MANTIS
INSTRUCTION MANUAL

Congratulations! You have chosen one of the finest R/C Helicopters available on the market today. The Mantis is a system that allows you to start as a beginner and progress towards a full collective acrobatic helicopter capable of flying the full AMA Expert Pattern. Beginning as a fixed pitch machine, you can learn to fly R/C helicopters and as your proficiency increases, you can upgrade the Mantis to a collective pitch configuration thereby giving you the equipment you need to fly with the experts.

The Mantis does require some construction and following this introduction, you will find a detailed step-by-step set of instructions. Each group of instructions is further accentuated by the use of detailed photographs which show the equipment at the completion of the instruction group. Read each instruction group thoroughly prior to beginning construction on the group.

In addition to the materials supplied in this kit, you will need the following items;

1. A four channel radio of your choosing
2. A .40 size r/c model engine
3. Paint (see text later for details)
4. A 6 oz. Sullivan round fuel tank
5. Blue non-hardening loctite
6. Various glues - - - epoxy, cynoacralate
7. Quick links Du-Bro
8. 1/16 and 1/8 inch 5 ply plywood – (Refer to Main Plan & Manual)

The construction is based on the use of groups of parts which are packaged in bags. The bags are numbered and you will be instructed to open the bags and inventory the parts at the beginning of each group of instructions. Parts will be called out by name when they are used in the instructions. Some shortened names may be used after the first use of each name. The instructions are none the less accurate and should be followed as written. The construction will use socket head screws (SHS), pan head screws (PHS), and pan head screws which are self tapping for use in the nylon parts (PHS-ST).

Remember to read each instruction group thoroughly and have fun building your Mantis!

( ) Open Bag #1 mechanical and hardware (They contain the following):

Bag #1:
- 1 – M/R drive gear
- 2 – 7/8 OD bearing blocks w/bearings installed
- 1 – 5/16 ID gear washer
- 1 – M/R drive pulley

Bag #1 Hardware:
- 6 – #4 x 3/8 PHS-ST
- 2 – #4 x 1/2 PHS-ST
- 8 – #4 Flat washers
- 1 – 5-40 x 1" SHS
- 1 – 5-40 locknut
- 2 – 6-32 x 1/4 set screws
- 9 – 4-40 x 1 1/8 PHS & hex nuts
- 4 – #4 x 1/4 PHS-ST
- 4 – 4-40 x 1-1/4 SHS

MAIN FRAME ASSEMBLY

( ) Remove molded side frames from kit box and remove all mold flashing.

( ) Refer to photo No. 1.

( ) Locate the M/R drive gear and insert one end of M/R shaft into hub of gear. Orient it so the protruding hub on the gear is flush with one end of the shaft. Secure with 5-40 x 1" SHS and lock nut thru hole in shaft and gear.

( ) Place 5/16 gear washer on M/R shaft followed by a 7/8 OD bearing block. Gear washer should be sandwiched between M/R drive gear hub and bearing surface.

( ) Now slide M/R drive pulley onto shaft so hub projection fits into bearing block and against bearing.

( ) Refer to photo No. 2.

( ) Push M/R drive pulley firmly against bearing in bearing block while applying pressure on bottom hub of M/R drive gear. Install 6-32 x 1/4 set screws into pulley and tighten against shaft. This now locks all components together and automatically spaces components.

( ) Secure this assembly loosely to right side frame by using 2 No. 4 x 3/8 PHS-ST and 2 No. 4 flat washers under the heads through lower rear holes in side frame and into bearing block.

( ) Refer to photo No. 3 and main plan.

( ) Now fit the left half of side frame to right by using the 9 4-40 x 1 1/8 PHS and 4-40 hex nuts. There are recesses in right frame half for head of screws and hex recesses in left frame half for nuts.

( ) Install 2 4-40 x 3/8 PHS-ST screws with 2 No. 4 flat washers under the heads through left frame half and into bearing block (Do Not Tighten!).

( ) Refer to photo No. 4.

( ) Locate the molded motor mount. Clean off all mold flashing.

( ) Refer to photo No. 5.

( ) The motor mount has molded flanges on the back side to attach the mount to the main frames. Insert motor mount into main frames as shown.

( ) Refer to photo No. 6.

( ) With one hand firmly pressing mount into position, using the holes in main frame as a guide, drill mounting holes into motor mount. Note: Drill bit size 1/8.

( ) Refer to photo No. 7.

( ) Remove motor mount and cover front side with masking tape (1 layer) or use rubber cement to glue paper to front surface. This is temporary. Do not use permanent glues. Trim the covering precisely to the edges with a sharp knife or razor blade.

( ) Locate and pencil on the paper covered motor mount the vertical center line of the motor mount. This measurement and those in the next series of steps where you mount the engine are critical to the success of your Mantis. Use extra care!

( ) Place the landing cross struts into the notch in bottom of side frame and secure with No. 4-40 x 1-1/4 SHS and No. 4 flat washer under the head into cross strut mount tab inserted between frames. Hardware located in Bag No. 1.

( ) Snap the landing skids into the feet in the cross struts. Adjust skid so curved fronts are facing up and parallel with skids on opposite side.

( ) From the rear of the skids measure 3½ inches from rear of cross struts and drill small pilot hole through cross strut foot and into skid to accept No. 4 x 1/4 PHS-ST to hold skid in position. Hardware located in Bag No. 1.

( ) Refer to photo 8B.

( ) Refer to Main Plan and Photo No. 9.

MAIN DRIVE ASSEMBLY

( ) Open Bag No. 2 Mechanical & Hardware (They contain the following);

Bag No. 2. Mechanical	Bag No. 2. Hardware
2 – 5/8 OD bearing blocks w/bearings installed	8 – No. 4 x 3/8 PHS-ST
1 – Bell housing w/pinion installed	16 – No. 4 flat washers
1 – Clutch assembly	1 – 8-32 set screw
1 – 1/4 10 locking collar	4 – 4-40 x 1 1/2 SHS
2 – Engine mounting blocks	8 – 4-40 locknuts
1 – Clutch lining	2 – 8-32 x 1/2 SHS
1 – Engine fan	4 – 4-40 x 1/2 SHS

INSTALLATION OF CLUTCH LINING

( ) Using epoxy! Lightly sand the inside surface of the bell housing (inside diameter) place the lining inside with dark side against bell housing for a fit check. (If lining is slightly warmed it will form to bell housing easily) Remove lining and mix up a small amount of epoxy - spread it around the inside surface of the bell housing surface until epoxy sets up.

( ) Hot Stuff: Place lining inside bell housing carefully, run a bead of hot stuff around the base of the lining where it contacts top surface of bell housing. Hold lining against bell housing surface and place another bead of hot stuff on upper surface of lining where it contacts bell housing, let dry.

( ) Install one bearing block onto pinion shaft with bearing contacting flange on pinion. (Note Main Plan).

( ) Slide the other bearing block onto pinion shaft bearing facing up. (Note Main Plan).

( ) Slide 1/4 locking collar onto pinion shaft and install 8-32 set screw into collar, do not tighten on shaft.

( ) Refer to photo No. 10

( ) Slide this assembly into and between main frames in front of rotor shaft and M/R drive gear. Attach with No. 4 x 3/8 PHS-ST, and No. 4 flat washers. Adjust collar on pinion shaft by pushing up on bell housing and down on collar. Then tighten set screw.

( ) Refer to photo No. 11.

( ) The engine should be broken in per the manufacturer's instruction prior to this step. Low idle stop should kill the engine.

( ) Remove the prop nut and front drive washer. The rear washer should remain on the engine shaft

( ) Place the fan over the prop shaft with the metal drive plate next to the engine rear washer. The deep well in the fan should be pointing away from the engine.

( ) Thread and tighten the prop nut onto the engine shaft. When you tighten, grip the entire fan assembly and not just a few fan blades. This procedure avoids possible damage to the fan. Do not use mechanical devices such as vice grips or channel locks to hold the fan during this step.

( ) Place clutch assembly on top of the fan. Set the retainer pins located on the fan into the alignment holes in the clutch.

( ) Insert the 2 8-32 x 1/2 SHS through the holes in the clutch and tighten into thread holes in fan assembly. Tighten using procedure described in securing engine fan to the engine.

( ) Refer to photo No. 12.

( ) Re-install motor mount into frames.

( ) Because some engines vary in size and length it is necessary to, at this time, make the proper calculations for drilling the motor mount. Caution must be taken in the next steps!

( ) Measure from the bottom of the cooling fan blade to the first mounting hole on your engines' mounting lug. This is the one nearest the prop nut.

( ) Refer to photo No. 13.

( ) To this measurement, add 1 3/16". Mark this dimension down on a piece of paper.

( ) With the engine mount in position between the sideframes, measure downwards from the lower edge of the bell housing towards the engine mount. Use the measurement you just wrote down on a piece of paper.

( ) This location describes the position of the two front engine mounting holes. Remove the mount and draw a line on the engine mount that is perpendicular to the center line you previously drew and which passes through the point you just established.

( ) Using the drill pattern for your motor, and you may have to make one yourself, layout a drill pattern on the engine mount. Assure that the pattern is properly centered and aligned with the centerline.

( ) Remove engine mount. Drill 1/8" holes in the locations you just described on the engine mount. At this time drill a 1/8" hole in the bottom center of the engine mount to act as a guide for the fore & aft push rod.

( ) Refer to photo No. 14.

( ) Put the engine mount back into main frames and secure with 4 4-40 x 1/2 SHS with No. 4 flat washers under the heads and 4-40 locknuts.

( ) Refer to photo No. 15.

( ) Insert engine assembly into main frames, make certain bell housing pinion shaft is inserted into bearing in clutch. (Note: it may be necessary to loosen and slide bell housing up in main frame to install clutch into bell housing. The length of your engine will determine if this is necessary. If this is your case insert clutch into bell housing and slide bell housing back into position and re-attach to side frames).

( ) Secure engine to motor mount using 4 4-40 x 1 1/2 SHS with No. 4 flat washers under the heads and 4 4-40 locknuts through engine mounting blocks and engine mount.

( ) Refer to photo No. 16.

TAIL FIN ASSEMBLY

( ) Refer to photo No. 17.

( ) Transfer information from the plan sheet to the 1/8 plywood for the tail fin assembly.

( ) Cut out the plywood tail fin and attachment plate.

( ) Sand to a smooth finish. Take care in cutting the slot in the attachment plate adjusting so that the tail fin fits in securely. Do not sand off the location of the two holes you marked on the parts.

( ) Using the plan sheet, measure the location of the attachment plate on the tail fin. Epoxy the tail fin into the slot taking care to assure that the fin is perpendicular to the plate.

( ) Drill out hole A on the attachment plate - - - 1/8" diameter.

( ) Drill out hole B on the attachment plate - - - 1/16" diameter.

( ) Refer to photo No. 18.

( ) Locate the fin assembly on the bottom of the reartail rotor block. Secure to the block with the No. 4-40 x 1/4 SHS and No. 4 flat washer into the pre-drilled pilot hole.

( ) Align the fin assembly so that it is parallel with the tail boom. When aligned, epoxy the alignment block - 1/4 square pine - on the top of the attachment plate and tight against the rear of the tail rotor block. Do not epoxy to the block – only to the attachment plate. Use a piece of saranwrap if necessary to prevent gluing the alignment block to the rear tail rotor block.

( ) When set, remove the tail fin assembly and store it and the screw until assembly later.

TAIL ROTOR SYSTEM

( ) Open Bag No. 3. (the following are the contents of the bag);

Bag No. 3 - Mechanical

4 – Tail rotor blade holder halves
1 – Tail rotor shaft
1 – Tail rotor drive pulley
2 – Tail rotor shaft bearings 1/2 o.d.
2 – Tail rotor blade holder bearings 3/8 o.d.
1 – Tail rotor hub
1 – Tail rotor pitch control with links
1 – Tail rotor control rod short
1 – Tail rotor drive belt
1 – Tail rotor control bell crank with grommet
2 – Pitch change collars
2 – Tail rotor blades

Bag No. 3 - Hardware

2 – 5-40 x 3/8 SHS
2 – No. 5 lockwashers
2 – 5-40 x 5/8 SHS
2 – 5-40 locknuts
6 – 2-56 1/2 PHS
7 – 2-56 nuts
2 – No. 4 x 1/4 PHS-ST
6 – No. 4 flatwashers
1 – 2-56 x 3/4 PHS
5 – No. 2 flatwashers
2 – 5-40 set screws
4 – 4 x 40 set screws
4 – No. 4 x 3/8 PHS-ST

( ) Do not mix the 5-40 hardware with other hardware!

( ) Refer to photo No. 19.

( ) Place the tail rotor drive pulley on the tail rotor shaft.

( ) Put one of the tail rotor shaft bearings on the tail rotor shaft.

( ) Refer to photo No. 20.

( ) Place the tail rotor drive belt in the tail boom beginning from the rear rotor block. That is the one with the holes for the tail rotor bearings.

( ) Refer to photo No. 21.

( ) With the front tail rotor block facing you and the tail fin attachment hole pointed down, insert the tail rotor shaft into the bearing hole on the right side of the rear tail rotor block. The pulley should enter first. The shaft should pass through the belt loop. Note that the smooth side of the belt should be touching the pulley.

( ) From the left side of the rear tail rotor block, place the other tail rotor shaft bearing on the tail rotor shaft.

( ) Refer to photo No. 22.

( ) Squeeze the two bearings into their respective holes using finger pressure. If the use of pliers or other mechanical methods are required, use extreme care not to damage the bearings.

( ) Refer to photo No. 23.

( ) Using a No. 4 flat washer, lock the two bearings into the tail rotor block with the No. 4 x 1/4 self tapping screws.

( ) Adjust the position of the tail rotor drive shaft such that the right end of the tail rotor shaft is flush with the outer surface of its bearing race when the fin attachment hole is down and the rear block is near you. Use loctite on the 4-40 pulley set screws when you tighten them on the drive shaft.

( ) Refer to photo No. 24.

( ) Place the tail rotor hub over the extended end of the tail rotor drive shaft. Insert the 5-40 set screws, with loctite, into the threaded holes in the ends of the hub and tighten onto the extended end of the shaft. The end of the shaft should be flush with the outer surface of the hub.

( ) Refer to photo No. 25.

( ) Place a tail rotor holder bearing into the molded slot in one of the tail rotor holder halves. Push it firmly into the slot.

( ) Refer to photo No. 26.

( ) Place the other half of the blade holder over the first, they are not special pairs. Secure the two halves together with 2-56 x 1/2 slotted pan head screws and nuts. Use loctite on the screws and nuts.

( ) Repeat the above procedure for the other two blade halves and the remaining bearing.

( ) Refer to photo No. 27.

( ) Remove the balls from the arms of the tail rotor pitch control.

( ) Insert a 2-56 x 1/2 slotted pan head screw through the hole in the ball and then through the hole in the tab on the blade holder as shown in the picture. Secure with a 2-56 nut and loctite.

( ) Repeat the above step with the remaining ball and 2-56 x 1/2 PHS.

( ) Refer to photo No. 28.

( ) Snap the plastic control arms into the H shaped yoke of the tail rotor pitch change control.

( ) Refer to photo No. 29.

( ) Place a No. 5 lockwasher on the 5-40 x 3/8 socket head bolts and insert them through the blade holder bearings from between the blade halves.

( ) Lightly coat the end of the bolts with loctite being careful not to allow any on the bearings in the blade holder.

( ) Fasten the blade holder to the tail rotor hub and tighten the bolt. Do not overtighten!

( ) Refer to photo No. 30.

( ) Rotate the blade holders so that one blade holder is pointed up.

( ) Looking down the tail rotor shaft, hub towards you, twist the blade holder on its axis so that the ball on the tab is on the right.

( ) Install the tail rotor blades in the blade holders with 5-40 x 5/8 socket head bolts and locknuts. The hollowed out part of the blade near the attachment point should point towards the tail boom. Ball links will be on the tab on leading edge of blade.

( ) Refer to photo No. 31.

( ) Re-attach the tail fin assembly to the tail boom.

( ) Mount the nylon bell crank to the attachment plate in the orientation shown. Insert the eyelet into the bell crank from the bottom. Then from the top, install a 2-56 x 3/4 slotted pan head screw with a flat No. 2 washer. Under the eyelet should be one flat washer. The assembly is then secured with a 2 x 56 nut and No. 2 flat washer. Use loctite.

( ) Refer to photo No. 32.

( ) Push the control rod through the hole in the tail rotor shaft from the end opposite the tail rotor hub.

( ) As it exits the hub, place on it one of the pitch change control collars and a No. 2 flat washer.

( ) Refer to photo No. 33.

( ) Place the pitch control on the control rod. Do not forget the small brass bushing in the yoke!

( ) Refer to photo No. 34.

( ) Finally place on the last No. 2 flatwasher and the last 1/16 collar. Tighten the collars lightly, with 4-40 set screws.

( ) Flex the end of the bell crank and put the end of the control rod in the outer hole.

( ) Refer to photo No. 35.

( ) Rotate the blades in their holders so that they are set for clockwise rotation as in the photo.

( ) Snap a control arm over the ball link. Ball link should be on leading edge of blade.

( ) Repeat for the other blade holder.

CABIN FORMERS

( ) The parts used in the next few steps are located in bag No. 7, which you opened previously.

( ) Refer to photo No. 36.

( ) From the plan sheet, transfer the outline, parts locations and drilling information for the front bulkhead to the 1/8 plywood sheet. This can be accomplished by using carbon paper or any other method which accurately transfers the information from the plan sheet to the plywood sheet.

( ) Using a coping saw or power jigsaw, cut-out the outer dimension of the front bulkhead. Use a fine cut blade to avoid fraying the edges of the cut.

( ) Now cut out the inner piece of the front bulkhead from the piece you have just finished cutting. In final assembly the inner and outer pieces come together to hold the canopy to the fuselage to your cut. The match line and the saw kerf is the tolerance for finishing material build-up on the edges. Use a small drill for the access hole for the saw. Do not use a sabre saw for this operation.

