

Section 11

Drive Train Installation

Procedures covered in this section:

Install secondary assembly; install main rotor shaft; install fan and fan pulley; install secondary sprocket and locking assembly; fabricate and install retainer plate; mount main drive sprocket to hub; temporarily install drive chain; fabricate and install main shaft safety spacer.

Cards used in this section:

HARDWARE CARD E49 CARD 1F
E23 CARD 1F E49 CARD 2F

Prints used in this section:

E23-2000 E49-2001
E49-2000 E49-2002

Templates used in this section:

E23-1

Tools required for this section:

Air or electric drill	Drill press	Level	Snap ring pliers	Utility knife
Allen wrench	Files	Pliers	Spring scale	Vise
Band saw	Framing Square	Ruler	Straight edge	
Digital Protractor	Grease pencil or marker	Screwdriver	Tape measure	
Drift punch	Hammer	Side cutters	Torque wrench	

Drill bits of the following sizes: 1/16", 1/4", 5/16", Letter "D"

Ratchet with sockets of the following sizes: 7/16", 1/2", 9/16"

Wrenches of the following sizes: 7/16", 1/2", 9/16"

Notes:

1. **BUILDING SEQUENCE:** Before beginning any work on the drive train, read Sections 11 through 16 to become familiar with the entire procedure. Follow this sequence when assembling the drive train components:
 - A. Install the main rotor shaft. Do not Loctite bearings or set lock rings yet because the main shaft will be removed to fit other components.
 - B. Align the secondary drive unit with main rotor shaft, shim as necessary, and final install.
 - C. Install engine and shim as required.
 - D. Install clutch idler pulley assembly and torque link.
 - E. Install fan drive countershaft, water pump, alternator and voltage regulator.
 - F. Remove chain and raise main rotor shaft to fit the oil bath.
 - G. Final install the oil bath pan on the airframe. Install the oil seals and glue them in place.
 - H. Final install main rotor shaft and drive train.
 - I. Check chain tension, master link and master link clip. Safety wire secondary retainer plate bolts, hub to sprocket bolts, and hub to shaft bolts.
 - J. Complete oil bath cover and seal it to the oil bath lower pan.

All components that need to be painted, including the airframe, must be painted before gluing the rear oil bath seal in place. Once the seal is in place, the secondary shaft and oil bath pan must not be moved or the seal will leak.

2. **MAIN ROTOR SHAFT:** The main rotor shaft must be installed 90 degrees to the drive mount tubes in the fore and aft and lateral planes. We recommend using the digital protractor supplied, or a large builder's square (framing square), for checking squareness when installing the main rotor shaft. This will be more accurate than using a protractor level as shown in the photos.
3. **BEARING LOCK RINGS:** In this application the bearing lock ring must be set in the direction of rotation. This is done by using a drift punch (sized for the hole in the lock ring) and a hammer approximately 10 to 14 oz. in weight. Strike the punch in the direction the bearing is turning. (The main rotor shaft will turn clockwise viewed from above.) No more than 2 or 3 strikes are necessary to set the ring in position. Then tighten the set screw firmly. If the application requires Loctite, wait until the Loctite is dry before setting the lock ring. Keep in mind the larger the bearing and lock ring, the more force it will take to set.
4. **TEMPERATURE STRIP:** Check to verify that a temperature strip is installed on the upper bearing housing of the secondary unit, as shown in the photo below. (If this strip is not present, one must be installed. Contact RotorWay's parts department. To install, clean the area with acetone and apply the self-adhesive strip to the housing.)

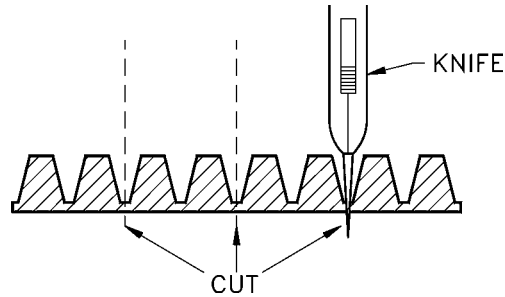
The temp strip is a means of monitoring bearing temperatures and should be examined after every flight. The heat sensitive "dots" will darken if the indicated temperature is exceeded. During normal operation, the bearing temperature should be in the 170° to 180° range, and may be slightly higher just after adding grease. If the 200° dot darkens, it is an indication that there is a problem which is causing the bearing to run hot. If this happens, discontinue flight and contact customer service for further assistance.

The sensor for the secondary temp gauge should also be installed on the upper bearing housing. Refer to Section 21 pages 2,3 and 15 for installation of the sensor and gauge.

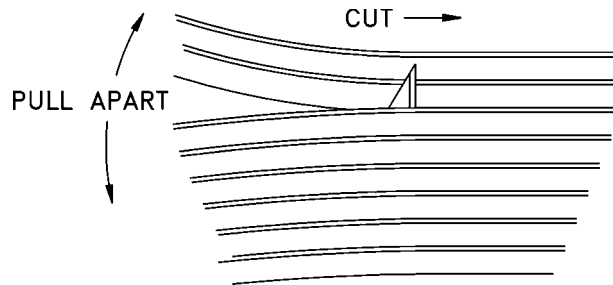


MAIN DRIVE BELT CUTTING INSTRUCTIONS

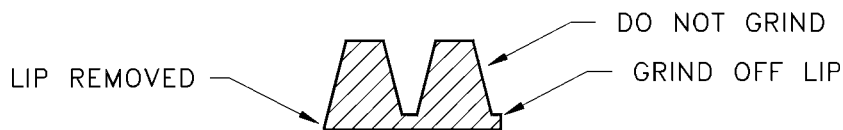
1. To ensure that the main drive belts are all the same length, one wide belt is supplied. This wide belt is then cut into FOUR narrow belts, each with one groove and two peaks. To do this, make a starting cut into one of the grooves, going all of the way through. Use a utility knife with a new, sharp blade.



2. Remove the knife and insert it into the starting cut from the opposite side of the belt. This will allow you to see the blade and keep it centered in the groove. Have someone else pull the belts apart as you cut.



3. If needed, lightly touch the edges of the belt on a grinder or sander to remove the excess "lip". Be careful not to grind the surface of the belt that comes in contact with the pulley.



4. Repeat this process to make four equal belts.

SECONDARY DRIVE INSTALLATION

Photo #1

Use print E23-2000 and template E23-1 when assembling the secondary drive.

Parts as received from RotorWay International.

Before installation, remove the following from the secondary drive assembly:

1. The tail rotor drive pulley and related hardware.
2. The lower bearing and flanges.

Photo #2

It is critical that the upper bearing, aluminum housing and rubber seals do not pivot on the shaft during installation. They must be held in alignment with the shaft to prevent damage to the bearing and to keep the seal from leaking. To do this, install spacers or shims between the bearing housing and the auxiliary drive pulley as shown by the arrows. The spacers should fit snug and must be equal thickness on both sides of the pulley to ensure correct alignment.

