisfactory throughout the pitch range. The blades were drilled according to the instructions and covered with heat shrink blade covering, they were then inserted into the molded holder and installed in the main blade holders. Collective pitch range was set mechanically for -4 to + 9 degrees total pitch travel and then dialed down at the transmitter. The pitch was then set to -1 to + 7.5 degrees using the pitch curve facility. I then removed the head from the mast and balanced it on the „High Point" balancer.



The mechanics all ready to be installed in the fuselage.

Balancing is a technical art, one which is shrouded in mystery. For some reason manufacturers do not give much information in correcting imbalances in spinning systems. Balancing a rotor head by weighing the blades and correcting for the light blade is much like having the wheels on your car bubble (static) balanced. The fact is correcting for just blade weight and C.G. is just a part of the overall picture. What do you do about the C.G. of the flybar and the Z axis? What? (Main Shaft) I've always been told that my rotor system must be dynamically balanced. Well, the simple truth is, if a „High Point" balancer is used to correct the span-wise and chordal center of gravity of the rotor head, and the blades are in track, the rotor head is dynamically balanced. The only way to properly balance a rotor head and know in any quantitative terms is to balance it in its plane of rotation. Any machinist who has balanced grinding wheels will agree with the previous statements. If you have followed along so far you now understand the basic principle of the „High Point". I'm sure Colin will get lots of letters on this, but, I will tell you my Agusta was dead smooth the very first time I flew it. If more information is desired I suggest reading a few back issues of „Model Builder" that cover this subject in depth.

Painting

Painting is always the fun part of any project, and with a little luck it usually goes well for me. I thoroughly blew all the dust from the fuselage and primed all areas that I did any work to with lacquer primer-surfacer. All material that I used on the model was shot with a gun. The fuselage was then sanded with 360 grit wet or dry working my way to 500 grit paper. Acrylic lacquer was used for the color coats with acrylic urethane for the clear coat. A word of caution; if you don't have the proper respirator equipment DON'T SPRAY ANY ISOCYANATE PAINT, PEROID. The colors I chose were Glacier white, Autumn Firemist metallic and Subaru Blue metallic. The paint scheme came from a „Sikorsky S76" that was pictured on the cover of „Rotor & Wing" magazine. Although there is a lot of difference in the shape of the two machines the paint scheme came out fairly well.

Final Set-Up and Flying

I chose a JR Century VII with NES 501 BB servos and Futaba S-8 retract servos and a Kraft KG-1 gyro. A 1200 mah Varta battery pack was used for the flight pack along with a seperate 500 mah battery for the retracts. Set-up information was minimal, so I used my own experience as a guide. Basically, the swashplate and tail rotor moved stop to stop. I set the throttle slightly ahead of the pitch servo with the plan being to fine tune the machine with the hovering throttle pot and pitch trim. The engine I chose was an O.S. .40 FSR ABC which started and idled right out of the box.

A muffler for the Agusta was not available here in the States so I made one from the muffler provided with the engine. The mechanics were installed back in the fuz and the fun began . It was a good job just hooking everything back up. Careful routing of all the wires will ensure easy access to the servos and cyclic control rods as well as looking nice. A Sullivan slant tank was used in place of the stock tank to provide a little more room in the fuz.

When the first flights were attempted the weather was not very cooperative, in fact it was twenty one degrees with a wind chill down to zero. Nothing worked quite right that day so I waited a day and tried again. My friend Lance Lewis was not available to shoot pictures of the Agusta hovering because of the weather. I still managed to fly the Agusta by starting it in my garage and carrying it out to the field next to my house. It took a little while to sort everything out, but I finally got it trimmed fairly well. The machine hovers very well even with a rotor speed of about 1150 RPM. This rotor speed requires a bit more pitch

than I'm used to running in my other helicopters. The Morley head is high in „Hiller" authority so a change in flybar paddles can make a pronounced difference in the flying characteristics of this machine. My final pitch settings were O to + 8.5 degrees. The O.S. .40 had no trouble flying the Agusta even weighing eight and three quarter pounds. Limited forward flight was tried with the Agusta with no problems being encountered. This machine really penetrates well especially with the gear up. The counter-clockwise rotor coupled with the low speed gearing take a little getting used to but after everything is sorted out I found the Agusta to be very tractable. The clutch engagement was silk smooth with the entire mechanics package performing very well.