( ) Cut out the pushrod access holes and a hole for your radio switch.

( ) Sand all the edges you have just cut.

( ) Transfer the information for canopy mounting tabs from the plan sheet to the plywood you have left from the bulkhead.

( ) Cut out the mounting tabs, sand smooth and attach to the outer bulkhead piece where indicated by the information you previously transfered. Use epoxy for this attachment.

( ) Drill 1/8" holes where indicated on the inner bulkhead for bulkhead attachment.

( ) Place the inner and outer bulkheads together and drill 1/8" holes through the mounting tabs where indicated. The hole should continue through the inner bulkhead so that the two pieces are in alignment later for assembly.

( ) Install the 4 x 40 blind nuts in the mounting tabs using epoxy to secure them to the tabs. The tabs are on the front of the outer bulkhead and the blind nut backs should be on the front of the tabs.

( ) Refer to photo No. 37.

( ) Transfer the information concerning the servo tray assembly from the plan sheet. The side frames are 1/16 plywood and the servo trays are 1/8" plywood.

( ) Cut out the side frame pieces using exacto knife, coping saw or jig saw. Do not use a sabresaw for this step. Use a fine cut blade on your saw.

( ) The servo tray assembly consists of two side pieces and two servo tray pieces. The locations you transfered from the plan sheet include suggested cutouts in the servo trays for the mounting of your servos. It is now necessary for you to modify those dimensions, maintaining the centerline positions, for your servos. In the picture we have shown our servos mounted in the tray. The dimensions may be different for your servos. Cut out the holes for the servos on the dimensions you drew for your servos and adjust until an acceptable fit is achieved.

( ) Refer to photo No. 38.

( ) Epoxy one of the side frames to the inner bulkhead in the position you identified when you transfered the information from the plan to the bulkhead. Assure that the side frame is perpendicular to the inner bulkhead.

( ) Refer to photo No. 39.

( ) Now epoxy the two servo trays to the inner bulkhead and the first sideframes. Assure that the trays are perpendicular both to the inner bulkhead and the servo tray sideframe. Refer to main plan.

( ) Refer to photo No. 40.

( ) Epoxy the second servo tray sideframe to the two servo trays and the bulkhead. If the previous gluings have been executed correctly, this final sideframe will be square to the other pieces.

( ) Refer to photo No. 41.

( ) Find the two small screw eyelets located in bag No. 7. Spread one eyelet so that it becomes a hook to just fit into the eyelet of the other.

( ) Locate the 1/4" round green starting belt.

( ) Screw the eyelets into both ends of the starting belt. Use a No. 60 drill or straight pin to make a pilot hole. Set the belt aside until you're ready to fly.

( ) Refer to photo No. 42.

MAIN ROTOR BLADE PREPARATION

( ) Assure that your hands are clean and free from grease as is the working area.

( ) Lightly sand the blades with x-fine sandpaper. The blades are weight matched therefore sanding is only to smooth the surface for the covering material. Additional sanding may change the weight of the blade.

( ) Remove the sanding dust from the blades.

( ) Refer to photo No. 43.

( ) On the bottom, flat side, of the blades, make a mark at the trailing edge 2 inches from the end with the pre-drilled holes.

( ) Using hot stuff or similar instant glues, coat the blade around the area of the three pre-drilled holes. Apply the glue on the top and bottom of the blade and on the end near the holes. This will strengthen the wood fibres in the area of blade attachment.

( ) Refer to photo No. 44.

( ) Remove the paper backing from one piece of the covering material. Place the material on a flat surface sticky edge up. Orient the material so that the long direction is going from left to right.

( ) With the curved surface of the blade facing down and the trailing edge towards you, lay the blade down on the material aligning the left edge of the material with the mark you made on the blade in an earlier step. Allow the material to extend 3/8 inch beyond the trailing edge of blade for an overlap.

( ) Refer to photo No. 45.

( ) Fold the 3/8 inch extra material around the trailing edge of the blade and secure it to the bottom of the blade. Again smooth the material from the center of the blade outward. Make sure that the edge is tightly wrapped.

( ) Smooth the remaining material around the leading edge tightly and as before, smooth it onto the bottom of the blade. Cut off the remaining material at the trailing edge. Do not wrap the extra material around the blade!

( ) Refer to photo No. 46.

( ) Using 4-40 x 5/8 SHS screws and lock nuts located in Misc. Hardware Bag No. 7, attach 2 blade retainers to the blade. The 3 holes in the retainer line up with the 3 holes in the blade. Put the head of the screw on the top surface. Do Not tighten.

( ) Tighten the center screw and nut. Assure that the retainers are parallel to the blade leading edge and tighten the remaining screws.

( ) Repeat the above two steps for the other blade.

MAIN ROTOR HEAD ASSEMBLY

( ) Open bag No. 5. The following are the contents of the bag;

Bag No. 5 - Mechanical

1 – seesaw
2 – side supports
1 – pitch change control arm
2 – flybar paddles
1 – flybar
1 – 5-32 collar
1 – rotor head
2 – stability collars
1 – rubber damper grommet

Bag No. 5 - Hardware

4 – 4-40 x 3/8 SHS
4 – No. 4 lockwashers
4 – 6-32 set screws
4 – 4-40 x 5/8 SHS
2 – No. 4 flatwashers
4 – 5-40 locknuts
1 – 5-40 locknut
2 – 5/32 brass flat washers
1 – 4-40 socket set screw
2 – No. 2 flat washers
2 – 2-56 x 1/4 PHS
1 – 5-40 x 5/8 SHS

( ) Locate the small bag of rotor head parts in bag No. 5.

( ) Place the large control shaft support cylinder into the M/R hub small round hole. Use a little vaseline or lithium grease to assure easy rotation in the hole.

( ) Secure the control shaft support into M/R hub block using 2-56 x 1/4" PHS with No. 2 flat washers under the head and insert into tapped holes. (Use loctite).

( ) Refer to photo No. 47.

( ) Insert the small tube through the larger opening in the hub and through the hole in the first cylinder.

( ) Center the tube exactly on the hub & secure with a 4-40 set screw into the cylinder. Use loctite. Set screw should be visible from hole in top of rotor head.

( ) Refer to photo No. 48.

( ) From the bottom of the seesaw, press the rubber grommet into the center hole. The bottom of the seesaw is the outside of the slight curve in which the seesaw is bent.

( ) Orient the grommet so that the slot in the center goes across the short dimension of the seesaw.

( ) Use zap or pliobond epoxy silicone to secure the grommet into the hole.

( ) Refer to photo No. 49.

( ) Using 2 4-40 x 3/8 SHS and lockwashers, fasten one side support to the seesaw. The seesaw is bent into a slight curve. to create the coning angle for the main rotor blades. The side support should be attached so as to point up from the bottom of the curve like the handle on the shilouette of an open umbrella. Do not tighten the bolts!

( ) Refer to photo No. 50.

( ) Place the large hole in the side support over the rotor hub control shaft protruding from the side of the main rotor hub. The flat square top of the main rotor hub should point up as shown in the picture.

( ) Attach the other side plate per the above description. Assure that the seesaw pivots freely on the control shaft.

( ) Refer to photo No. 51.

( ) Make a mark on the fly bar 3/4 inch from a threaded end. Use a felt tip pen to avoid damage to the fly bar.

( ) Refer to photo No. 52.

( ) Screw one of the flybar paddles until the mark is reached. You may need to use pliers to hold the flybar. If so, grip near the paddle so that the remainder of the fly bar is not scored which could prevent it's insertion through the hollow control shaft on the main rotor hub.

( ) Slide one of the stability weights on the fly bar and push it near the paddle. Tighten with 6-32 set screw.

( ) Now slide the control arm on the shaft with the finger pointing away from the paddle.

( ) Slide on one of the 5/32 flat washers.

( ) Insert the remaining threaded end of the fly bar into the hole in the rotor hub control shaft.

( ) Place a 5/32 flat washer on the fly bar followed by a 5/32 collar and stability weight in that order. Insert the set screws in the collars and control arm and tighten lightly.

( ) Refer to photo No. 53.

( ) Mark the fly bar 3/4 inch from the remaining end and screw on the remaining paddle to the mark. Use the same gripping point as before if pliers are used.

( ) Adjust the two paddles such that they are parallel through their chord lines. The orientation should be opposite on either end. In other words, le and te are opposite on either end.

( ) Measure the distance from the outside edge of one paddle to the outside edge of the other. Divide by 2 and adjust to the nearest 1/32 inch. Metric measurement is more accurate in this procedure.

( ) Adjust the position of the flybar in the control shaft until the distance from the center of the rotor hub to the outer edge of paddle is the distance you just calculated. In other words, center the flybar.

( ) Lock the flybar postion by moving the 5-32 collar next to the rotor hub control shaft and tighten the set screw.

( ) Move the control arm next to the other end of the control shaft. Rotate the arm until it is parallel to the paddle chord line and the finger points to the L.E. of one of the paddles. Tighten the set screw.

( ) Move the other stability weight next to the paddle and tighten the screw. This is the best position for beginning helicopter flyers. Intermediate flyers should be more towards the center and experts should find the weights near the hub. These weights will also be used in the final trimming to balance the rotor head.

( ) Adjust the flybar with a square until it is 90 degrees to the seesaw. Hold it in this position and tighten the four side support screws.

( ) Refer to photo No. 54.

( ) Using 4-40 x 5/8 SHS, No. 4 flat washer under heads, mount the rotor blades to the seesaw. The flat part of the blade should be on bottom. Secure to the seesaw with locknuts.

( ) Snug the outer screw so you can still pivot the blade with some resistance. Loosely tighten the inner bolt also.

( ) You must now align the rotor blades so that they are exactly 90 degrees to the flybar. There are many methods to do this. The use of a square is one of the easiest. You will later learn to align the blades by eye.

( ) Refer to photo No. 55.

( ) Place the completed rotor head between tow balance points as shown in the photo. The flybar is the axis of rotation.

( ) If the rotor head is out of balance, use plastic vinyl tape to add weight to the tip of the lighter blade. Do not add screws to the blades to add weight as they may loosen and fly off during flight and hurt someone! Wrap tape in the same manner as the blade covering.

SWASHPLATE ASSEMBLY & FINAL FRAME ASSEMBLY

Prior to this step, the engine and clutch system should be installed and the side frame construction complete. The tail boom, tail rotor and main rotor head assembly should be complete also.

This portion of construction refers only to the fixed pitch version of the Mantis. If your Mantis is the collective pitch version or you are installing the collective pitch kit on a fixed pitch version, refer to collective pitch instructions.

( ) Open bag No. 6. (the following are contents of the bag.);

Bag No. 6. - Mechanical
- 1 — Locking follower arm
- 1 — anti-rotation lock
- 2 — swashplate locks
- 1 — swashplate

Bag No. 6 - Hardware
- 1 — 2-56 x 1" SHS
- 3 — 2-56 x 3/8 PHS
- 7 — 2-56 nuts
- 2 — 2-56 x 1/2" PHS
- 1 — 4-40 x 3/4" SHS
- 5 — ball links
- 1 — 4-40 locknut

( ) Extend the tail rotor drive belt from the front mounting block. Assure the belt is not twisted in the boom and that the smooth side of the belt is on the inside.

( ) Grasp the tail boom by the rear block and orient so that the tail rotor assembly is pointed up. Place the belt over the tail rotor drive pulley. Insert the belt from top and down around the main rotor drive pulley.

( ) Twist the tail boom 90 degrees counterclockwise from the rear so that the tail rotor is pointed to the left.

( ) Install the second main bearing, bearing facing up into position by sliding it down the main rotor shaft and securing into position between frames with a No. 4 x 3/8" PHS-ST and No. 4 flat washers on left frame. Do not tighten!

( ) Refer to photo No. 56.

( ) Place the anti-rotation lock in position on right side frame and secure it to frame and upper bearing block with No. 4 x 1/2 PHS-ST. Do not tighten!

( ) Place a single piece of paper towel between the pinion gear and the main gear on the main shaft. Push the two gears together. Align the main shaft so it is vertical and then tighten the 8 self tapping screws holding the bearing blocks into the side frames. As an aid, tighten one screw in the lower block after the gears are pushed together so as to hold position. Align for a vertical shaft and then tighten the rest.

( ) Refer to photo No. 57.

( ) Place the tail boom front block between side frames and secure in position using 4 No. 4 x 3/8" PHS-ST and 4 No. 4 flat washers. Do not tighten!

( ) Pull the tail boom back approximately 1/2 way in slots in side frames and using 4 No. 4 x 3/8 PHS-ST tighten the 4 No. 4 x 3/8 PHS-ST (Note: make certain tail boom is level or at a slight upsweep. If belt slips as helicopter is run it may be necessary to pull tail boom back further to put more tension on T/R drive belt).

( ) Install the lateral bell crank on left side of main frame. Place one spacer between bell crank grommet and the side frame. Secure the bell crank to frame using 2-56 x 1" PHS, No. 2 flat washer and 2-56 nut. This hardware is located in bag No. 7. (Note: Hole is pre-aligned in side frame, you will have to enlarge hole a small amount to allow 2-56 x 1" bolt to be inserted through frame.)

( ) Refer to photo No. 59.

( ) Install the forward and aft bell crank on lower right frame and between frames. Place one spacer between right frame and grommet and secure in place with 2-56 x 1" PHS, No. 2 flat washer and 2-56 nut. Again this hole is pre-marked by a small hole and will have to be enlarged for 2-56 bolt. You must cut off a section of one arm on bell crank so it will not interfer with skid.

( ) Refer to photo No. 60.

( ) Insert a 2-56 x 1/2 PHS through the hole in a ball link. Secure with 2-56 nut against ball link, use loctite. Now insert protruding portion of screw through small hole in locking follower arm and secure with 2-56 nut, use loctite.

( ) Prepare a second ball link as above except with a 2-56 x 3/8 PHS and insert it into one of the two threaded holes in the upper swashplate ring. Use loctite.

( ) Place the 2-56 x 1" SHS through the ball in a ball link. Secure it with a 2-56 nut. Use loctite. Now place a second nut on the screw and run 1/2 up the shaft. Using loctite, insert the screw into the second hole in the upperswashplate. Use the second nut to lock into position against the swashplate upper ring.

( ) Place 2-56 x 3/8" PHS through the balls in 2 ball links and secure with 2-56 nuts and loctite. Then screw the assemblies into the two remaining holes in the lower swashplate. Use loctite. The third hole in the lower swashplate has already been fitted with a steel pin.

( ) Refer to photo No. 61.

( ) Place a brass spacer on the main shaft followed by the swashplate assembly, the next spacer and the swashplate follower. The picture shows the orientation of all of the parts. Note that the steel pin in the swashplate is placed in the slot in the anti-rotation bracket. Insert the 4-40 x 3/4 SHS into hole in follower followed by 4-40 locknut.

( ) Lift the helicopter by the main rotor shaft and push down on the swashplate follower to pull the parts together. Tighten the swashplate follower. This is a temporary situation and final adjustment will be made later.

( ) Refer to photo No. 62.

( ) Set the assembled main rotor head on the main rotor shaft and secure with a 5-40 x 5/8 inch allen head screw and locknut. Assure that the flybar paddles are oriented on rotation of the head. The leading edge of the paddles in the same direction as the main rotor blades.

( ) Select one of the 4 inch threaded pushrods and cut off the threaded end. Thread one end into the ball link retainer on the swashplate follower. The other end will screw into the ball link retainer on the short screw in the upper swashplate ring. Cut the other end of the threaded piece so that it will so connect and thread completely into this second ball link. The follower will now pull the upper swashplate ring with it as the main shaft turns.

( ) Loosen the swashplate follower locking nut and rotate the follower and upper swashplate ring so that the hiller arm on the upper ring - - the long SHS - - is directly under the flybar control arm.

( ) Lift up the main shaft again and retighten the swashplate follower to the main rotor shaft.

( ) Prepare the other 4 inch threaded rod by screwing a ball link onto one end of the rod.

( ) Slide the rod through the hole in the seesaw under the flybar control arm towards the hiller arm on the upper swashplate ring.

( ) Snap the ball link retainer onto the ball on the hiller arm. This push rod will have a slight bend in it.

( ) Connect the other end to the ball link on the flybar control arm adjusting so that when the swashplate is level, the flybar paddles are at 0 degrees angle of attack, or level. Do not adjust the position of the control arm on the flybar as it will reduce the linearity of the system.

( ) Refer to photo No. 63.

TRIAL ASSEMBLY PROCEDURE FIXED PITCH VERSION

We are now going to complete the assembly of your Mantis using the unfinished cabin. This step is necessary to assure that all of the holes in the wooden parts are in the correct locations prior to sealing the wood from model aviation fuel.

( ) Place the cabin into position against the front web of the fuselage and transfer to the rear cabin walls the position of the 2 pre-drilling mounting holes on that web. Check the plan for position and assure that the holes are on the vertical centerline of your cabin. Drill 1/8" holes at the 2 locations.

( ) Bolt the cabin to the main frame using 4 x 40 x 3/4 SHS, (Located in Hardware Bag No. 7). Use No. 4 flat washers under screw heads. The screws thread into plastic former mounting tabs.

( ) Refer to photo No. 64.

( ) Install your servos in the trays you previously prepared. Connect the servos to your receiver and assure the system is operating correctly. Set all transmitter trim levers to zero with the exception of throttle which should be set to the lowest position. The throttle control should also be set to the low throttle position.

( ) Refer to photo No. 65.

( ) Select a 5 inch threaded pushrod from Misc. Hardware Bag No. 7. Thread a quicklink into one end, until the threads appear between the blades of the link.

( ) Connect the quick link to the output arm of the left/right cyclic servo, top left looking from the rear of the helicopter. The other end will be attached to the left/right cyclic bellcrank on the left side of the fuselage. Cut the threaded rod so that the bellcrank is in the position shown when the quicklinks are installed at both ends.

( ) Refer to photo No. 66.

( ) Retrieve the push rod you cut for the swashplate follower in a previous step. Cut off the other threaded end. Thread the factory prepared end into one of the quick links. Thread it in as you did before into the quick link.