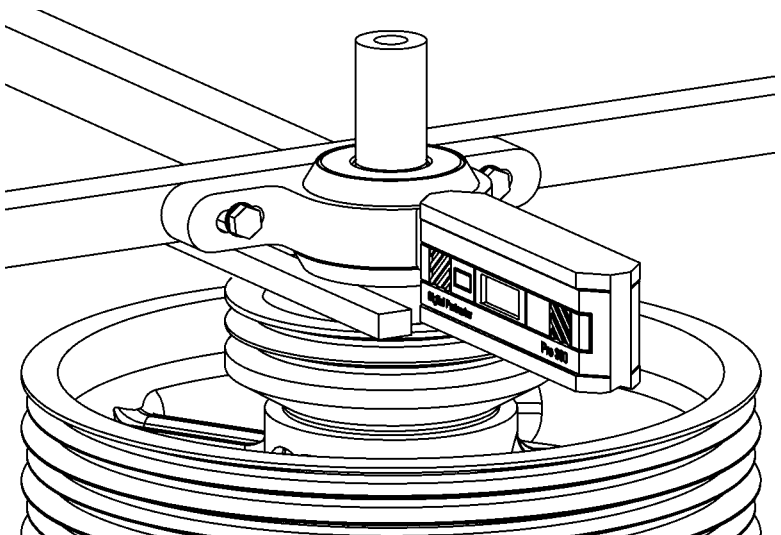
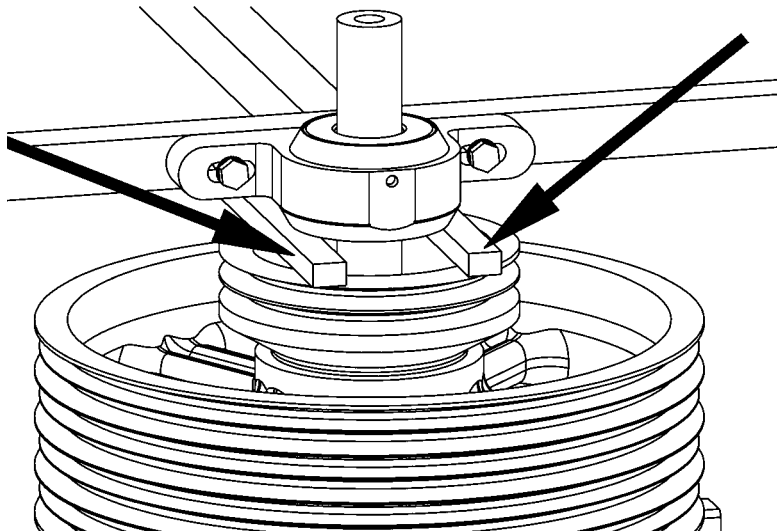
Install the secondary assembly, centered on the airframe tube.

Note: The main drive belts, upper fan drive belt and water pump belt must be installed at this time.

Photo #3

Level the airframe fore/aft and laterally at the square drive mount tubes by shimming under the skids as necessary. For the secondary assembly to be installed correctly, the following conditions must be met when the upper bolts are tight:

1. The secondary shaft and the main rotor shaft must be parallel with each other and perpendicular to the square drive mount tubes of the airframe, both fore/aft and laterally. Confirm this by placing a level on top of the large secondary pulley and then on the main sprocket. Both should be parallel with the drive mount tubes in all directions.
2. The upper bearing housing of the secondary assembly must be perpendicular (90 degrees) to the secondary shaft and parallel to the square drive mount tubes of the airframe, both fore/aft and laterally. Use the flat surface under the grease fitting to verify alignment of the upper bearing housing. (Unscrew the grease fitting and remove any burrs on the edge of the threaded hole. The end of the level can then be placed against the flat surface.) Note: A digital protractor works best for this installation. For accuracy, the same level should be used for all measurements.



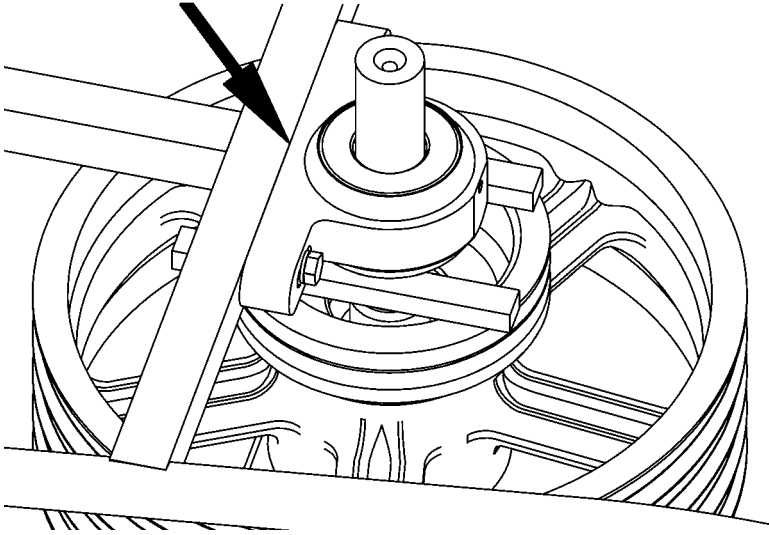


Photo #4

If the bearing housing, pulley or shaft are not level to the square drive tubes, it is an indication that the lateral square tube is not square to the fore/aft tube. In that case, the upper mount requires modification by changing the angle of the mounting surface. Filing or sanding the upper mount can accomplish this.



Photo #5

Install the lower bearing and flange on the shaft. Use the lock ring on the bearing to hold the flange in the proper up or down location. The top of the flange should be approximately even with the top of the square tube. When the flange is in the right position, tighten the two clamping bolts that hold the halves of the flange together. If there is any gap between the flange and the airframe, install shims as required to achieve a snug fit. **DO NOT TRY TO ELIMINATE THE GAP BY TIGHTENING THE BOLTS.** After the shims are in place, install and tighten the mounting bolts. **WARNING:** Any misalignment of the upper bearing to the shaft may result in failure of the assembly.