Roger Moore displays the reviewed model. Very carefully built and this can be seen in this immaculate model of a lovely scale design. ***Photo: Lance Lewis***

Model or fullsize? Pretty impressive isn't it. ***Photo: Jim Morley***

A nice shot showing the retracting gear in operation. ***Photo: Mike Young***

Critique and Final Comments

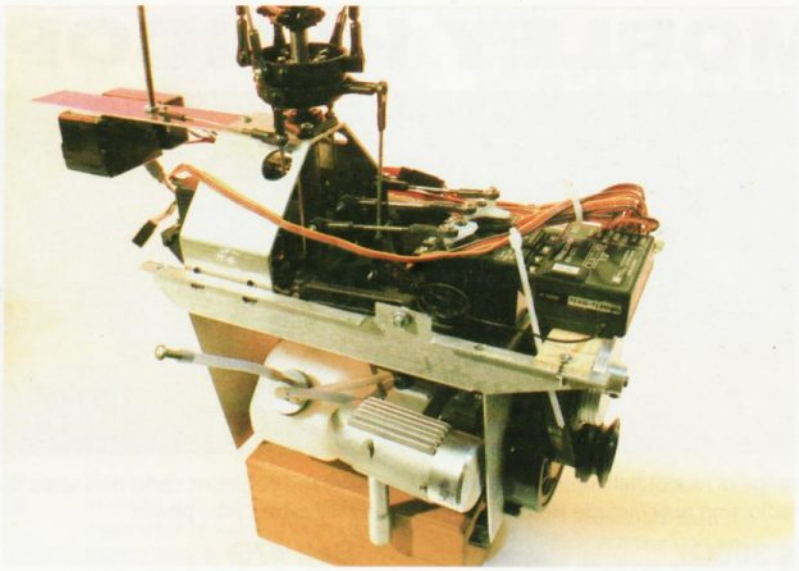
The negative aspects of this kit are as follows: 1) The instructions need improvement as mentioned earlier. 2) The engine mounting rails should be flat where the engine is mounted. 3) The ball links should be molded more accurately. 4) The flywheel should be drilled by the factory. 5) The tail rotor blades and blade holders should be molded more accurately to insure correct tail rotor tracking. 6) In my opinion the bronze bushing used to support the main shaft should be changed to a ball bearing.

The Machinery's Handbook gives explicit advantages and disadvantages that apply to plain bearings, in most cases plain bearings have higher power consumption and require more stringent lubrication practices. In this case the latter is the deciding factor for suggesting a change to a ball bearing. In some of Morley's other helicopters the bronze bushing will work fine, but in this machine it is a real hassle to keep a constant supply of oil on this bearing. 7) Finally, I should not have to drill main blades, this should be done by the factory.

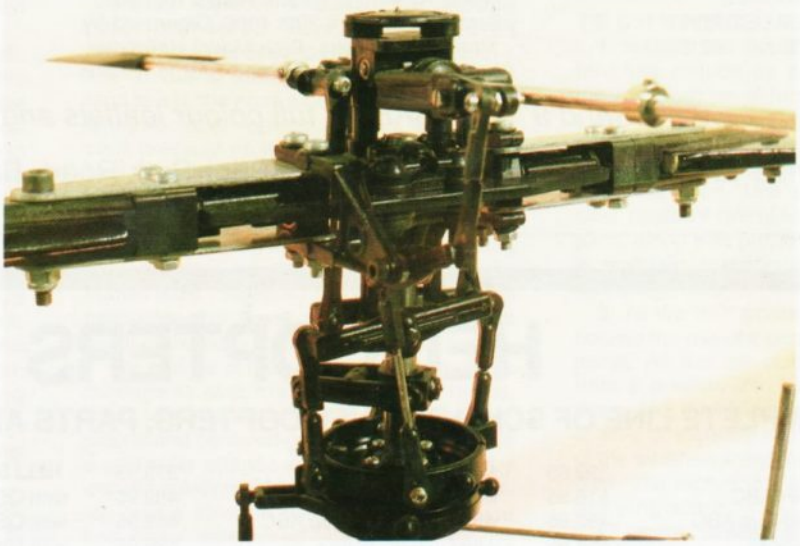
The positve aspects are: 1) This helicopter has an exceptionally reasonable price. 2) The spare parts prices are without a doubt very reasonable. 3) This kit with its retract landing gear makes all the other Agustas look plain. 4) The rotor head isn't ten inches above the top of the helicopter like some other Agusta models. 5) The mechanics are relatively easy to remove requiring about nine actual minutes to remove. 6) This is the only .45 size scale model with retracts on the market. 7) Fuselage surface detail is excellent with a very nice gelcoat finish.

Overall I am pleased with this model. I think Jim Morley deserves tremendous praise for producing this model and concentrating on producing .45 size machines that can be afforded by almost anyone. The use of injection molding to produce parts for his line and keeping parts common througout the line spells economical prices. In the future a manufacturers ability to produce plastic helicopters will decide whether or not that manufacturer will be able to command a position in the marketplace. We are starting to see that now with models produced by other companies. I don't think .60 size machines will ever fall by the wayside, but, its clear .45 and .28 size machines are the ones to watch. Plastic helicopters will not find favor with everyone, (those who don't have them to sell). The Agusta is a very nice helicopter and I look forward to trying another Morley helicopter and possibly the four bladed head.