( ) With the left/right cyclic bellcrank in the position shown in the picture, connect the quicklink to the outer hole in the bell crank. While holding the swashplate level, mark the position of the threaded rod which allows you to screw it fully into the ball link retainer. The ball link should still be attached to the swashplate from a previous step.

( ) Cut the threaded rod, dress the end and screw it into the ball link retainer.

( ) Re-connect the links to the swashplate and bellcrank. Adjust the quicklink to obtain a level swashplate when the bellcrank is level and the servo is at neutral. You will adjust later in trimming.

( ) Refer to photo No. 67.

( ) Select a 7-1/2 inch threaded pushrod from Misc. Hardware Bag No. 7. Screw a quicklink onto one end of the rod.

( ) This end will connect to the output arm of the fore/aft cyclic servo. Lower left looking from the rear of the helicopter. You must now fit the push rod through the hole in the front keel. Through the drillhole in the engine mount and connect it with a second quicklink to the fore/aft bell crank in the lower rear of the fuselage. The bell crank must be in the position shown in the picture when the connection is complete. The push rod must be bent by you to provide a path which does not bind. It is a bend and fit operation which will be unique for your servos. A plastic golden rod or other similar push rod may be used also but is not included in this kit.

( ) Select a 7-1/2 inch threaded push rod from Misc. Hardware Bag No. 7. Thread this push rod through the hole in the top shear web.

( ) Connect a quicklink to the lower threads and connect to the middle hole on the fore/aft cyclic bell crank.

( ) Adjust the length of the push rod so that the swashplate is level when connection to the ball link retainer is complete.

( ) Turn on the radio system and check for the following movement. Right aileron on the transmitter should cause the swashplate to dip to the right side of the fuselage when viewed from the rear. Left aileron on the transmitter is the opposite.

( ) Pulling back on the elevator control on the transmitter should cause the rear of the swashplate to dip down. Conversely, forward stick should cause the front of the swashplate to dip down.

( ) If any of these control functions do not perform as described, you must select the opposite arm on the servo or change the direction of servo operation until the correct operation is achieved.

( ) Refer to photo No. 68.

( ) Find the long tail rotor push rod which will be encased in a plastic sheath. Also locate the tail rotor keeper bracket which will be in bag No. 7.

( ) Using quick links at each end, connect the pushrod, the tail rotor servo, upper right looking from the rear, and the tail rotor pitch change bellcrank. The bellcrank should be in the position shown when the servo is in the neutral position and a right command on the yaw control of the transmitter should cause the tail rotor blade pitch to increase. This can be observed on the blades themselves or noting that the pitch change control rod moves the pitch change control towards the tail boom. Note: main plan shows tape on tail boom to help secure push rod.

( ) Refer to photo No. 69.

( ) Finally, install the final pushrod to the throttle servo and the throttle of your motor in a manner similar to the above operations. Assure that the throw of the servo and that required by the throttle match so as not to put any strain on the throttle servo in one of the extreme positions.

( ) Refer to photo No. 70.

( ) You will now have to custom fit the fan shroud to your engine allowing for the throttle, exhaust, and throttle pushrod. The air exit pieces which fit over the head of the engine should not touch the engine. The air intake should be trimmed very close to the top of the shroud so as not to interfere with operation of the starting belt. This is a very exacting portion of the assembly of your Mantis and must be done with great care! Start with the smaller of the two pieces which fits on the outside of the left frame. Put it into position and note the interferences that you find. Cut away enough plastic to avoid the interference and then move to establish the next interference and so on. With the larger piece you will need to squeeze the plastic slightly to insert it between the frame sides. Insert the fan part of shroud first and then gently squeeze the exhaust part into position. Don't forget to center the fan shroud on the fan blades so that they will not rub on the shroud.

( ) When the trimming is complete, fasten the fan shroud to the fuselage with 2 4-40 x 1/2 SHS, flat washers, and locknuts. Use flat washers under the head of the screw. This will protect the plastic from damage. Assure that none of the flange is being put under stress when the nuts are tightened. You may require some additional trimming at this point. Drill holes in the shroud flanges and side frames for the screws.

( ) Refer to photo No. 71.

( ) Assemble the fuel tank per the manufacturer's instruction and insert it into the hole provided. This should be a very tight fit. leave the edges of the nylon smooth to avoid any possibility of tank puncture inflight.

( ) Refer to photo No. 72

( ) Locate the large clear plastic sheet. Cut out the butyrate canopy. The canopy has an overlapping design in the center of the unit. There are light score lines on the mold which indicate where to cut for the correct overlap. On the back of the canopy, where it goes around the outer front bulkhead, leave as much overlap as possible.

( ) Refer to photo No. 73.

( ) Get the outer bulkhead and fit it into the space in the canopy halves. Close the canopy around it. Use maksing tape to hold the canopy together. Later we will use acetone or butyrate dope thinner to glue the two halves of the canopy together. Note the position of the two tabs inside the canopy prior to gluing. If you wish to do any color or trim finishing of the canopy from the inside, it must be done prior to gluing the halves together. Be sure to leave the overlap area free from paint so that the glue will hold. Assure a good string glue joint by wicking acetone between the joints all around from the outside and inside. Do not glue the canopy during this trial assembly.

( ) Refer to photo No. 74.

( ) Now mount the canopy to the front bulkhead with 4-40 x 1/2 SHS with No. 4 flatwashers. Loctite is used in the final assembly.

( ) Check for clearance of all pushrods and cut the outer or inner bulkhead accordingly.

( ) Now remove all the wooden component parts from the fuselage and finish the fuselage and other wooden pieces in the color scheme of your choice. We strongly recommend that you seal the wooden parts with polyester finishing resin and finish the wood with epoxy or polyeurothane paint for maximum protection. Other finishing methods will not yield fuel proofing to the same extent. This method will assure the longest possible life relative to fuel damage.

( ) When all the wood parts are dry, re-assemble the helicopter as required per the previously described steps. Re-install the servos. The radio receiver may be laid in the canopy, however it is recommended to be suspended, and the batteries between the servo trays and as close to the front bulkhead as possible. Be careful not to interfere with the action of the servos.

( ) Check the balance point (C.G.) under the main rotor shaft and add correction weights as required. The helicopter should hang level when lifted by the stabilizer rod.

( ) Now proceed to the final adjustments and flight checkout portion of this manual.

R/C HELICOPTER FLIGHT

In order to better understand the R/C Helicopter let's talk about helicopters in general.

An R/C helicopter flys much like its full-size counterpart. The helicopter is basically an unstable aircraft. Claims by others of "hands-off" stability are really false and misleading. If you brought your helicopter to a hover and literally took your hands off the controls the helicopter would, if in proper trim, hover in a stable state. However, the helicopter would not remain stationary. After a few seconds due to its inherent instability the helicopter will start to move. It may decide to move forward, sideways, or even backward. There are slight winds that will cause this as well as the control system of the helicopter. (Loose servo arms, loose push rods, and the like) Talk with any full size helicopter pilot and he will relate to you his experience with helicopter instability. (Most full size helicopters are now equipped with stabilization electronics).

In order to provide you with the best possible information on learning to fly this R/C helicopter we will take a step-by-step approach. As long as you continue your training regularly and stay within your capabilities, not moving ahead of your ability, you will succeed in learning to fly!

NOTE: OIL THE RUBBER DAMPENER M-10 BEFORE EACH FLIGHT!!!

CONTROL SYSTEM:

Let's discuss the control system of the helicopter so that we may have a better understanding of how the helicopter flys.

* CYCLIC CONTROL – The term "cyclic control" is used in regards to control of the swashplate. Moving the transmitter stick forward and rearward during hover will cause the helicopter to move forward and backward. Moving the transmitter stick forward and rearward during forward flight will cause the helicopter to pitch nose down and nose up.

  Moving the transmitter stick sideways will cause the helicopter to move sideways during hover. Moving the transmitter stick sideways during forward flight will cause the helicopter to roll left or right.

* TAIL ROTOR – The function of the tail rotor is to offset the torque of the engine and main rotor system. The tail rotor when properly adjusted will allow the helicopter to hover without application of tail rotor. During hover moving the tail rotor control stick on the transmitter will cause the helicopter to rotate around the yaw axis. During forward flight moving the tail rotor control on the transmitter will cause the helicopter to move around the yaw axis.

* THROTTLE – Increasing the throttle will cause an increase of the main rotor rpm and when sufficient rpm is attained the helicopter will rise off the ground. When throttle is decreased the resulting lowering of the main rotor rpm will cause the helicopter to descend.

* PRE-FLIGHT SET-UP – In order to achieve proper results from your helicopter we must trim the helicopter to rise vertically with no application of cyclic control or tail rotor control, or at the very least a very minimum amount of control. (It may be necessary to hold a slight amount of right cyclic input at lift-off to offset main rotor blade rotation.)

  Prior to trimming give your helicopter a thorough check-out, making sure all parts are secure and that all controls function in a free and easy manner. Make sure that your transmitter and receiver batteries are fully charged. If flying in cold weather the ball links will be stiff. Stick a ball point pen into the ball link and stretch it slightly to reduce friction – but be cautious – don't over do it!

  The swashplate should be level for the fore and aft movement. It should have a 2 to 3 degree of right tilt looking from the rear of the helicopter.

  For a starting point the tail rotor blades should be adjusted so that approximately 3/16" of positive pitch is established in the tail rotor blades.

  The throttle control should be adjusted so that the engine will idle smoothly at low throttle and high trim. (The blades may just barely be turning at high trim) The engine should stop at low throttle and low trim. The above adjustments, of course, may vary with different engines.

* MAIN ROTOR BLADE PITCH – There is a template provided in the kit to place the proper pitch in the main rotor blades. By gripping the seesaw with a pair of pliers, and holding the main rotor blade retainers with another, carefully twist up on the main rotor blades until the positive pitch is attained according to pitch gauge indication. This setting is, of course, approximate as altitude and engine types will vary. Make sure that your blades have been balanced according to steps outlined in this manual. For tracking purposes have a piece of colored tape on one blade tip.

TRIMMING FOR HOVER:

Before starting your engine you should become aware of 3 major points that will enhance your learning experience. You should make sure that you have achieved the correct: (1) Throttle Setting, (2) Pitch Setting on Main Rotor Blades, and (3) The Correct Engine Mixture.

In a previous step you balanced your main rotor blades using colored tape, (which should have been added to the lighter blade). For our purpose we will say that the tape was yellow in color. We will refer to this at a later point.

If you strive to achieve lift-off just before 1/2 throttle (1/2 stick) and your engine is just starting into a 2 cycle mode with your main rotor blades tracking on the same plane this is an indication that your helicopter is set-up properly. Once you become familiar with setting up your helicopter you can tailor it to your personal preference. There are a variety of pitch angles and throttle settings you can use to fly with. The ones given to you in the next steps are the best all-around settings for a beginner. The ones most easily adaptable for flight.

At low throttle, low trim, your engine should stop running. This is important in case you accidently tip your helicopter on it's side, the damage resulting will be far less.

With your engine set rich start your engine at low throttle, high trim, with the tail rotor trim and cyclic trim all at neutral. Remove all objects from around your helicopter. Standing 8 to 10 feet behind the helicopter and off to one side, slowly advance the throttle to 1/4 open. At this point take note of the main rotor blade track. If the blades are in track you can disregard the following step.

If the main rotor blades are not in track (on the same horizontal plane) you must correct for this by bending the main rotor blade straps to reduce pitch or increase pitch in either blade. For Example: Let us say the yellow-tipped blade is higher then the black blade by 1/2 inch. At this point your engine is set at 1/4 throttle and running slightly rich. To determine whether or not to increase pitch in the black blade, raising it to match the yellow, or to reduce pitch in the yellow, lowering it to match the black, you will have to do the following.

Increase your throttle very slowly past the 1/4 mark. As the RPM increases the helicopter should be getting light on it's skids as you begin to near the 1/2 stick level. We will say for our purposes your helicopter wanted to become airborne just after 1/4 throttle and any further advance would cause the helicopter to rise into the air. We now know that the yellow blade must be brought down (reduced in pitch) to match the lower black blade. As the helicopter wanted to become airborne too soon we realized that pitch was too high and accordingly must reduce it by lowering the higher blade. This action works to delay lift-off as it brings both blades into track.

If you had advanced your throttle near 1/2 stick and the RPM increased rapidly and you saw no indication of the helicopter becoming light on it's skids then you would have to bend positive pitch into the blade holder of the black main rotor blade to raise it to match the yellow - tipped blade.

If your main rotor blades were both in perfect track at 1/4 throttle and you continued to advance your power and again your helicopter breaks ground well before 1/2 throttle you would have to reduce pitch in both main rotor blades. If you advanced throttle and it gave no indication of becoming light on the skids you must increase pitch in both blades.

As you can see this is a trial and error method, but the only way to assure a proper pitch setting. During this process you should also be making final adjustments on your engine mixture setting. When you near the 1/2 stick (throttle) setting your engine should just be going from a rich into a semi-lean mode with both blades in track and the skids just breaking ground.

During this process it is to your advantage to semi-adjust your tail rotor so that at this setting of pitch and power the tail does not yaw.

TAIL ROTOR ADJUSTMENT:

Now, when you are satisfied that you have achieved proper trim, let's apply throttle to start lifting the helicopter off the ground.

Have a friend assist you if you wish, and by all means trim your helicopter in a no wind or very little wind condition.

You must advance the throttle smoothly so that no erratic torque movements are encountered. As the helicopter starts to become airborne note the condition around the yaw axis. If any yaw exists it must be slight. If the yaw is excessive reduce the throttle smoothly and make an adjustment to the tail rotor pitch. Carefully loosen the pitch change collars on each side of the tail rotor pitch change mechanism. If the yaw was "nose right" take a very slight amount of positive pitch out of the tail rotor blades. If the yaw was "nose left" add a very slight amount of positive pitch to the tail rotor blades. Re-tighten the collars making sure they are not squeezed against the washers. (Just a very small amount of play. And also use oil on the washers next to the pitch change mechanism)

After this adjustment again advance the throttle and see that you have made the proper adjustment. Repeat this adjustment until you are satisfied that the helicopter is smooth around the yaw axis.

CYCLIC CONTROL ADJUSTMENT:

Now that you are satisfied that the tail rotor adjustment is proper we are ready to trim out the cyclic control. Again slowly advance the throttle (stand to the rear and off to the side slightly) carefully watching the helicopter around the roll and pitch axis. The helicopter when in proper trim will want to rise vertically with no application of cyclic control, or if at all a very small amount due to wind, etc.

If during lift-off the helicopter wants to move forward reduce the throttle and make an adjustment to your fore and aft push rod. In other words, shorten the push rod slightly to bring the front of the swashplate up very slightly to counteract the forward movement tendency. If the helicopter wants to move to the rear you would then lengthen the fore and aft push rod slightly. When you are satisfied with the fore and aft adjustment then proceed to adjust the lateral (sideways) control by adjusting the lateral push rod until the helicopter lifts straight up with no sideways movement (Remember when all controls are in the neutral position there will be a slight amount of right tilt in the swashplate looking from the rear.). If you require an excessive amount of right tilt to prevent sideways movement to the left this would indicate a low rotor RPM due to excessive amount of positive pitch in the main rotor blades. Remember the helicopter will be more stable and also more responsive with a high rotor RPM. Excessive pitch in the main rotor system will cause the helicopter to have a "yo-yo" effect. In other words, a small amount of throttle will make the helicopter jump off the ground and a small amount of throttle reduction will cause a sudden loss of altitude. The lowest pitch setting with smooth ascent and descent is the optimum setting.

HOVERING:

Now that you are satisfied with the trim condition of your helicopter let's start our hovering training.

Always make sure your batteries are fully charged prior to flying. As you are moving the servos during training more then normal be careful of your time so that you don't run down your batteries. We suggest that you start your training in an open area so that you won't be confronted with obsticles.

Slowly advance your throttle so that the helicopter becomes airborne to a height of about 2 to 3 feet. The helicopter will undoubtedly start to move in some direction. When you apply a correction try to anticipate the movement of the helicopter. In other words, there is going to be a slight delay in response so don't keep the correction in too long! Try to make a correction and then return your stick to the neutral position. This type of control is exactly the same as a full size helicopter. A new flyer will undoubtedly over-control just as you will with the operation of your model. Also DO NOT try to keep the helicopter exactly above one spot. Allow the helicopter to move as long as it moves slowly. Walk with the helicopter and while walking make your corrections.

At first you will find that you are covering quite a distance walking with your helicopter. After a few tanks of fuel you will find that you are keeping the helicopter within a short distance and soon you will be hovering stationary over one spot. Keep working at your hovering until you can hover for at least 1 full tank of fuel without haveing to set the helicopter down.

The next step would be to practice turning the helicopter around the yaw axis utilizing the tail rotor control. You should be able to make 360 degree turns both left and right prior to forward flight. Remember about the slight delay and make your 360 degree turns slowly and start your correction just prior to the 360. Under no circumstances should you stop prior to the 360 degree turn completion as you will find it difficult to control the helicopter as it will be facing you and all controls will be reversed.

The next phase would be hovering the helicopter sideways left and right utilizing the cyclic control coordinating with the tail rotor to prevent the helicopter from weather vaning to the direction of sideways movement.

The next phase would be hovering the helicopter forwards and backward, coordinating with the tail rotor control to keep the helicopter in a straight line. Continue to practice your hovering manuvers until you are totally confident of your control at all times. You might even try a quick cyclic input to see if you are able to settle the helicopter down. There will be a point at which everything regarding hovering will just sort of fall in place. A threshold so to speak, where all of a sudden you have it with no more over-controling.

FORWARD FLIGHT:

Now that you have your hovering under control you are ready to progress into forward flight. Remember to keep an eye on you fuel level and battery time.