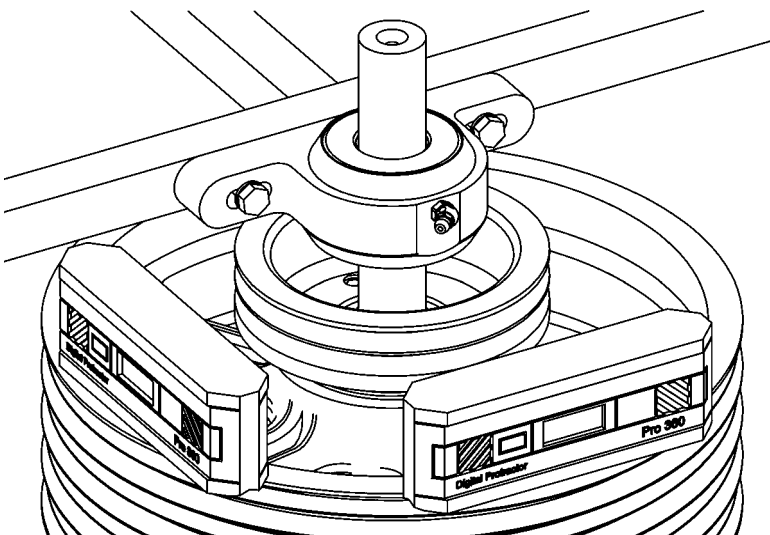


Photo #6

When installation is complete and all bolts are tight, the pulley and the upper bearing mount must be level in all directions, compared to the square drive tubes. Remove the spacers used to hold the bearing housing in alignment and re-install the grease fitting.

Photo #7

Make sure that the vertical position of the lower bearing and flange will allow enough clearance for the tail rotor drive pulley to be installed. The bearing and flange can be moved up if necessary. On final assembly, Loctite the lower bearing to the shaft. Set the lock ring and tighten the set screw.



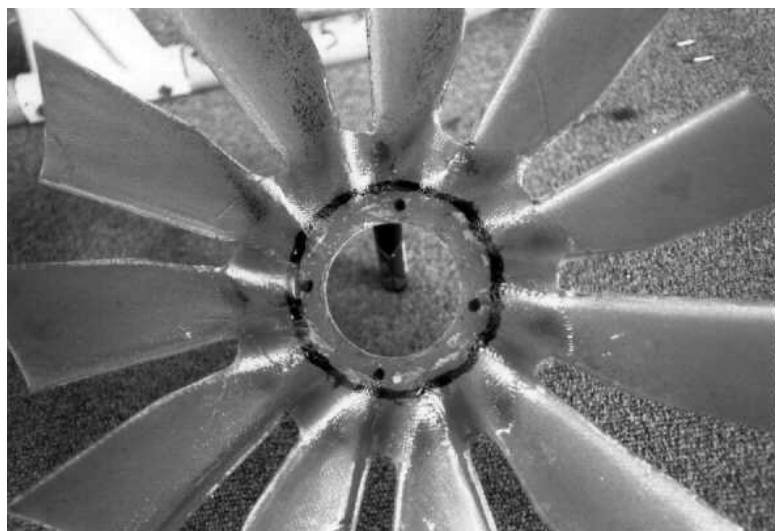
Photo #8

Place the fan pulley assembly on the fan and mark the outside diameter of the pulley with a felt marker. Note: The fan will be mounted "smooth side up". Be sure it is positioned correctly before drilling the holes.



Photo #9

Lay out the bolt holes to be drilled for mounting the fan to the pulley.



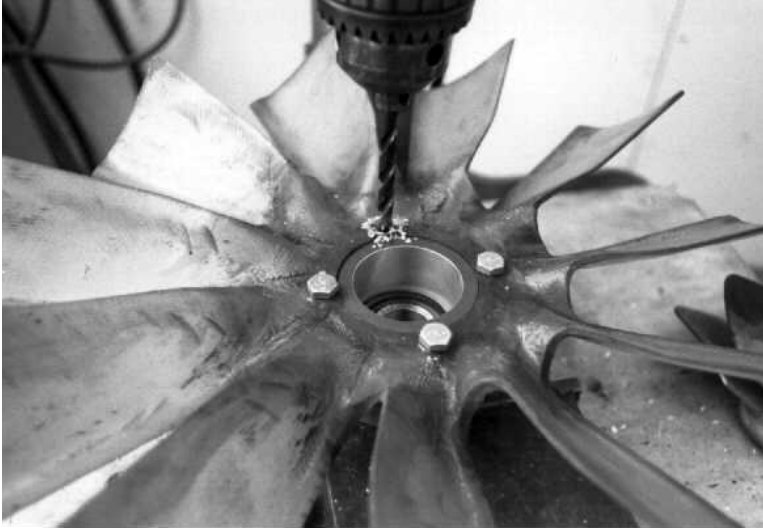


Photo #10

Place the fan drive pulley and the fan on a drill press and drill one 1/4" hole. Install a bolt then drill another hole. Repeat this procedure until all holes are drilled and all bolts are installed.

Note: Install each bolt with a 1/4" large washer between the head of the bolt and the fiberglass fan, and a 1/4" regular washer between the nut and the aluminum pulley.

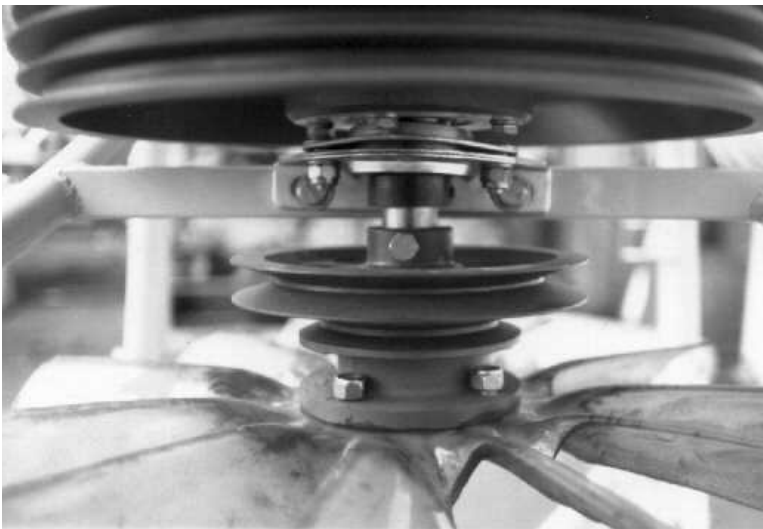


Photo #11

This shows the installation of the tail rotor drive pulley and fan assembly on the lower end of the secondary shaft.

Note: Final installation of the tail rotor drive pulley and the fan assembly must be done AFTER the radiator and fan shroud are installed (see Section 18, page A). On final installation, the fan pulley bearing must be Loctited to the secondary shaft. Allow time for the Loctite to cure, then tighten the two set screws.



MAIN ROTOR SHAFT INSTALLATION

Photo #12

Use prints E23-2000, E49-2000, E49-2001, and E49-2002 when installing the main rotor shaft assembly. Parts as received from RotorWay International.

Photo #13

Install the main rotor thrust bearing and bearing flanges in the hood bracket on the airframe. The inertia switch bracket should also be installed at this time (see Section 21, Photos 34 - 36).

Note: Hardware and small parts for the main rotor shaft are found on E49 CARD 1F and 2F. The inertia switch bracket and related hardware are on E25 CARD 4F.