Manuf. List
High Point Products/3013 Mary Kay Lane/ Glenview, Illinois 60025/(312) 272-8684
Fluoro glide Chemplast/150 Dey Road/ Wayne, New Jersey 07470
Hobby Radio/322 South Gallatin Road/ Madison, Tennessee 37115/(615) 868-6811



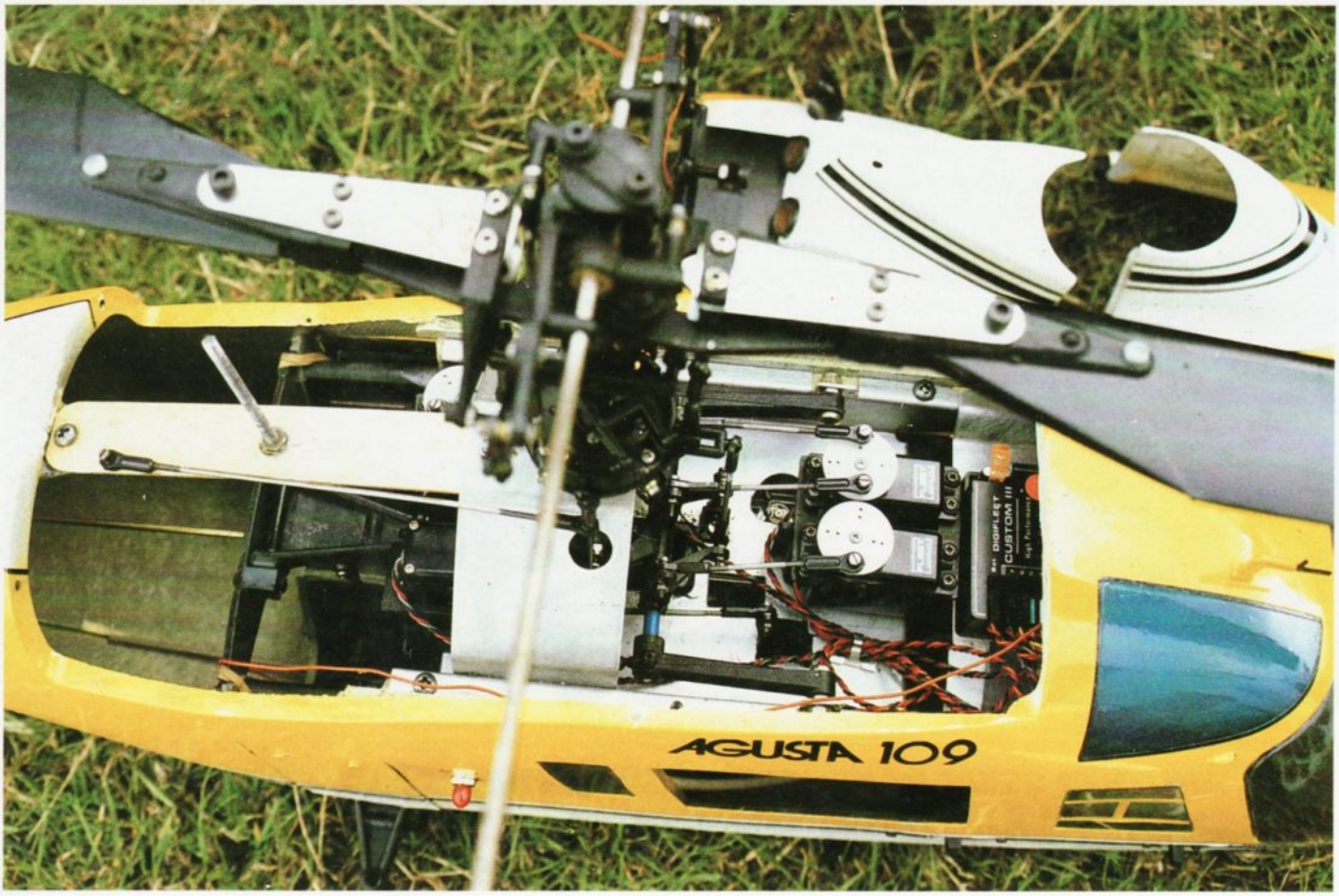
Homemade Muffler/Silencer made from stock unit, is very quiet. Also a sullivan slant tank was substituted to make a cleaner tank installation than the stock unit. The stock bronze bushing in my opinion should be replaced with a ball bearing. Due to inaccessibility mine was replaced after these pictures were taken.



Notice the similarity between the basic construction of the Morley head and Aerospatiales unit.

Tail rotor unit. A very nice working unit too. You will also note it is on the retreating blade side for a A.C.W rotating model. Shigetada Taya's model made use of this principle also but on the opposite side. Photos by: Lance Lewis.

The Morley Agusta 109 with the retracting undercarriage squared away. Makes for a nice streamlined shape. Photo: Jim Morley



Looking into the heart of a well designed machine (model and fullsize). This is Jim Morleys Agusta 109. The kit produced by Jim is certainly a very attractive and scale model of the fullsize. Utilising the Morley MK III mechanics and with his own design retract system, the model will be a popular choice for the builder/pilot who has a good knowledge of model heli building/ flying. See review this issue over the following pages. Photo: Editor.