Bring the helicopter to a hover into the wind. Now move the helicopter forward adding a small amount of power until it reaches the point of translational lift. You will actually see this happen. When the helicopter reaches a certain forward speed (a few miles per hour) the helicopter will be provided with additional lift due to the air passing over the rotor disc. At this point reduce power some to level flight. You will also notice that due to this additional lift, if you do not reduce your power settings the helicopter will start to climb. (only if you add more forward cyclic or reduce power will the helicopter stop climbing) As it starts to climb it will also increase speed. Try to keep speed forward, but not too fast!

Now I want you to stop the forward flight by moving the cyclic control to the rear. At the same time you must reduce power to keep the helicopter from pitching nose up. Remember in forward flight the fore and aft cyclic will cause pitch up and pitch down. As the helicopter comes to a stop you will need to add power and immediately move the cyclic control forward to neutral. Try to practice this forward flight and stopping straight ahead within a 10 to 20 yard forward space. Keep practicing until you have it perfected. You may need to coordinate some tail rotor control during this manuver.

Next, start making circular flight around yourself about 10 to 20 feet away, stopping the same way you did when practicing straight ahead flight. Make your circular flights both left and right so that you don't trap yourself into only turning in one direction. Keep practicing both forward and circular flight coming to a complete stop and hover.

After you have the forward and circular flights down perfect you are ready to fly a traffic pattern. Bring your helicopter to a hover into the wind. Slowly move the helicopter forward and as it gains speed it will start to climb out. You may need to add just a touch of power if you pick up too much speed. Try to make your first pattern at a rather moderate speed so you won't find your helicopter disappearing over the horizon. After you attain about 50 to 60 feet altitude make a left or right hand turn into the crosswind. Proceed only a short distance and then make another turn to your downwind leg. If there is much wind you may need to add additional power to prevent the helicopter from losing altitude. As you are making your turns keep turning your body with your helicopter as it turns so that you will not get crossed up on your controls. Try to keep looking back over you shoulder so your controls will always be as though you were behind the helicopter.

Turn your helicopter on the base leg and then turn to final approach. Slowly reduce your throttle and at the same time move the cyclic control rearward to reduce the forward speed. DO NOT under any circumstances reduce your forward speed to the point where the helicopter comes to a stop. If this should happen the helicopter will make an abrupt 180 degree turn and proceed the other way. Remember it is very important to keep forward speed during your approach to the hover landing. If you will always remember to keep that forward speed and gradually reduce it so that you come to a hover at zero ground speed or even a little forward speed, you will find that you will always have better control. Also you should always plan to come to a hover past your position so that you will be behind your helicopter when you come to a hover.

Keep practicing take-offs and landings (both left and right patterns) until you are confident of your control. After practicing you are then free to start flying around at various altitudes and speeds to get the feel of your ship operating under various flight conditions. Remember to keep practicing your hovering along with forward flight.

ADVANCED MANEUVERS

180 DEGREE STALL TURN:

The stall turn is a relatively easy manuver to accomplish. Fly your helicopter past your position at about a 50 to 100 foot altitude. After you pass overhead, proceed to about 100 feet past your position and start applying rear cyclic. You will see your helicopter climb. Keep applying rear cyclic until your helicopter is climbing at about 40 degrees nose up. As the speed dissapates add just a touch of tail rotor (against torque) as the helicopter comes to a stall, (stop its vertical climb). It is better to start stall turns against torque as the helicopter will rotate slower against torque. Later you can do stall turns with the torque. This will result in a faster turn.

After you complete the stall turn and are proceeding back down your flight path you will need to again apply some rear cyclic to level off your helicopter and proceed in normal forward flight. Also coordinate your power setting as you become more proficient you will be able to do 180, 360, and 720 degree stall turns! Practice and more practice pays off!!!

LOOP:

If you wish to loop your helicopter, gain sufficient altitude and start a shallow dive. After you gain additional speed apply steady rear cyclic until you complete your loop. You will need to experiment with different power settings. BY NO MEANS SHOULD YOU CUT POWER OFF DOWN THE BACKSIDE OF THE LOOP! Trial and error will provide you with the experience to accomplish the perfect loop.

ROLLS:

A roll is best accomplished by flying left or right in front of you at an altitude of at least 100 feet. The right roll is the best roll for helicopters, although you can roll left.

Start a very shallow dive and after additional speed is attained start applying gradual rear cyclic until the nose passes through the horizon. At that point apply right cyclic until the roll is completed. Neutralize the roll by application of opposite cyclic control. You may need to apply a slight amount of forward cyclic when inverted to keep the nose on the horizon. Again trial and error and variation of your speeds, along with plenty of practice will allow you to perform good rolls

There are many manuvers that you can experiment with as you become more familiar with the tendencies of your helicopter. Just remember not to get ahead of your own capabilities. Learn a little at a time and continue to practice the basic manuvers. A great deal of fun can be had with the basic manuvers such as hovering, like (1) hovering nose in towards yourself, (2) hovering stationary while you walk around your helicopter, or (3) hovering your helicopter around yourself both nose in and tail in.

Have lots of fun with your new helicopter and remember above all to practice safety and common sense at all times!

EFFECTIVE DATE: 5-1-82

MANTIS

.40 POWERED HELICOPTER PARTS LIST

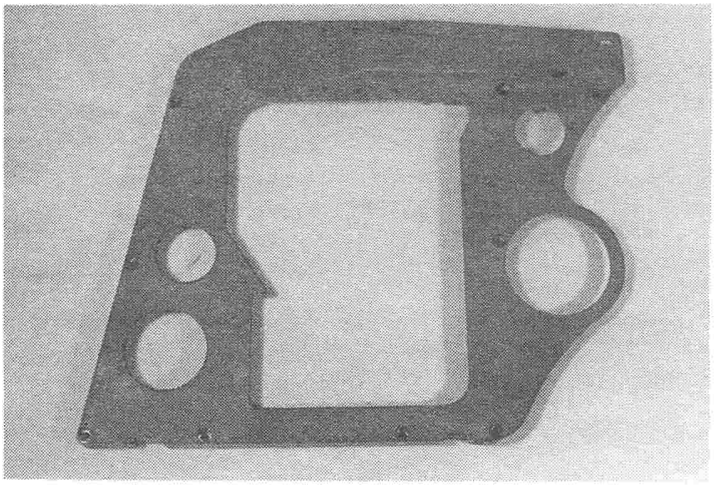
Part #	NOMENCLATURE	QTY.	PRICE	Part #	NOMENCLATURE	QTY.	PRICE
M1	M/R BLADES	1 pr	$10.25	M47	T/R PITCH CHANGE MECH.	1	$ 4.50
M2	M/R BLADE RETAINERS	4	5.50	M48	T/R PITCH CHANGE WIRE (short)	1	1.00
M3	M/R HUB BLOCK	1	13.00	M49	T/R PITCH CHANGE WIRE (long)	1	3.00
M4	M/R HUB STABILIZER SHAFT	1	6.25	M50	T/R PITCH CHANGE WIRE KEEPER	1	1.00
M5	M/R HUB STABILIZER SHAFT SUPPORT	1	4.00	M51	CANOPY	1	14.50
M6	STABILIZER ROD	1	4.75	M52	REAR CABIN FORMER	1	3.50
M7	M/R CONTROL ARM	1	8.75	M53	TAIL FIN	1	2.50
M8	SEESAW	1	10.25	M54	STARTING BELT	1	3.25
M9	SEESAW SIDE SUPPORTS	2	6.50	M55	ANTI-ROTATION LOCK	1	3.50
M10	RUBBER DAMPENER	1	2.50	M56	BELL CRANK with GROMMET	1	3.00
M11	CONTROL PADDLES	2	7.00	M57	BALL LINKS	10	6.00
M12	M/R SHAFT	1	11.00	M58	PUSH ROD PACKAGE	1	6.25
M13	FOLLOWER	1	5.00	M59	BELL CRANK STAND-OFF (Brass)	1	1.00
M14	SWASHPLATE LOCKS	2	3.00	M60	MAIN PLAN	1	5.00
M15	SWASHPLATE	1	39.00	M61	ASSEMBLY MANUAL	1	7.95
M16	BEARING BLOCK 7/8" BORE	1	3.50	M62	4-40 x 1/4 for PLASTIC	10	3.00
M17	BEARING BLOCK 5/8" BORE	1	3.50	M63	4-40 x 3/8 SOCKET HEAD SCREWS	10	3.00
M18	BEARING FOR M-16 (7/8" BORE)	1	10.00	M64	#4 x 3/8 for PLASTIC	10	3.00
M19	BEARING FOR M-17 (5/8" BORE)	1	9.00	M65	#4 x 1/2 for PLASTIC	10	3.00
M20	M/R DRIVE PULLEY	1	6.00	M66	4-40 x 1/2 SOCKET HEAD SCREWS	10	3.25
M21	M/R DRIVE GEAR	1	9.50	M67	4-40 x 5/8 SOCKET HEAD SCREWS	10	3.25
M22	M/R DRIVE GEAR WASHER	1	1.00	M68	4-40 x 1-1/8 PAN HEAD SCREWS	1	.75
M23	PINION SHAFT	1	15.50	M69	4-40 x 1-1/2 SOCKET HEAD SCREWS	1	.75
M24	PINION SHAFT LOCKING COLLAR	1	2.25	M70	4-40 LOCKNUTS	10	3.00
M25	BELL HOUSING	1	6.25	M71	4-40 BLIND NUTS	4	1.50
M26	BELL HOUSING LINING	1	3.75	M72	4-40 HEX NUTS	10	3.00
M27	CLUTCH	1	34.95	M73	#4 LOCKWASHERS	10	2.00
M27a	CLUTCH BEARING	1	9.25	M74	#4 FLATWASHERS	10	2.00
M28	CLUTCH SPRING	1	4.75	M75	5-40 x 3/8 SOCKET HEAD SCREWS	10	2.00
M29	ENGINE FAN	1	12.00	M76	5-40 x 5/8 SOCKET HEAD SCREWS	10	2.25
M30	COOLING SHROUD	1	10.25	M77	5-40 x 1 SOCKET HEAD SCREW	1	.75
M31	ENGINE MOUNTING BLOCKS	2	3.25	M78	5-40 LOCKNUTS	10	3.00
M32	MAIN FRAME	1 pr	15.50	M79	#5 LOCKWASHERS	10	2.00
M33	SKIDS	2	9.50	M80	8-32 x 5/8 SOCKET HEAD SCREWS	2	1.00
M34	CROSS STRUTS	2	9.75	M81	2-56 x 3/8 PAN HEAD SCREWS	10	1.00
M35	SKID CLAMPS	4	6.25	M82	2-56 x 3/4 PAN HEAD SCREWS	10	1.25
M36	TAIL BOOM (Complete with Blocks)	1	14.00	M83	2-56 x 1 SOCKET HEAD SCREW	1	.75
M37	TAIL BOOM BLOCK (Front)	1	3.00	M84	#2 FLATWASHERS	10	1.50
M38	TAIL BOOM BLOCK (Rear)	1	4.50	M85	2-56 NUTS	10	1.50
M39	T/R DRIVE BELT	1	8.25	M86	4-40 SET SCREWS	10	2.00
M40	T/R HUB	1	8.95	M87	5-40 SET SCREWS	10	2.00
M41	T/R SHAFT	1	6.25	M88	6-32 SET SCREWS	10	2.00
M42	T/R SHAFT BEARING	1	6.25	M89	8-32 x 1/8 SET SCREWS	10	2.25
M43	T/R BLADE HOLDER BEARING	1	5.50	M90	8-32 x 1/4 SET SCREWS	10	2.25
M44	T/R PULLEY	1	5.25	M91	1/16 WHEEL COLLAR	2	1.50
M45	T/R BLADE HOLDERS	4	5.00	M92	5/32 WHEEL COLLAR	2	2.00
M46	T/R BLADES	2	5.25	M93	COMPLETE HARDWARE PKG. 1-7	1	19.95

★ NOTE: *MINIMUM ORDER ON SPARE PARTS IS $5.00.*

ALL SHIPPING & HANDLING CHARGES F.O.B., SAN MARCOS, CALIFORNIA

★ PRICES SUBJECT TO CHANGE WITHOUT NOTICE!

American R/C Helicopters, Inc.
635-11 North Twin Oaks Valley Road ★ San Marcos, California 92069 ★ (714) 744-7533



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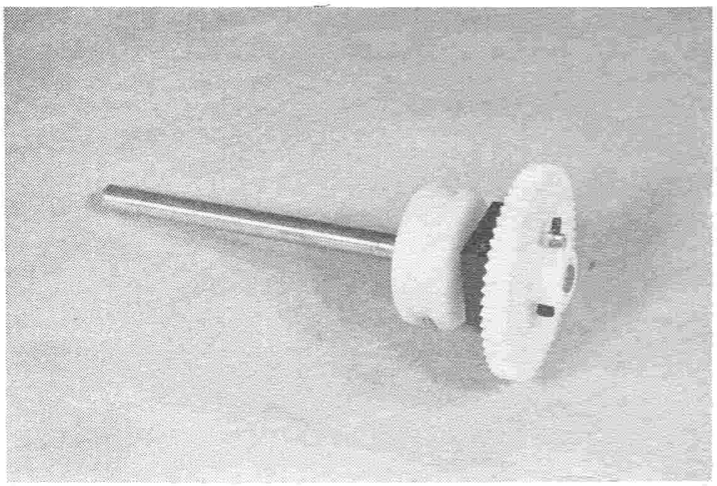

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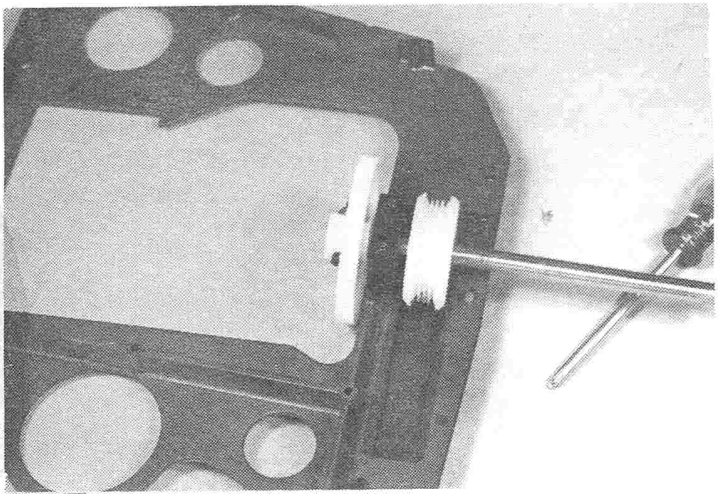

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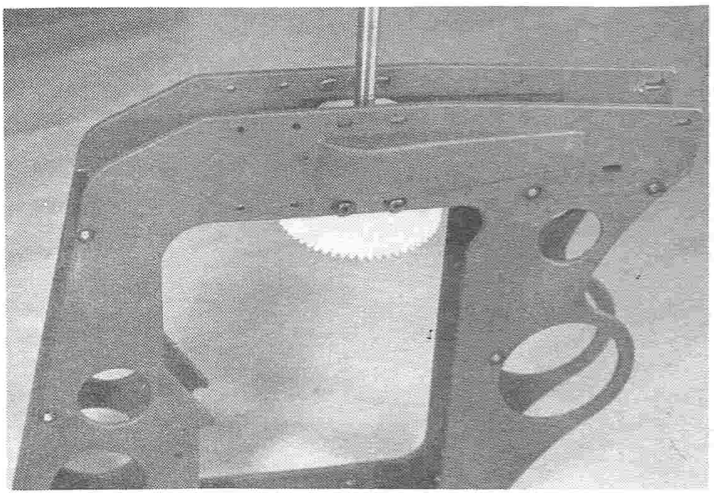

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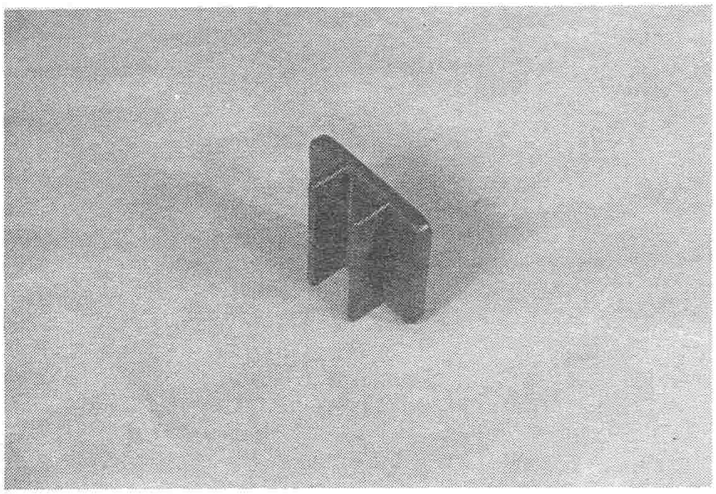

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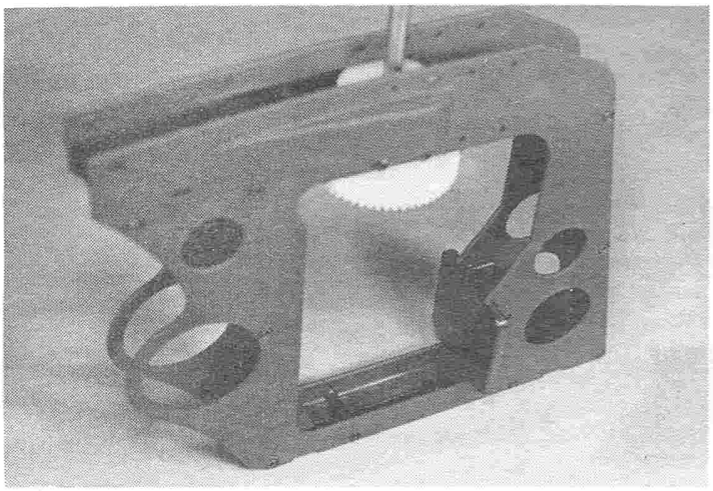