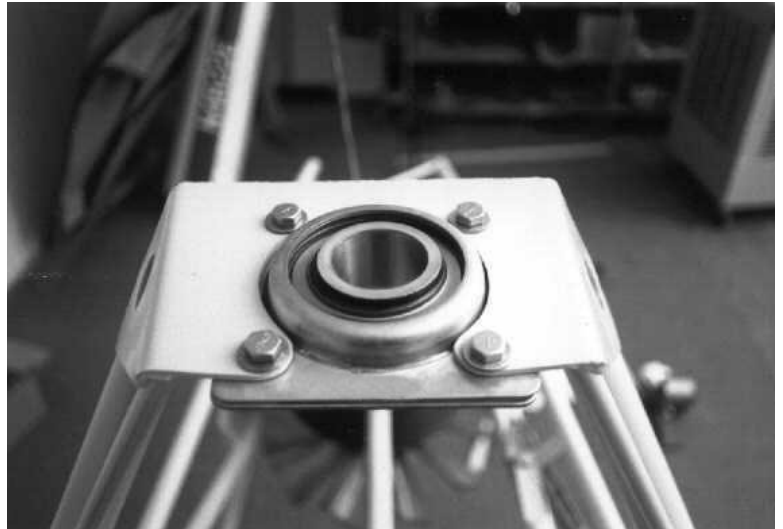


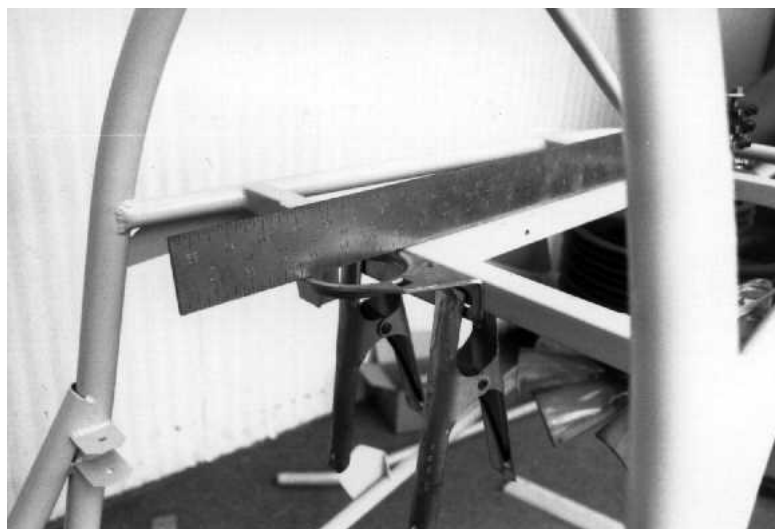
Photo #14

Clamp the upper engine mount clevis to the bottom of the square drive tubes. Place a piece of 1/8" scrap between the bottom of the square tube and the rear of the clevis. Then drill the bolt holes through the clevis, using the bushings in the airframe tubes as a guide.



Photo #15

Clamp the flange to the front of the square drive tube on the airframe.



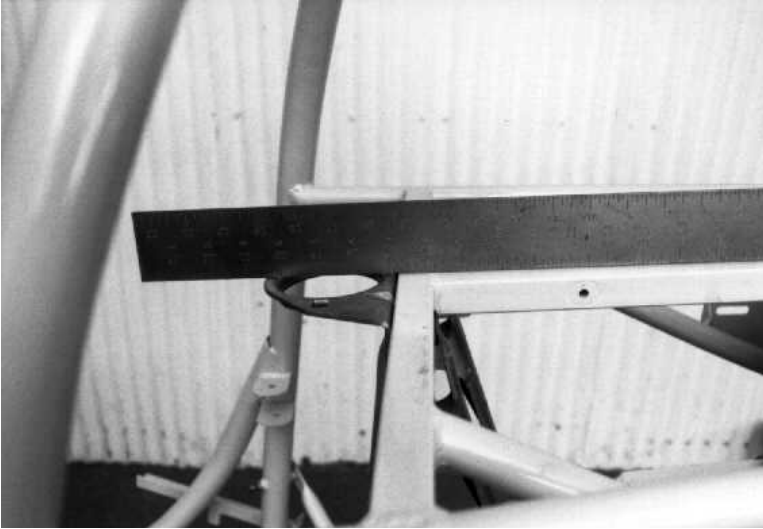


Photo #16

The top of the flange must be even with the top of the square drive tubes.

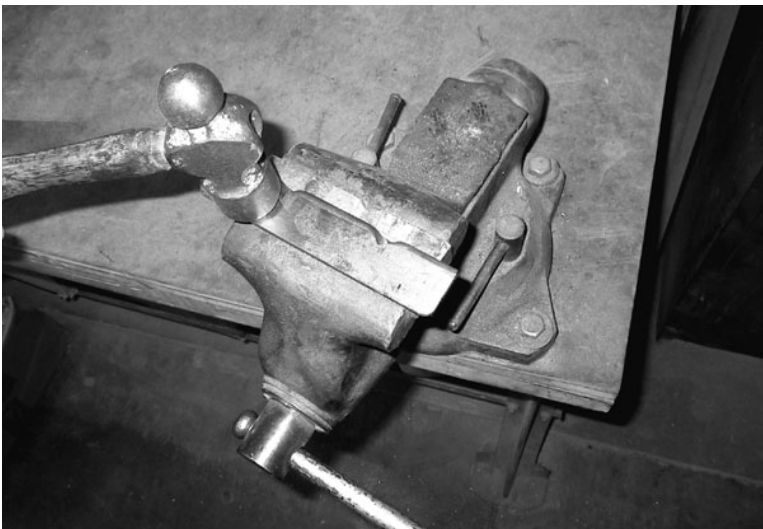


Photo #17

If the angle of the flange is not 90 degrees, clamp it in a vise and use a hammer to bend the flat part until it is at the correct angle. An alternate method is to slightly grind the flange to the correct angle, removing only as much material as is necessary.

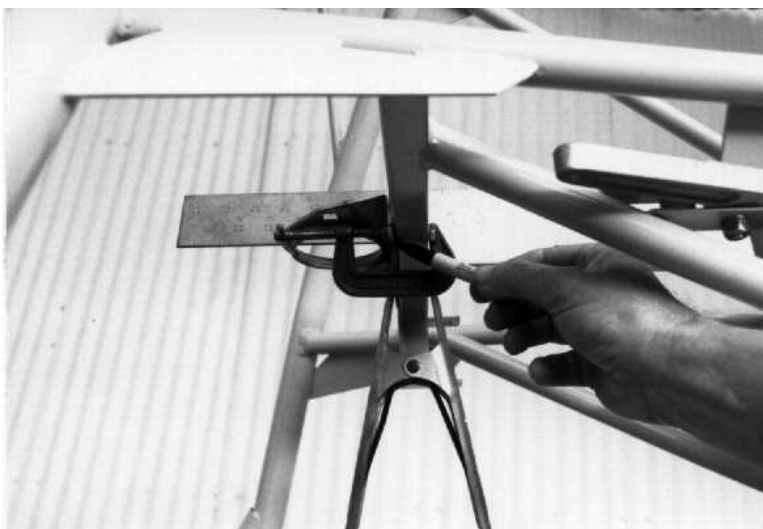


Photo #18

Clamp the flange to the front of the square drive tube so that the tops are even. Using a felt marker, draw a line where the flange will be cut to be flush with the bottom of the square drive tube.

Photo #19

Transfer the mark to the other side of the flange and cut off the excess with a band saw. It is necessary to remove this excess material so the bottom of the flange will not interfere with the upper engine mount clevis.



Photo #20

Assemble the lower main shaft bearing and clamp it to the square drive tubes. Remove the sprocket hub from the main rotor shaft assembly, then install the shaft in the bearings, rotating it so that the collective actuator fork is on the pilot's side. Place a level on the square drive tubes to check the level in the fore/aft and lateral planes. Shim under the skids if necessary to level the drive tubes. Set the protractor level for 90 degrees and fasten it to the main rotor shaft. Move the lower bearing laterally until the shaft is 90 degrees to the square drive tubes. The holes in the hood bracket may be elongated if necessary to make the shaft 90 degrees to the square drive tubes fore/aft. If the main bearing flanges come into contact with the airframe tube under the hood bracket, and more adjustment is needed, the bearing flanges can be ground off slightly to allow them to be moved back.

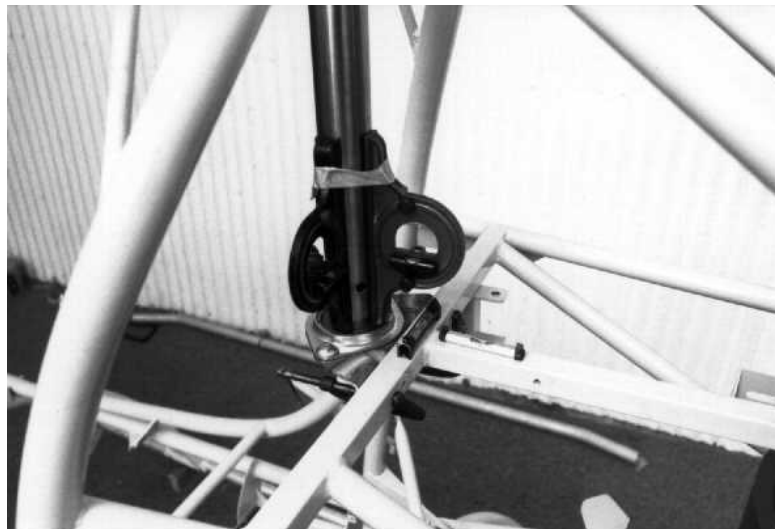
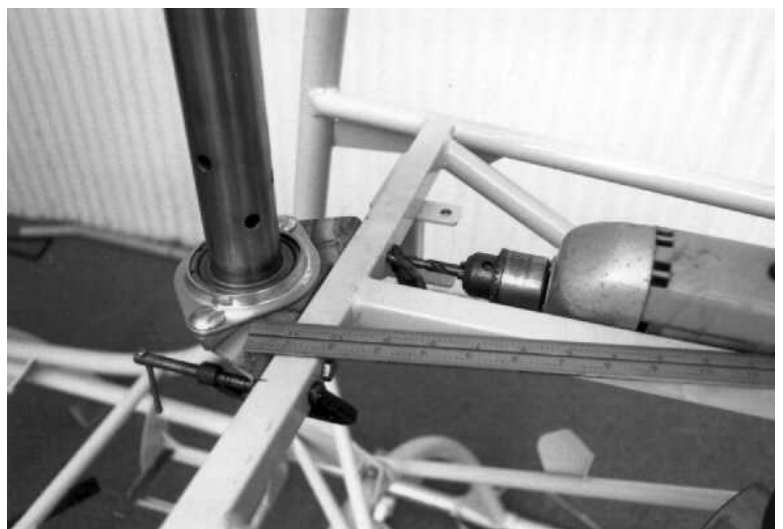


Photo #21

Check to make sure that the top of the square drive tubes and the bearing flange are even. Then drill the holes in the bearing flange using the airframe bushings as a guide.



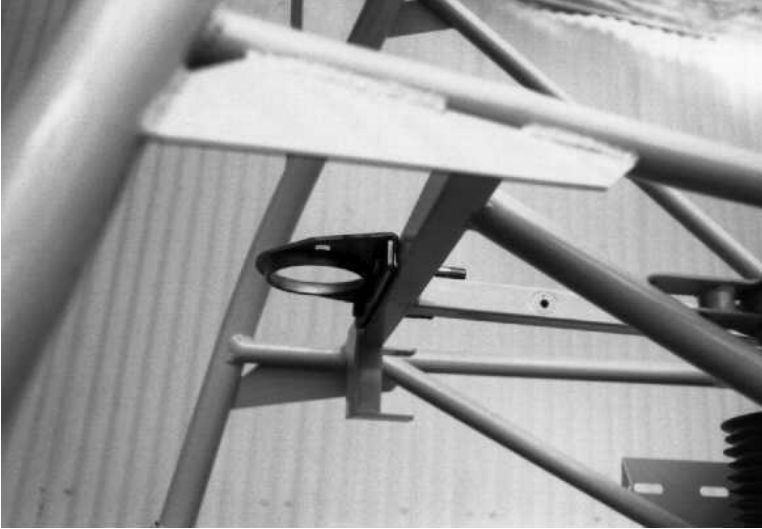


Photo #22

Check the hole alignment of the flange and square drive tube.

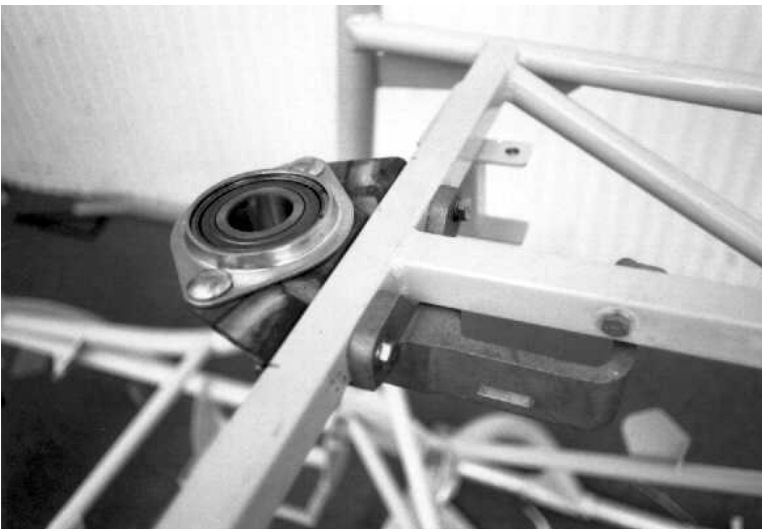


Photo #23

Bolt the lower bearing and upper engine mount clevis to the square drive tubes. Install the complete main rotor shaft assembly, temporarily install the pedal cross tube (see Section 10) and proceed with the body installation.