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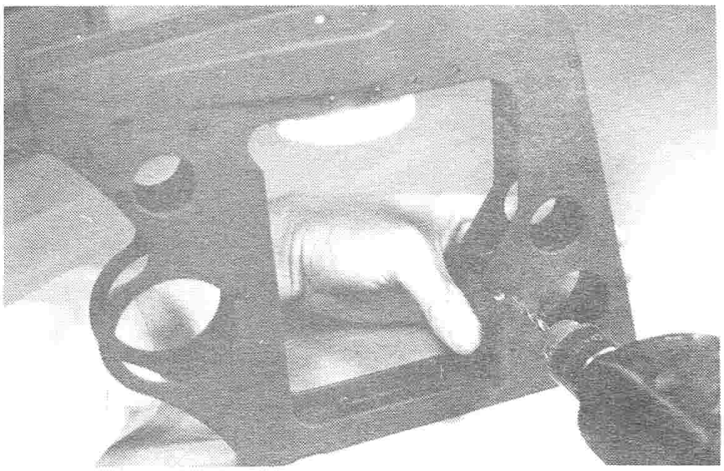

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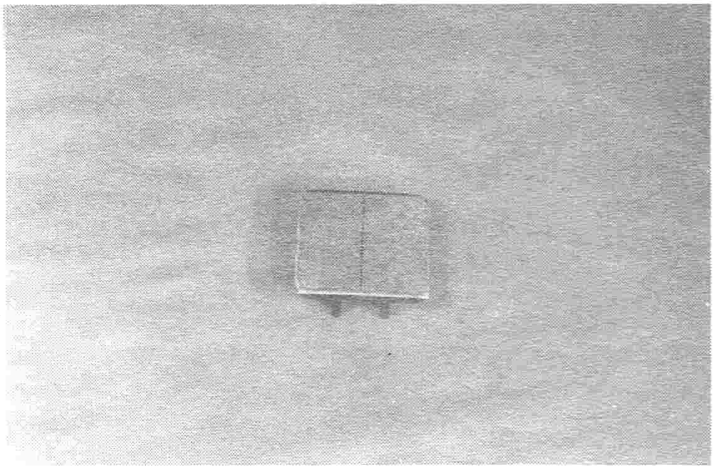

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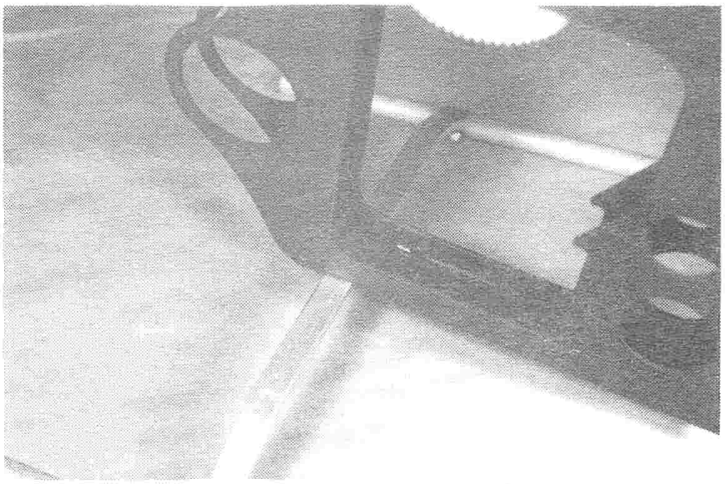

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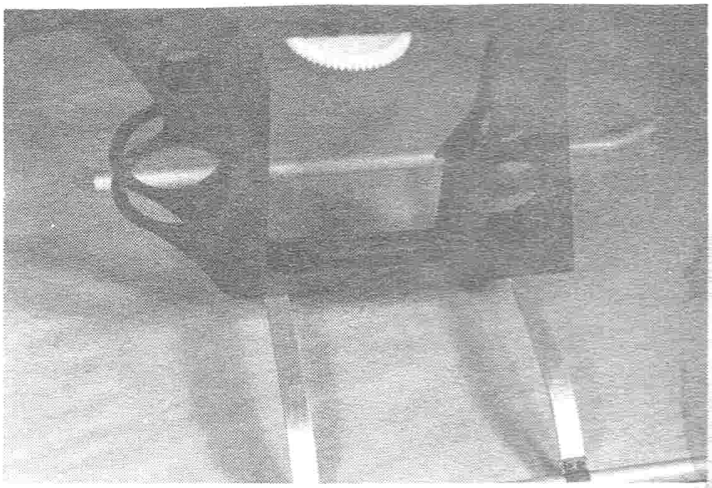

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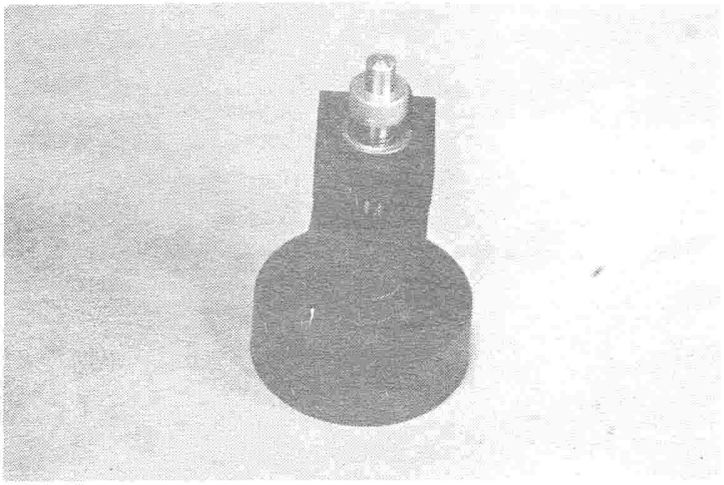

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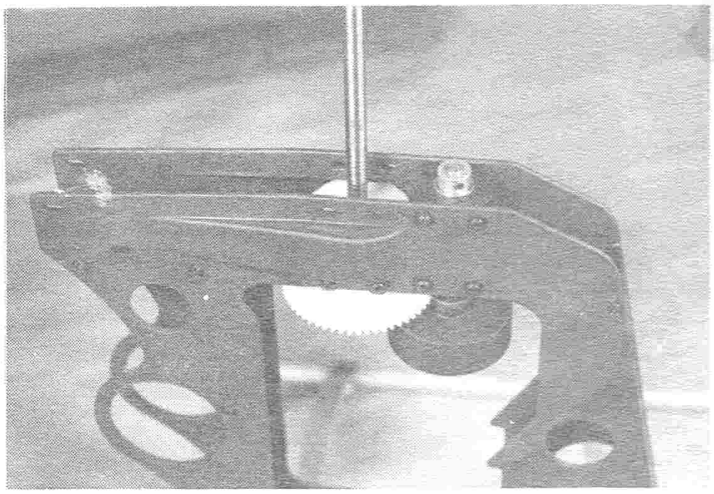

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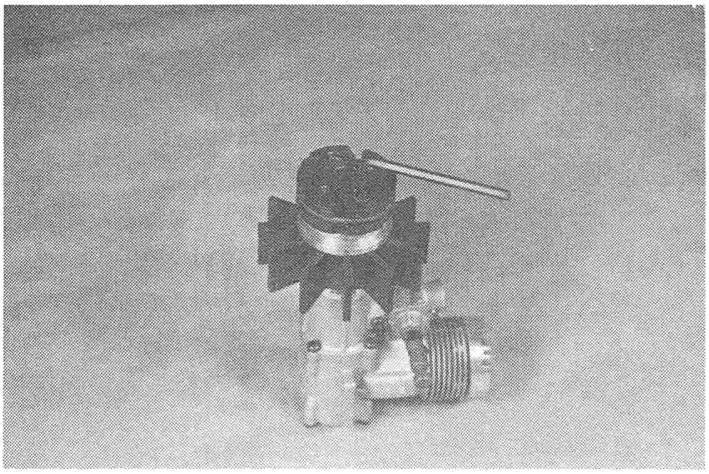

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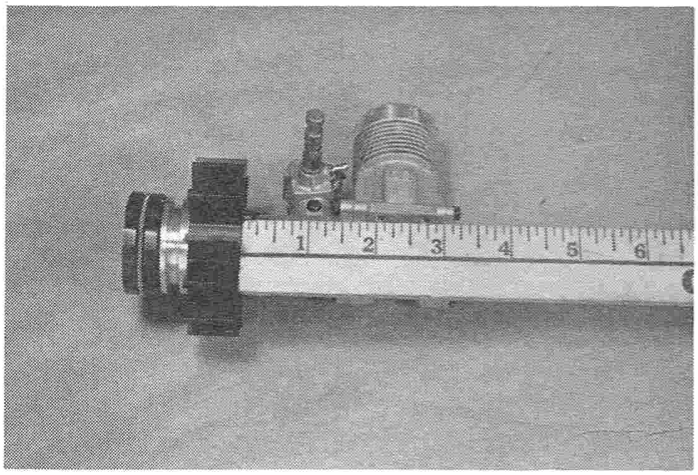

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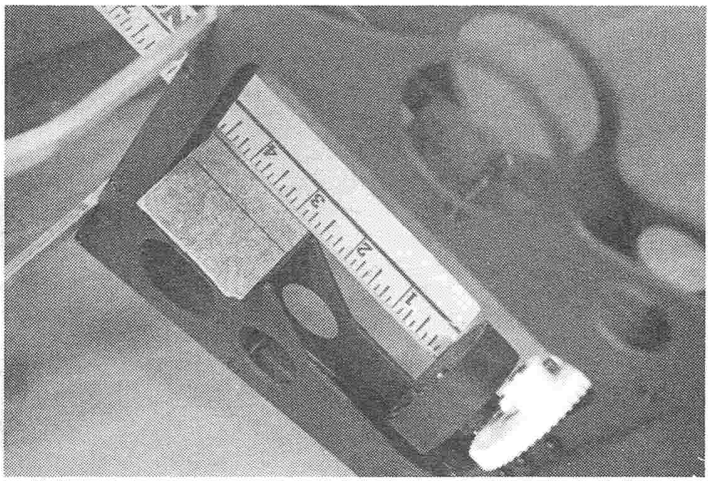

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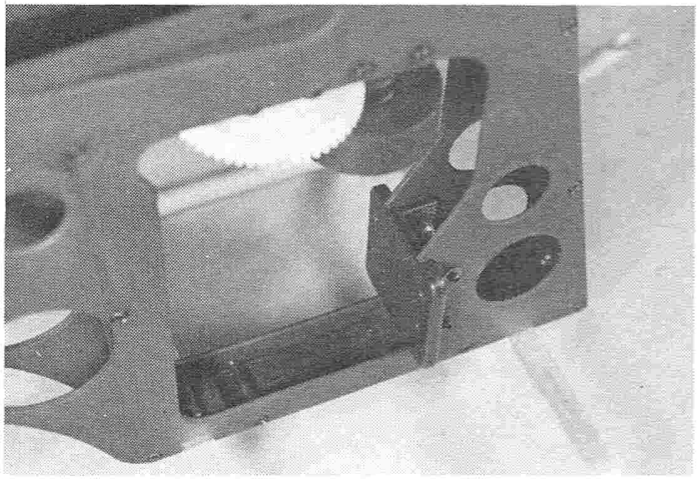

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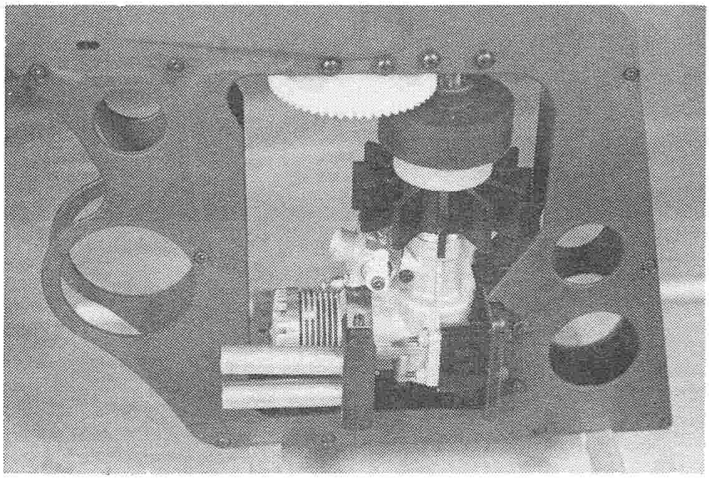

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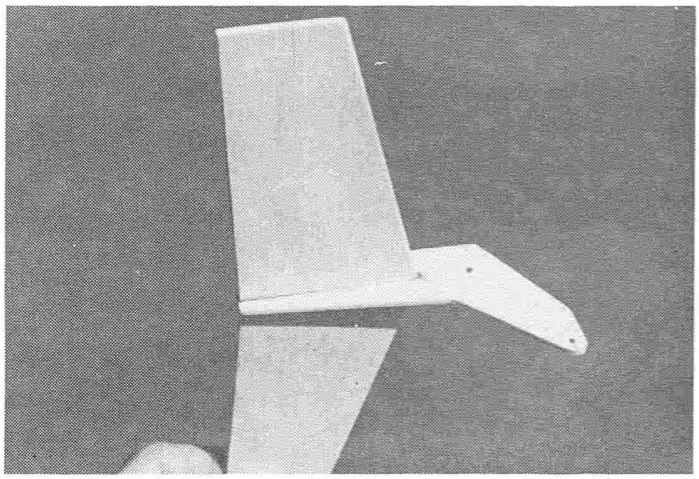

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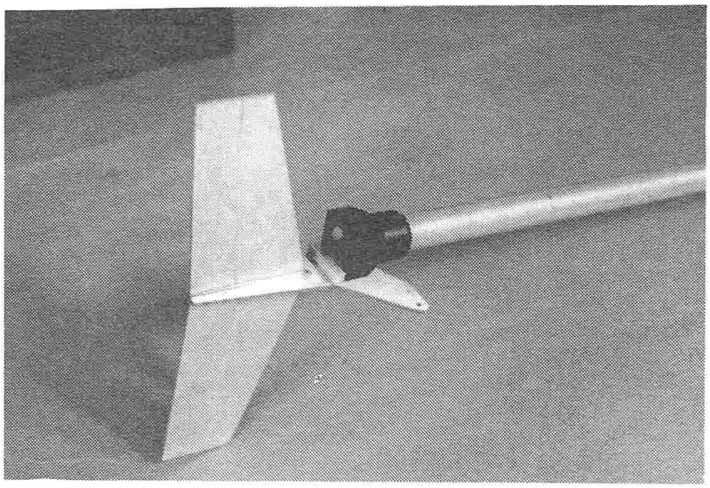

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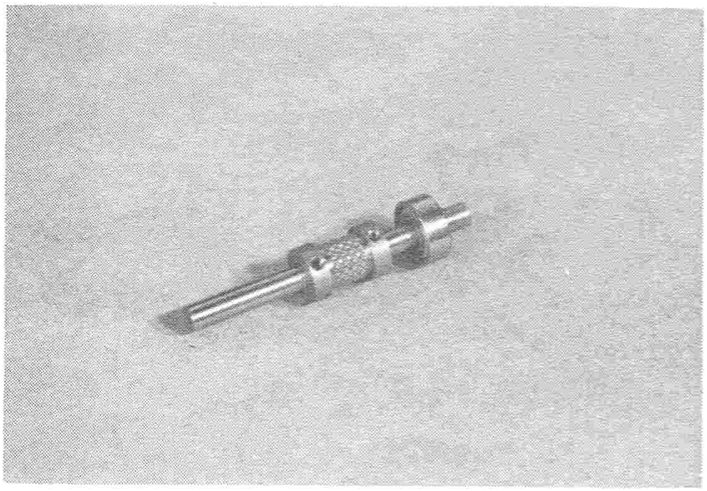

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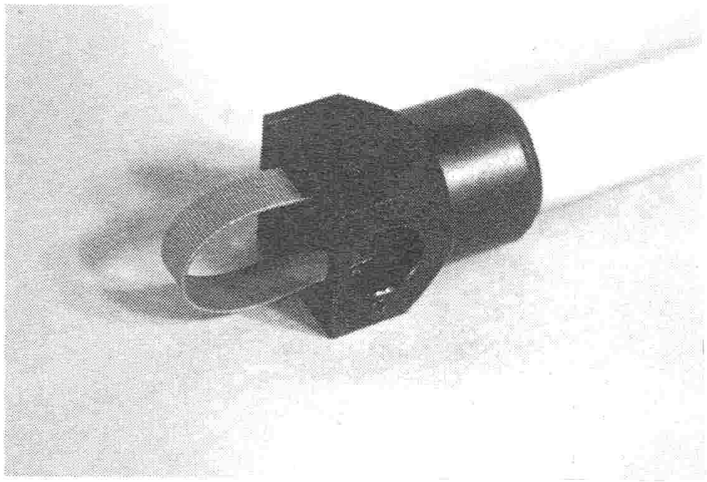

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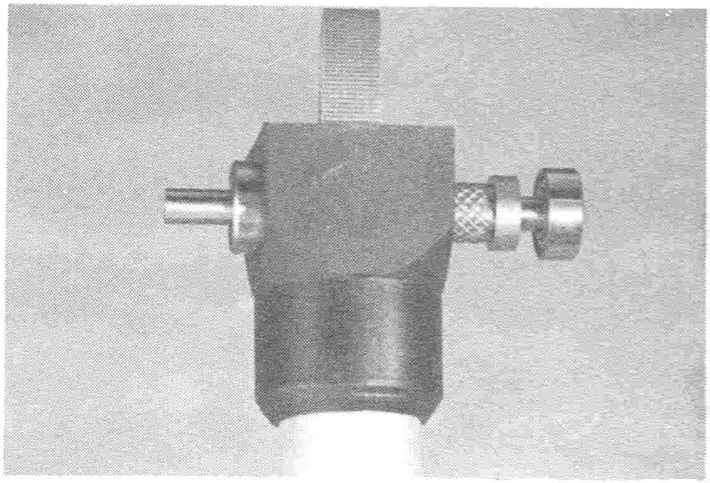

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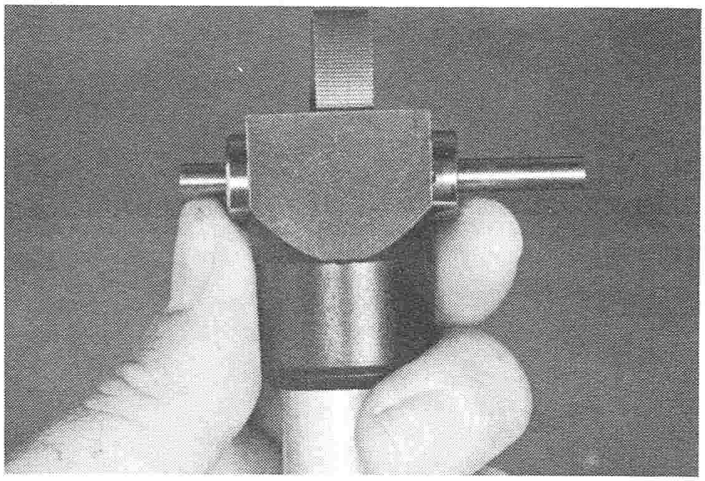

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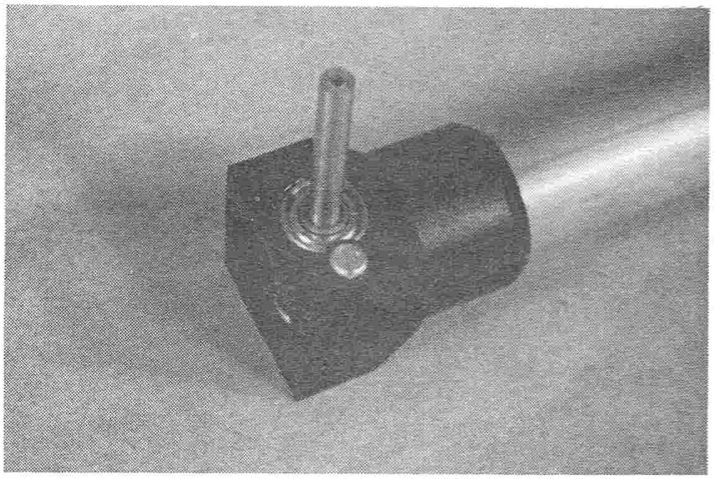

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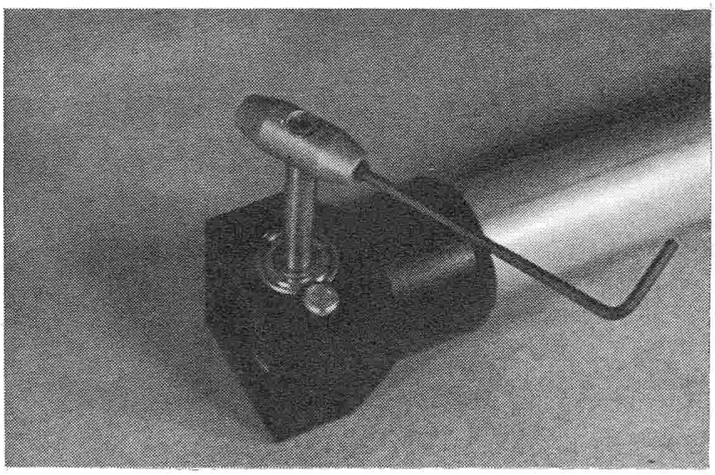

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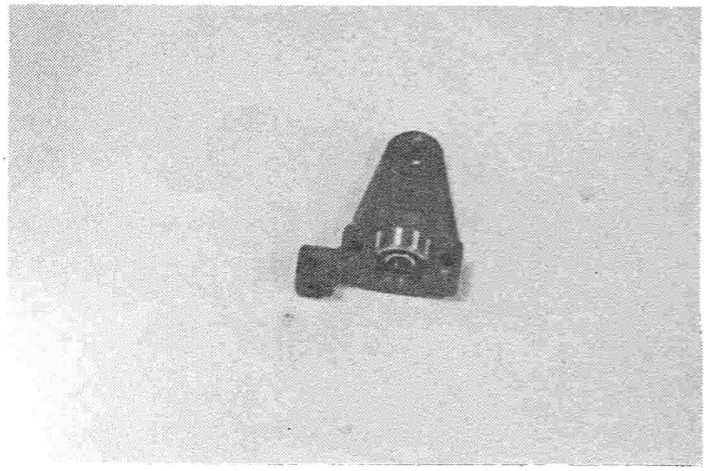

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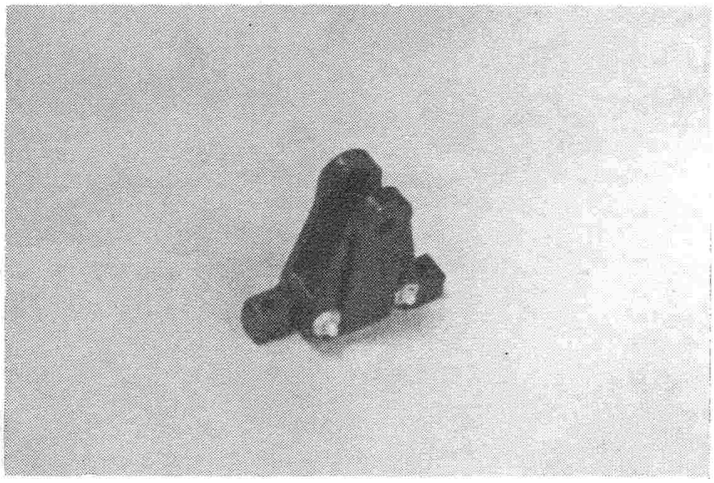

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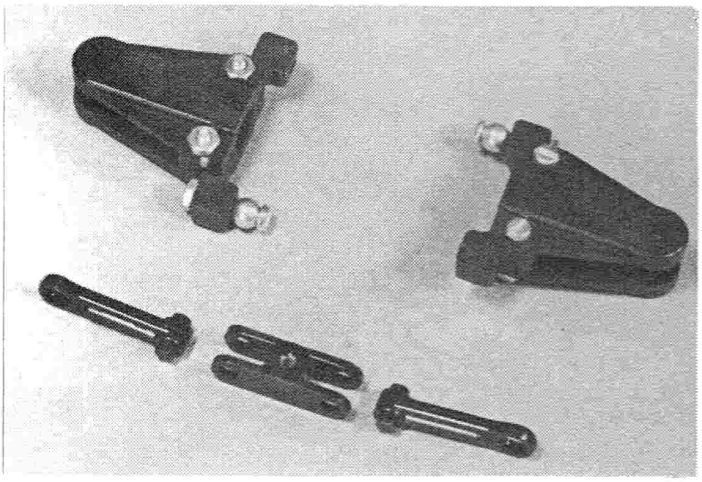

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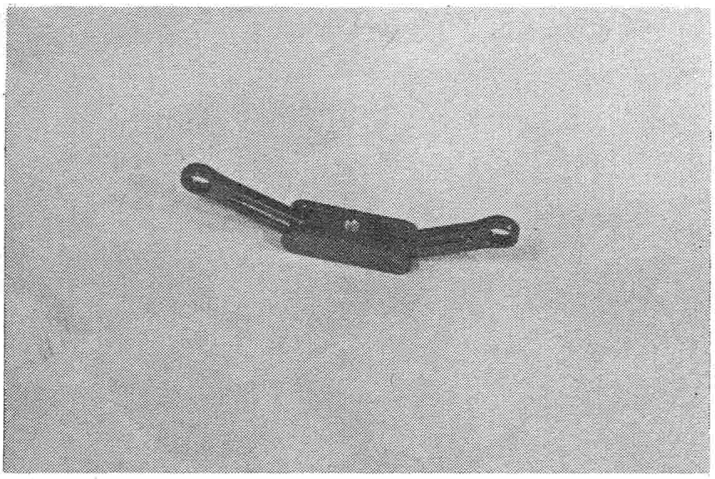

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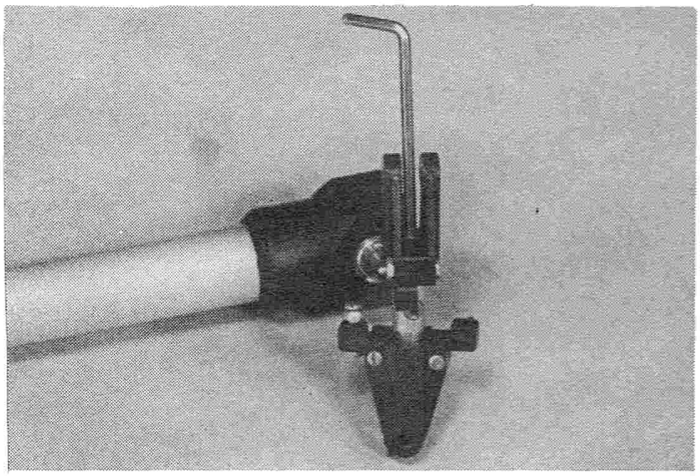

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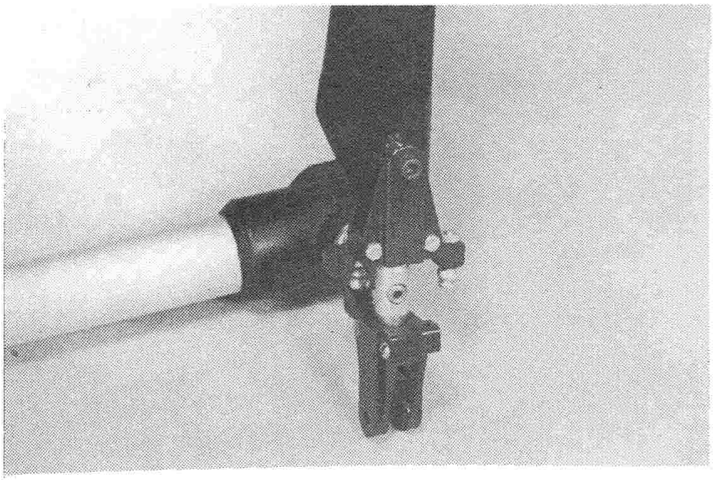

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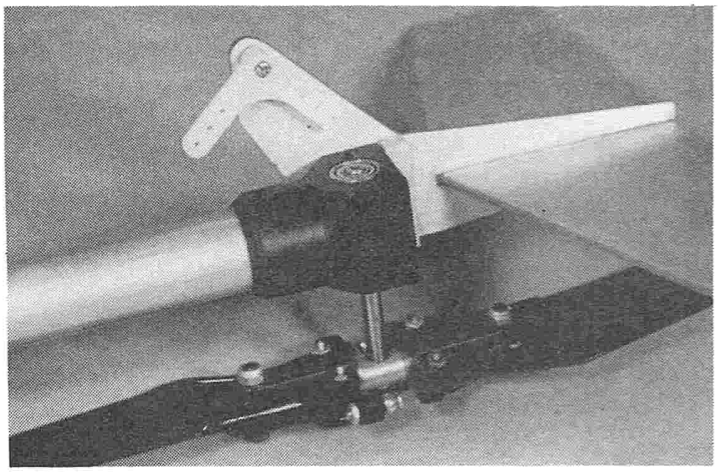

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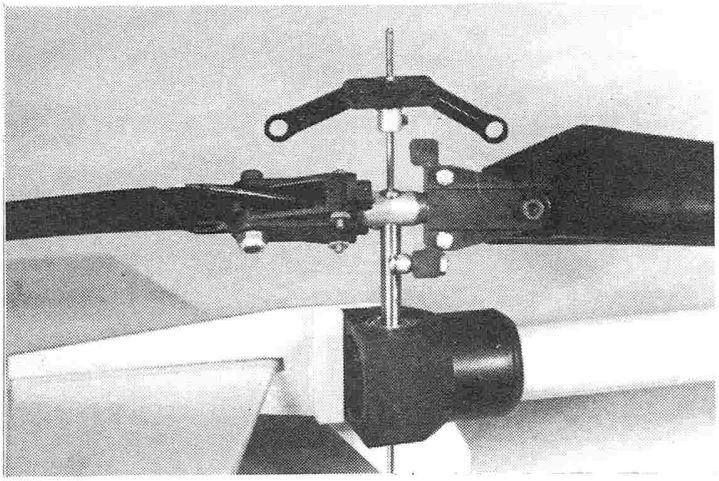

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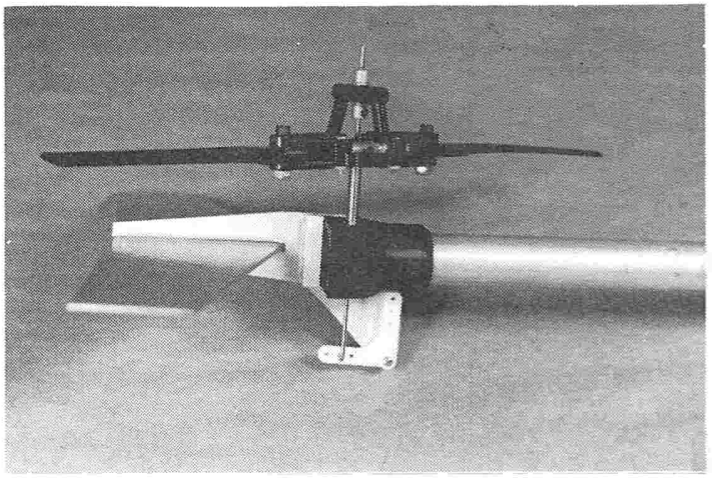

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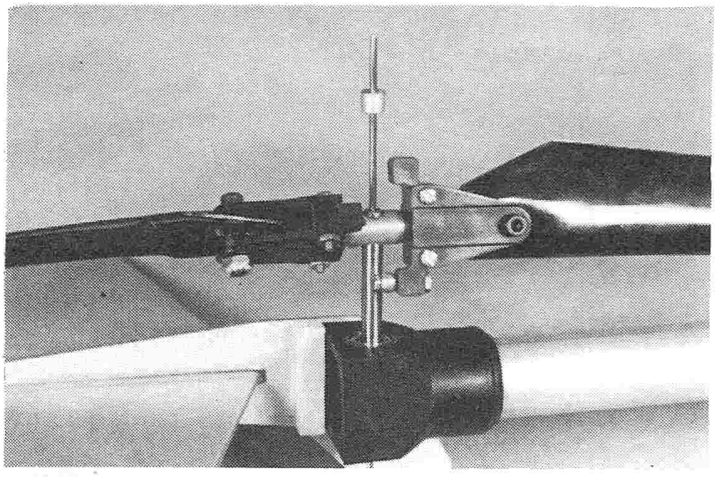

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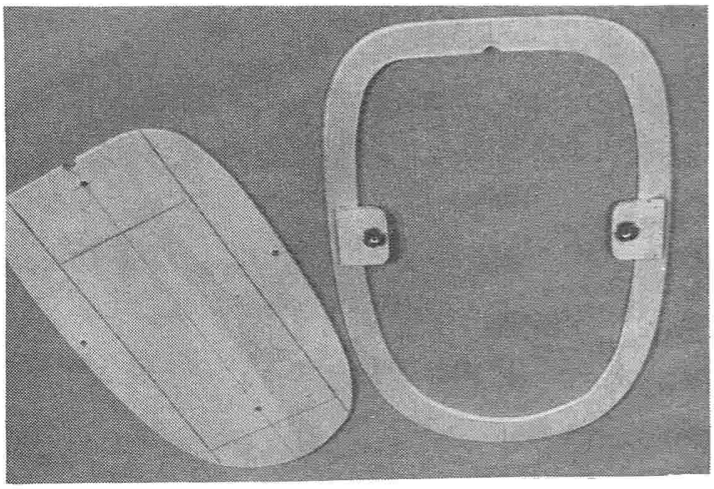

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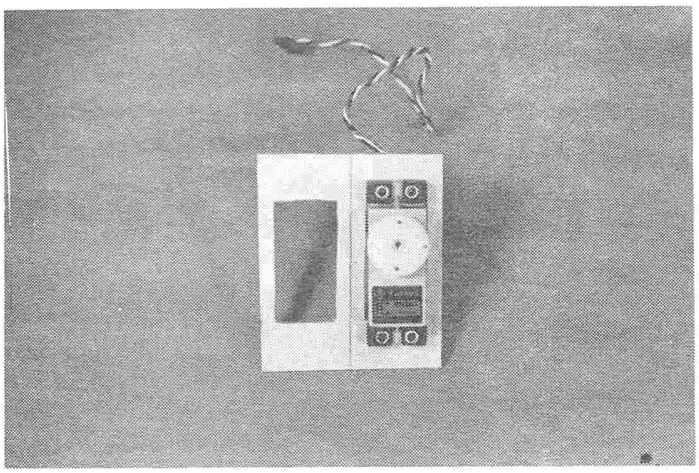

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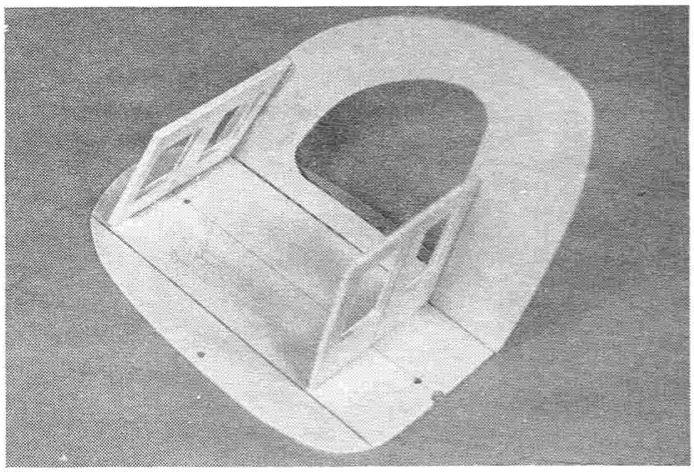