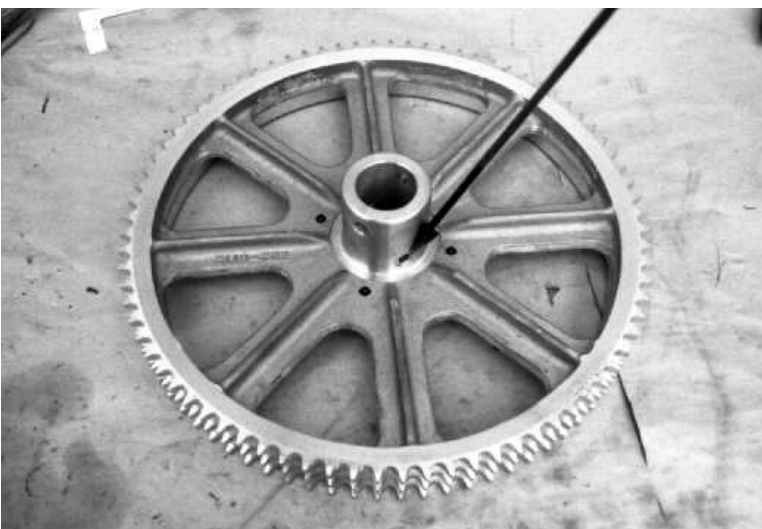


Photo #24

Place the large main drive sprocket on the sprocket hub so that the bottom hole in the hub is centered between the spokes without a hole.

Photo #25

Four 1/4" bolts hold the sprocket to the hub. IT IS EXTREMELY IMPORTANT TO DRILL THESE HOLES PROPERLY. Use a drill press to ensure that the holes are drilled perpendicular (90 degrees) to the face of the sprocket. Drill the sprocket and hub at the same time, first with a smaller drill, then **USE A LETTER "D" DRILL (.246")** to open the holes to the final size. (A letter "D" drill can be ordered from RotorWay, part number E08-3100.) The bolts should fit snug enough that it will be necessary to lightly tap them in place with a plastic hammer. Install the bolts from the bottom, with the head of the bolt flush to the hub flange (no washer required), and a combination of one or more washers under the nut to properly locate the nut. (Use 1/4" all metal thin locknuts, part no. E00-3410). After installing and torquing the four 1/4 inch bolts to 7 ft.lbs., safety wire the bolts as shown on print E49-2001. Drill small 1/16" holes through the sprocket so that each bolt head may be individually safety wired to the sprocket. Then safety wire the shanks of the four bolts together. (Photo #47 of this section shows the completed assembly with safety wire.)



Photo #26

On the bottom of the sprocket hub is an index mark.



Photo #27

The index mark on the sprocket hub matches one on the bottom of the main rotor shaft.



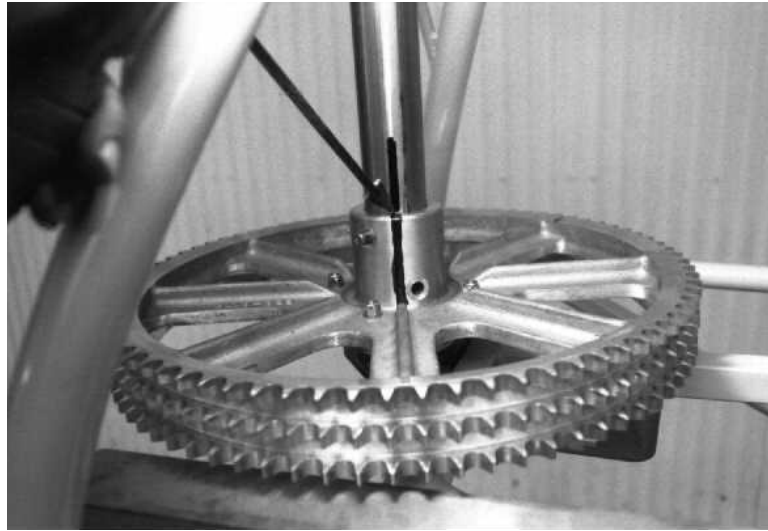


Photo #28

Install the upper bearing lock ring. Install the sprocket hub and attached sprocket onto the main shaft. Using a felt-tip marker, transfer the index mark to the upper side of the sprocket hub to ensure correct alignment. Temporarily install the 3/8" bolts that hold the sprocket hub to the main shaft. The entire rotor system and separately the sprocket hub will need to be raised in order to fit the oil bath and oil bath seals as discussed in Section 15. Check for proper clearance of 7/16 to 1/2 inch between the lateral square drive tube and bottom of the sprocket. If clearance cannot be achieved, one or two spacers (part no. E00-4851) can be added to the bottom of the main shaft just above the lower bearing to raise the shaft and sprocket.

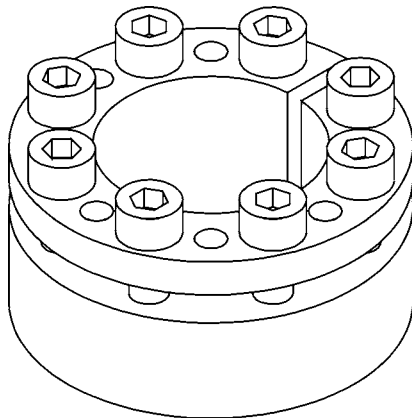


Photo #29

The locking assembly is a device that prevents the secondary sprocket from turning on the shaft. It **MUST** be installed according to these instructions to ensure that it will work properly. Handle the unit carefully to avoid nicks and scratches. Before installation, check all contact surfaces of the locking assembly. They must be clean and lightly oiled. This includes the screw threads and screw head bearing surfaces.
 Note: Do not use Molybdenum Disulfide, "Molykote" or any other similar lubricants.

TEMPLATE E23-1
 MEASURE BEFORE DRILLING
 MAT'L. 4130 STL. .125 THK.

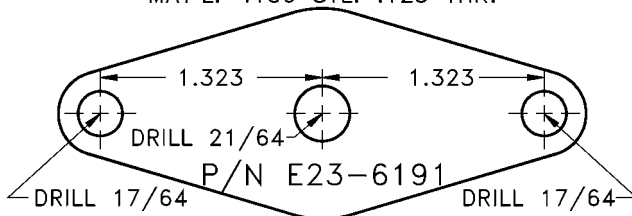


Photo #30

Cut out and drill the retainer plate according to template E23-1.