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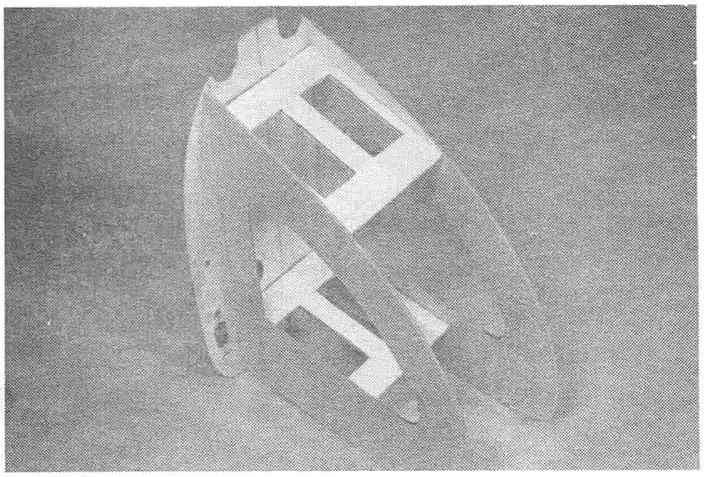

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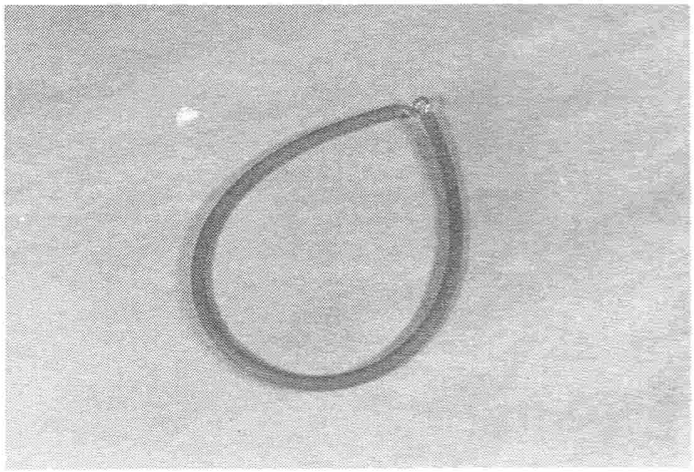

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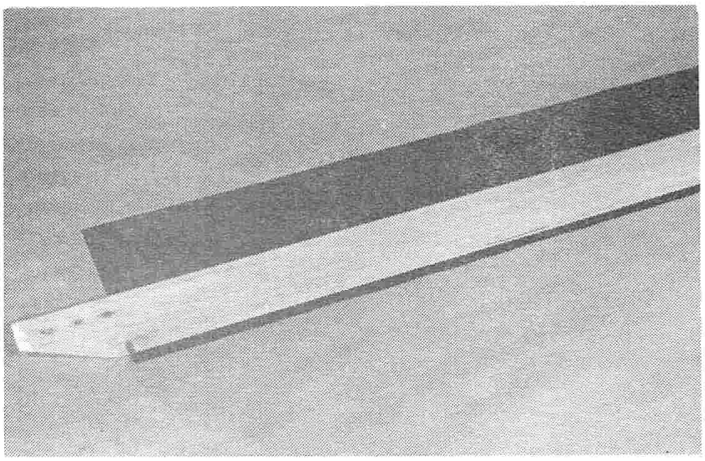

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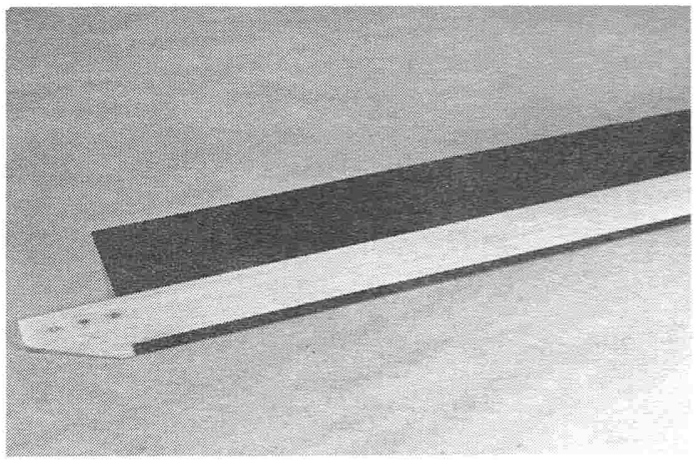

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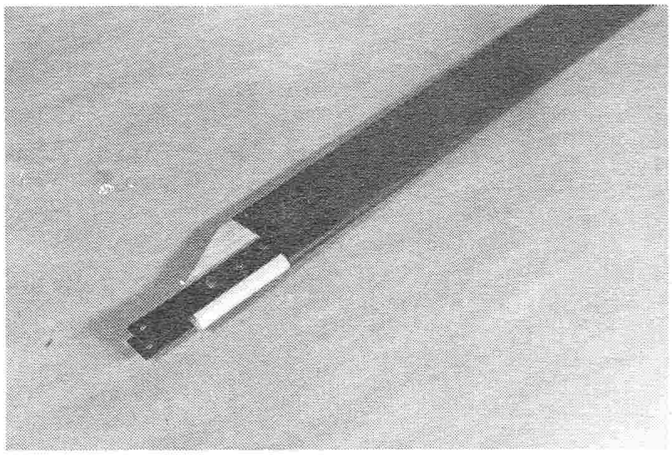

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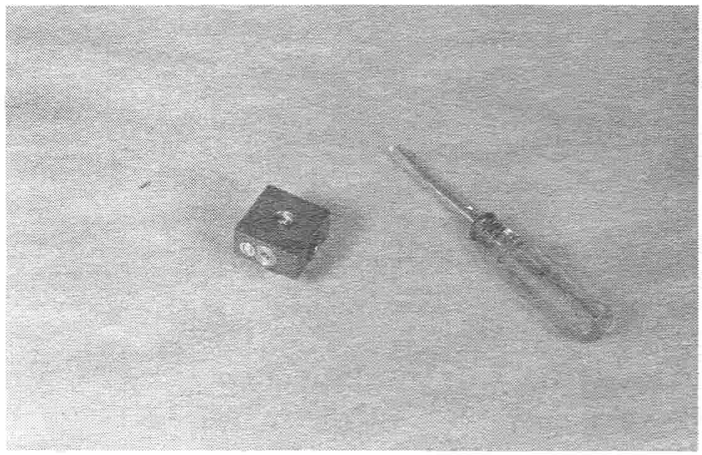

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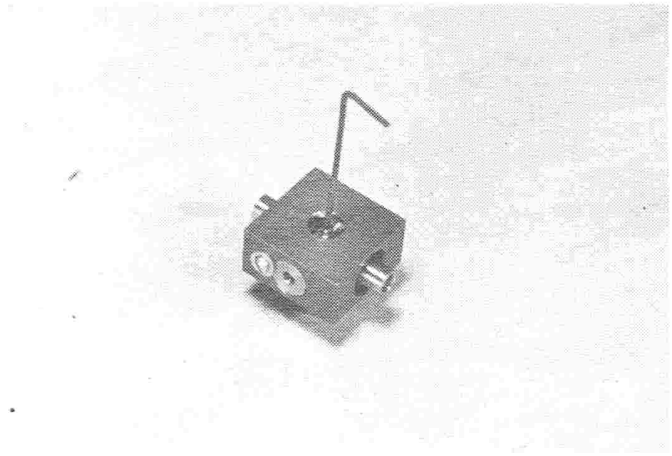

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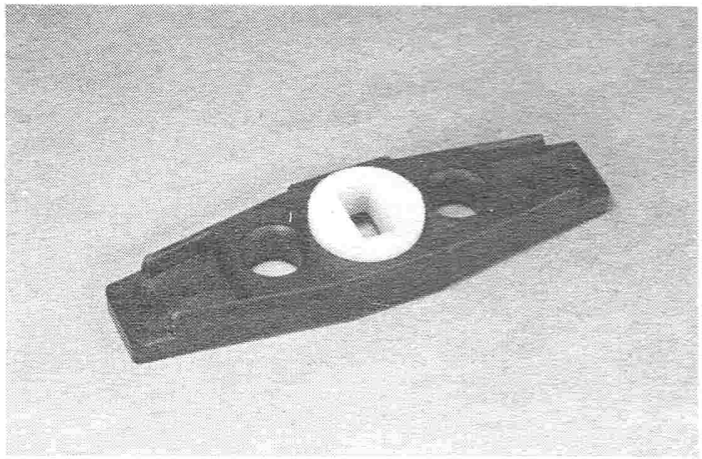

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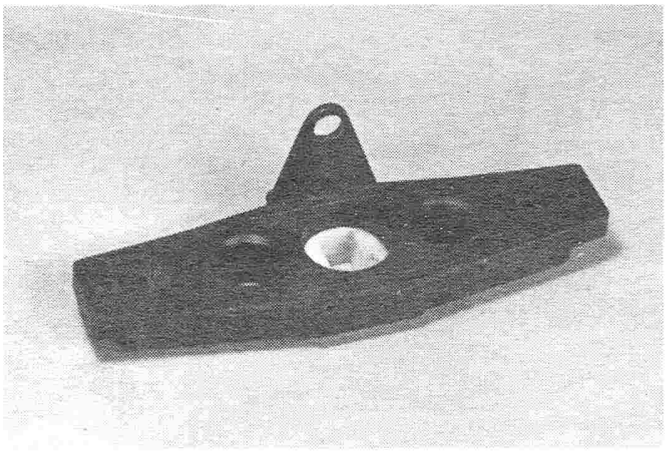

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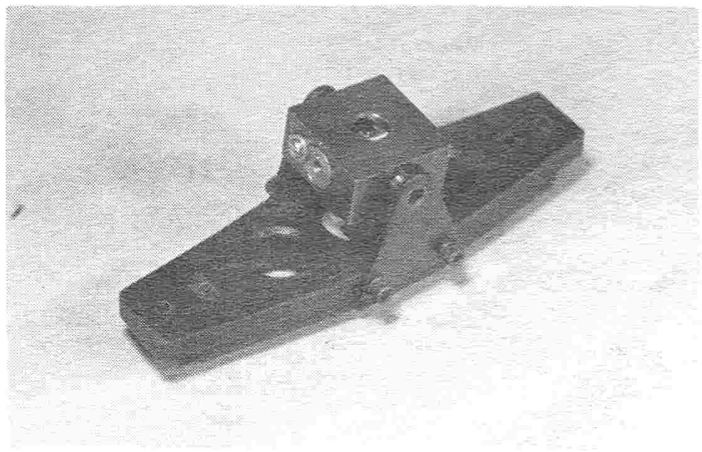

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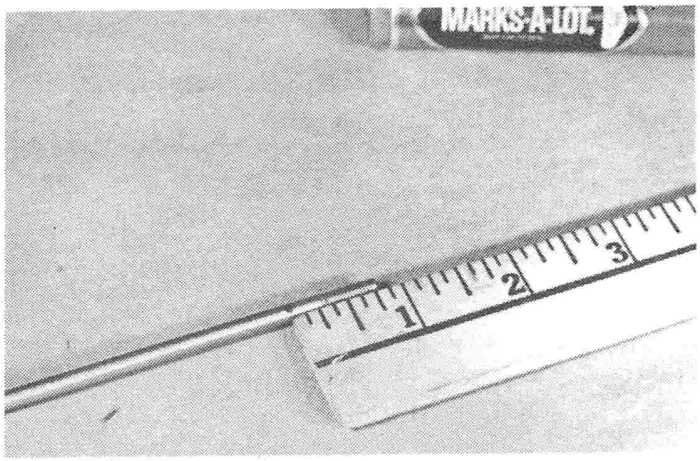

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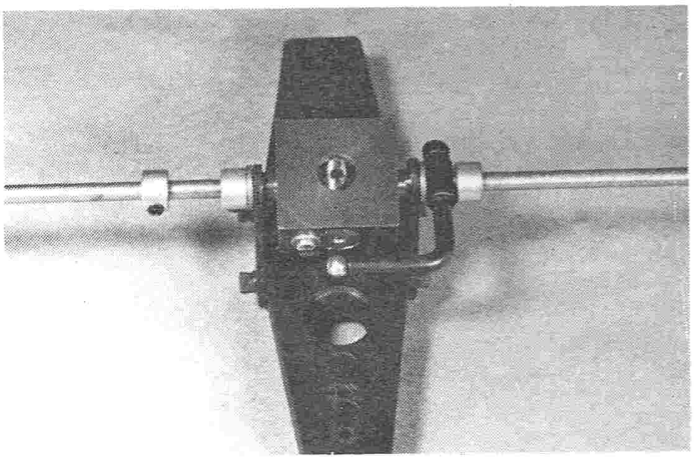

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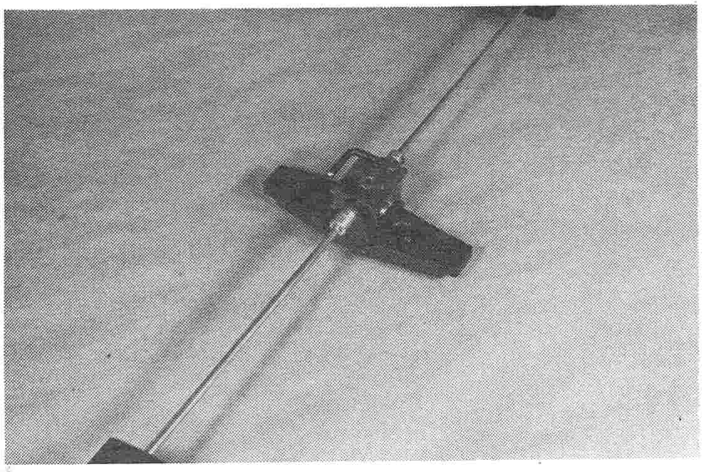

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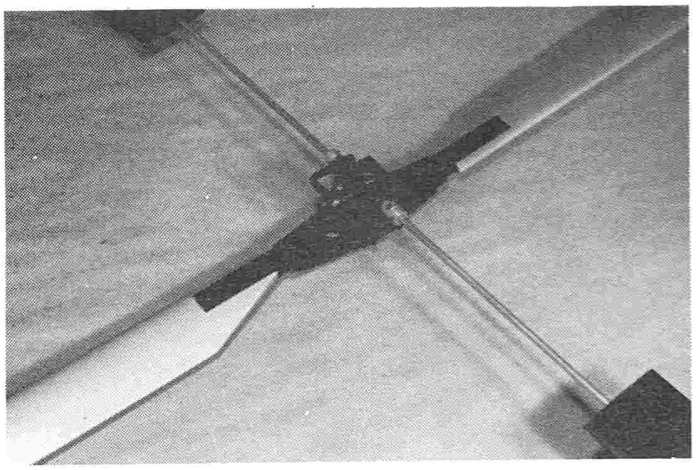

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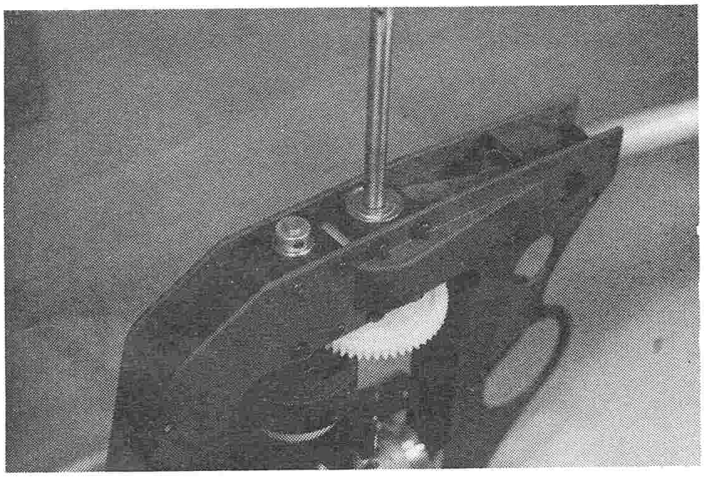

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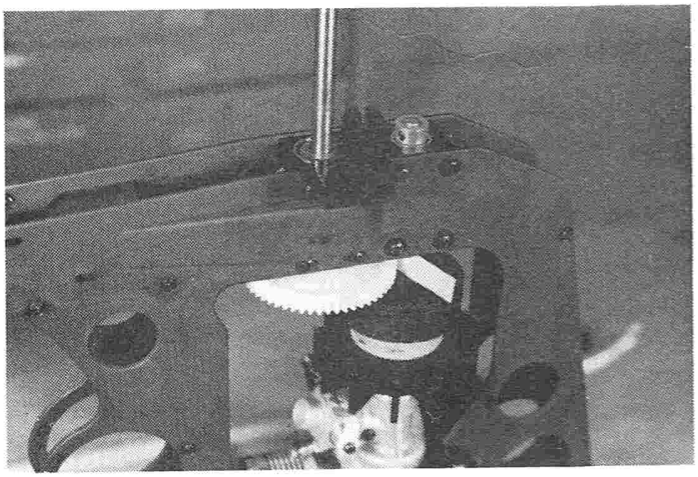

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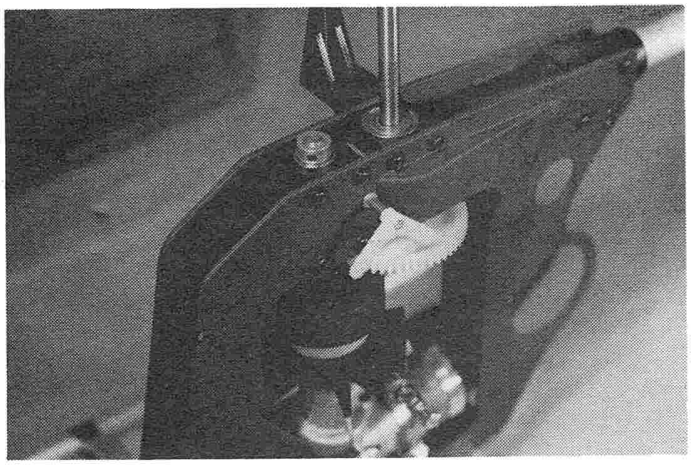