Photo #31

Back off all locking screws. Remove 2 screws opposite from each other and insert them into the adjacent push-off threads. Turn them by hand until they make contact. This will keep the locking assembly spaced apart. Insert the locking assembly into the sprocket bore. If necessary, back off the locking screws more and tighten the push-off screws until it fits. This is a very close fit. After the locking assembly is inserted, return the push-off screws to their original holes.

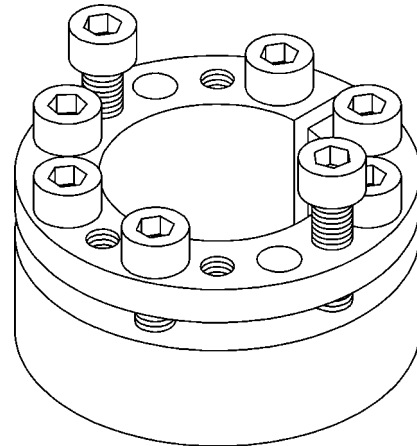


Photo #32

Install the retainer plate on the sprocket using two 1/4-20 drilled head bolts. Place the sprocket on the secondary shaft and hold it in place with the center 5/16 drilled head bolt.

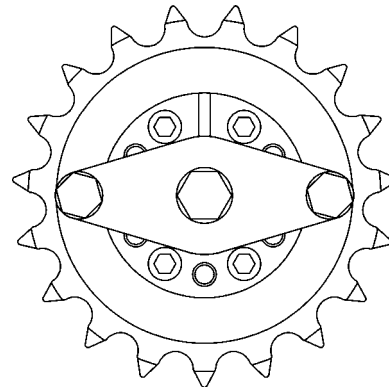
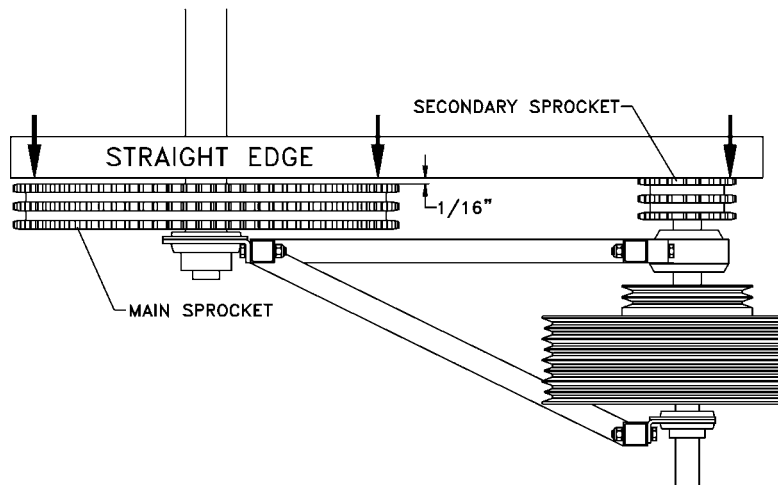


Photo #33

Check alignment of the main sprocket and secondary sprockets (using a straight edge as shown) in the three places indicated by arrows. When installed and all bolts tightened, the secondary sprocket should be 1/16 inch higher than the main sprocket. If it is necessary to raise the secondary sprocket, add washers under the retainer plate. After correct alignment is achieved, remove the 1/4 retainer bolts and loosen the center 5/16 bolt slightly to allow the retainer plate to pivot. This will allow access to the locking assembly bolts.

Note: While the locking bolts are being tightened, the locking assembly and sprocket may have a tendency to raise, which will affect alignment. Observe the amount of lift and re-adjust if necessary.



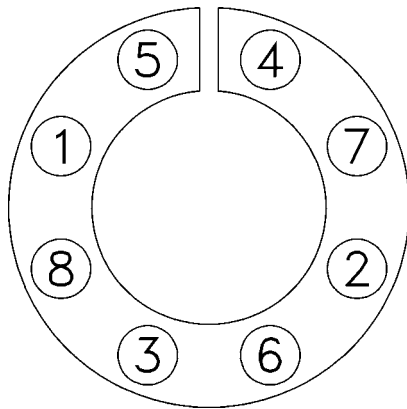


Photo #34

Hold the sprocket and the locking assembly in the desired position up against the retainer plate, and begin tightening the screws. The screws must be tightened gradually and in several stages, using the tightening sequence shown. The bolts must be torqued to 10 ft. lbs.

Note: As described above, the locking assembly and sprocket may have a tendency to raise while the bolts are being tightened. Height must be verified after the bolts are torqued.

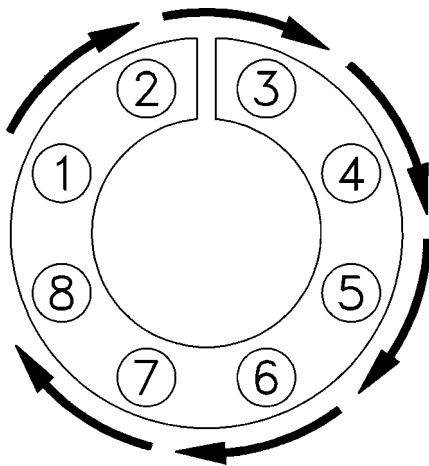


Photo #35

After installation is complete, check torque of the screws again in a clockwise or counter-clockwise sequence. Make sure that none of the bolts can be turned at 10 ft. lbs.

Note: After the first hour of operation, re-check the torque of these bolts. If any looseness is detected, re-check the torque at subsequent intervals until the bolts remain tight.

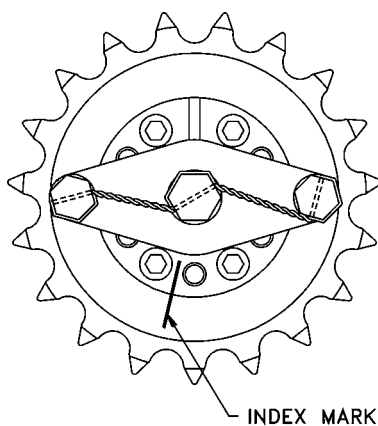


Photo #36

Make an index mark on the sprocket and locking assembly with dye or a permanent marker. Although it is very unlikely that the locking assembly will slip, this will indicate if it does. Install the retainer plate. On final assembly, safety wire the bolts as shown.

Photo #37

If it becomes necessary to remove the locking assembly in the future, first loosen all screws 2 turns, then remove them and transfer them to the push-off threads. Progressively tighten the screws, using the tightening sequence shown, until the assembly is released.

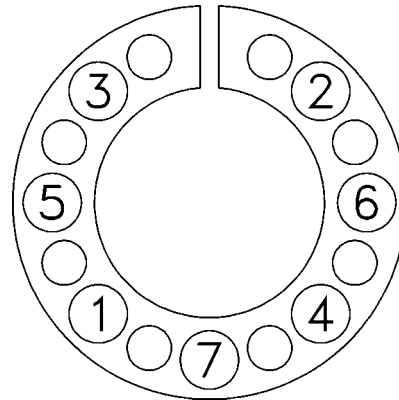


Photo #38

On final assembly, Loctite the lower main shaft bearing to the shaft, then tighten the set screws. Note: This procedure is to be done after the lower oil bath pan has been installed.