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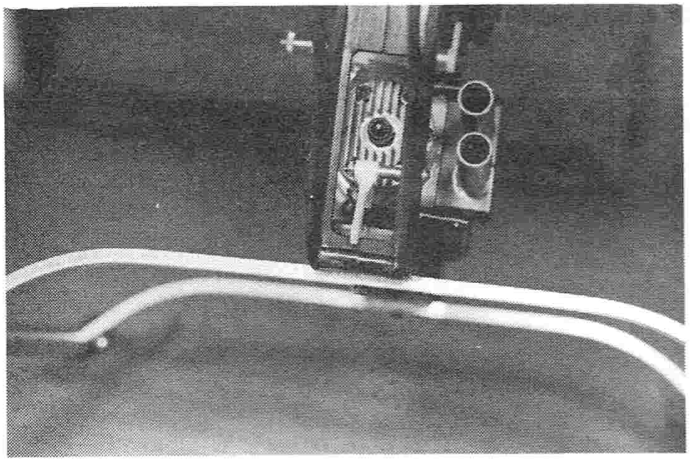

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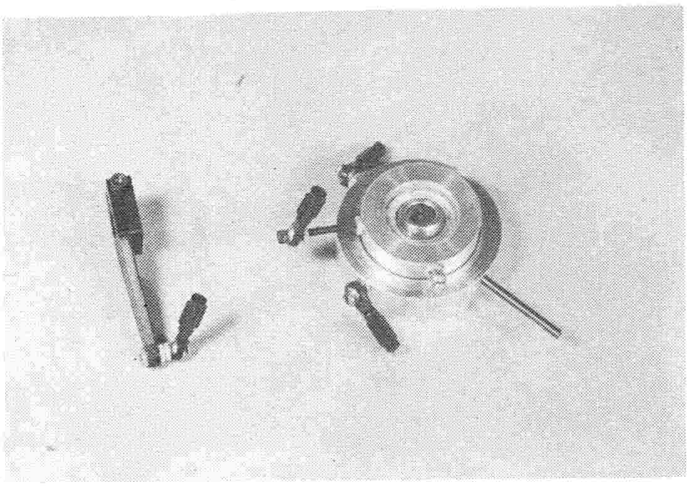

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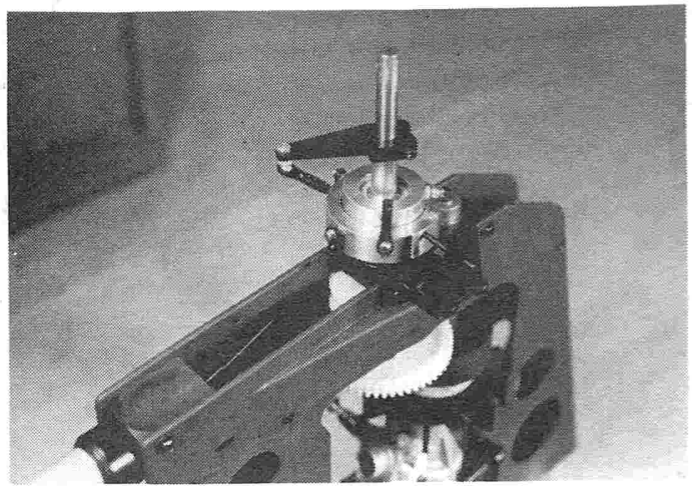

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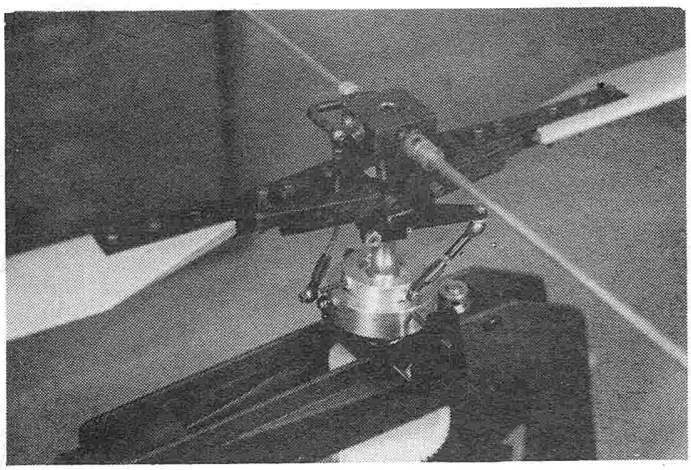

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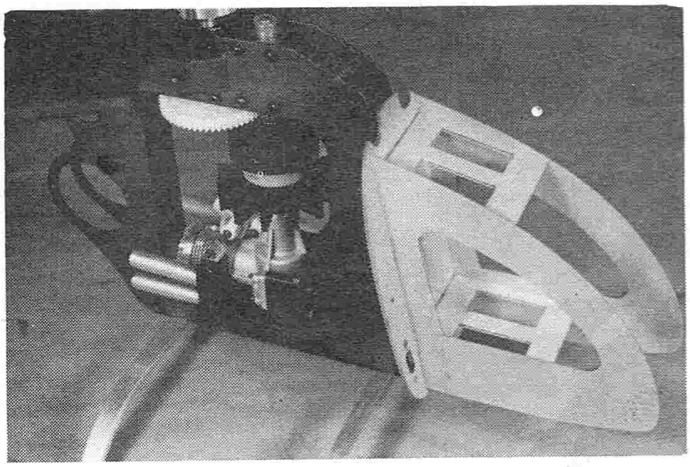

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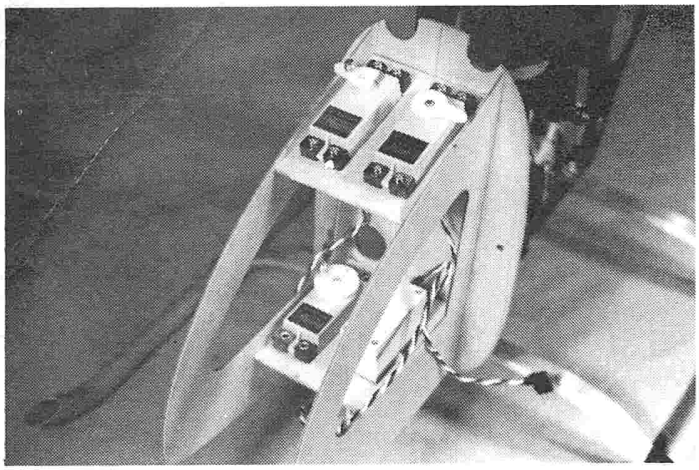

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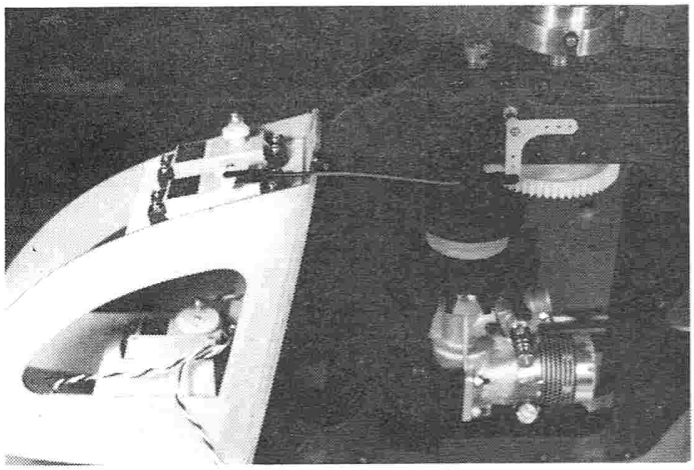

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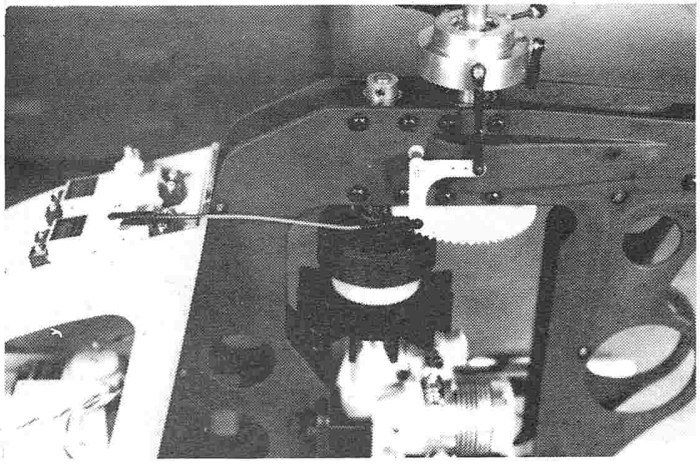

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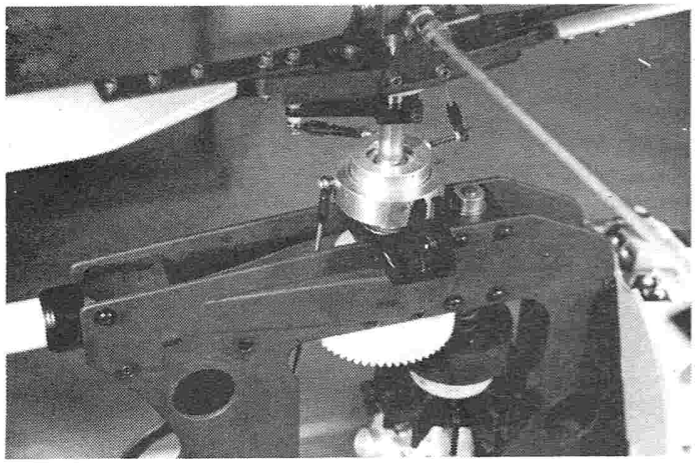

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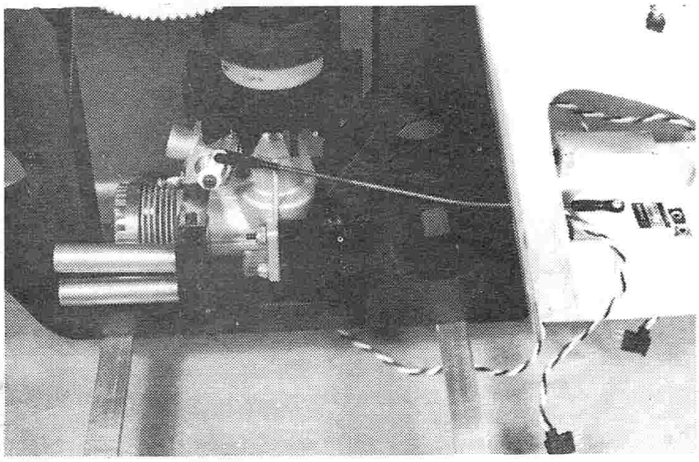

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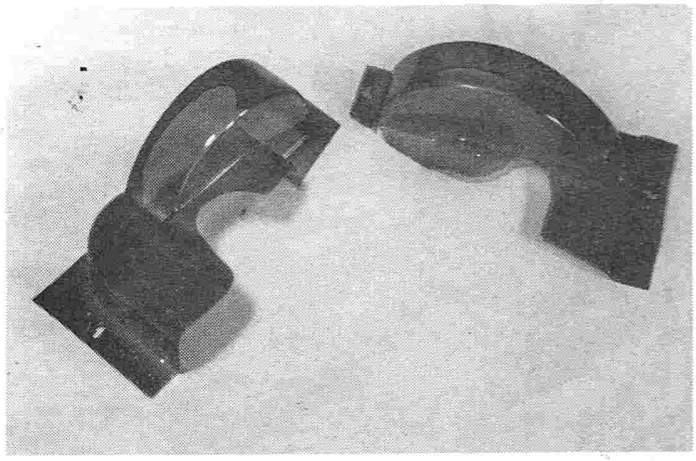

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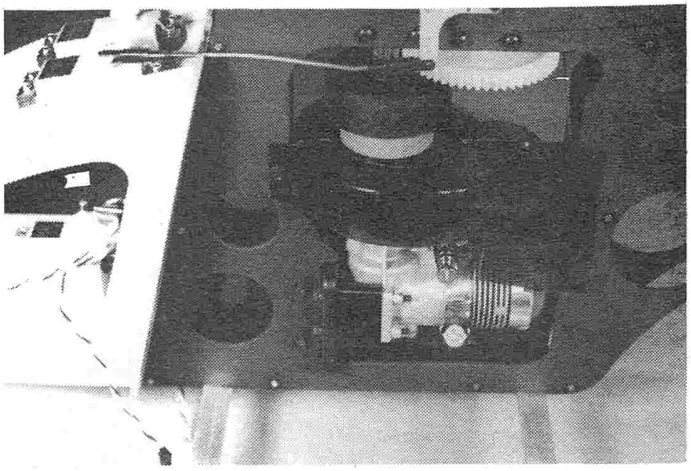

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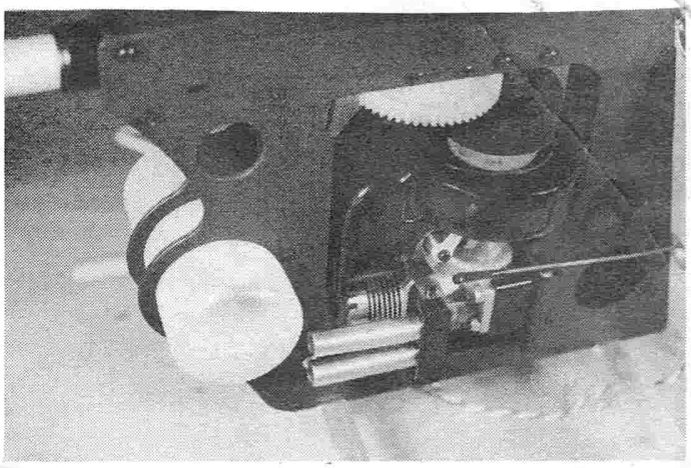

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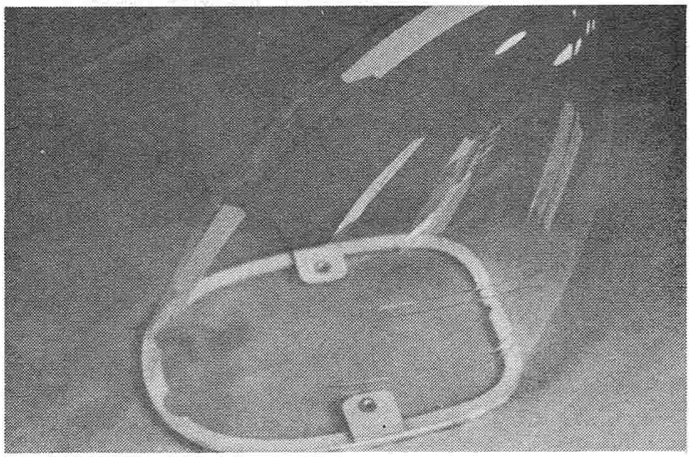

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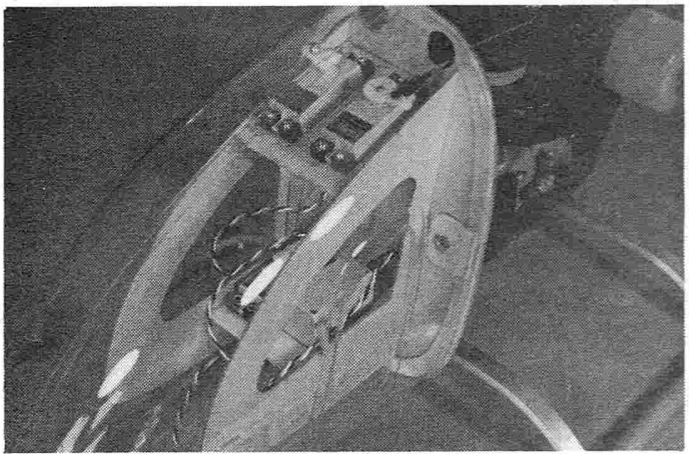

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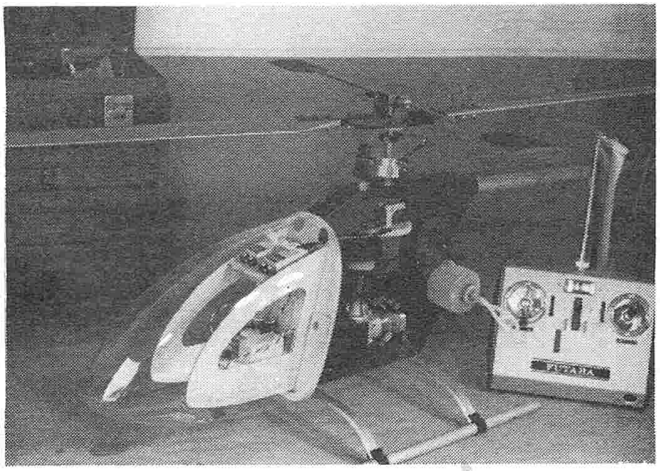

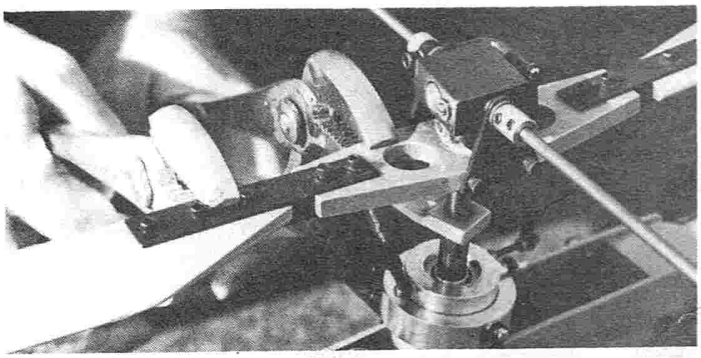

ADJUSTING MAIN ROTOR BLADE PITCH:

You will need a pair of channel locks or vice grips for this step. Firmly attach one pair to the seesaw. With the other attached to main rotor blade retainer bend a slight amount of positive pitch into the main rotor blades. Use a pitch gauge to give an approximate angle.