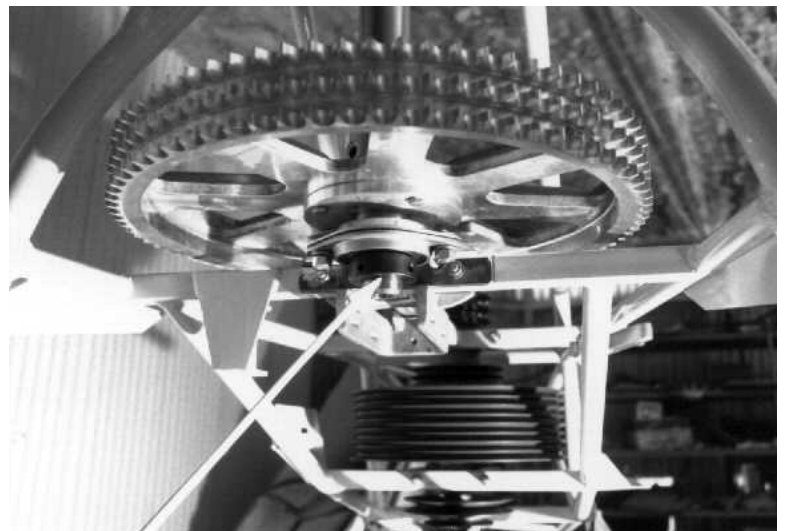
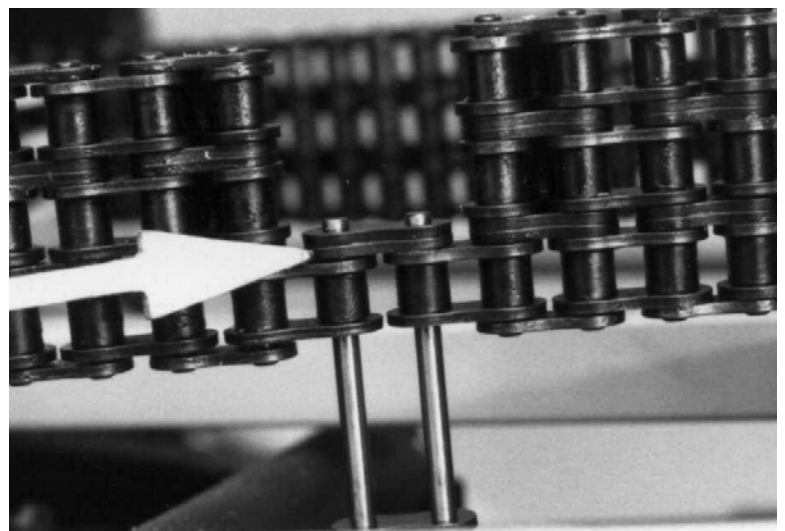


Photo #39

Preliminary installation of the drive chain. Do not forget the two link plates that go between each row of rollers when installing the master link.



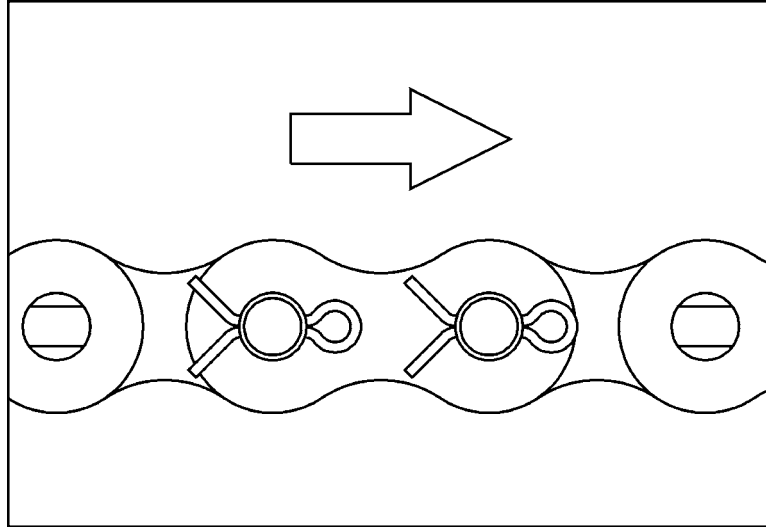


Photo #40

Do not install the cotter pins in the master link until after correct chain tension is established and all adjustments have been made. The cotter pins should be used only once. When removal is necessary, use new cotter pins on re-assembly. If the cotter pins are too long, they can be shortened with wire cutters before installing.

Install the cotter pins with the loop towards the direction of chain travel, as indicated by the arrow. (The main rotor shaft will turn clockwise viewed from above.) Bend cotter pins as shown, no more than 90 degrees total (45 degrees each leg).

The master link is a pre-flight check item, which is the reason for the plexiglass inspection window in the oil bath cover.

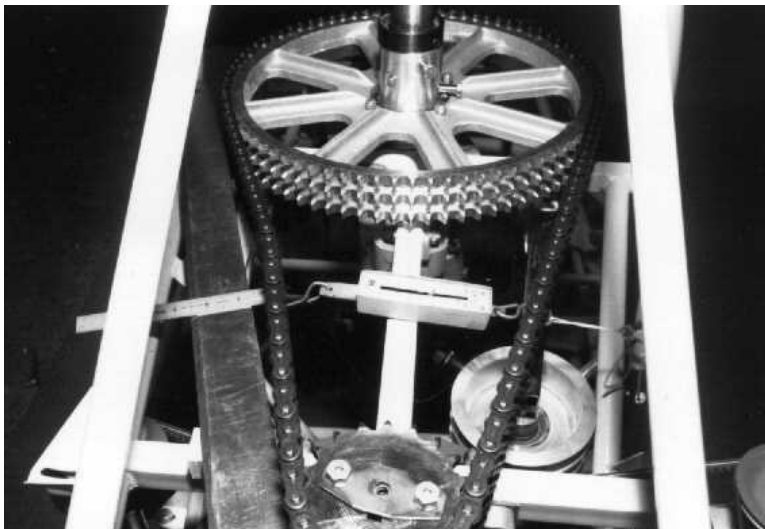


Photo #41

Use a straight edge and a spring scale to check the tension of the chain. Pull ten pounds with a spring scale midway between the sprockets. The chain should move 1/2". To tighten the chain, install shims equally between the top and the bottom bearings and square drive tubes on the secondary drive unit.

Note: After correct alignment and tension of the chain is achieved, rotate the main sprocket a few times to check for smooth operation throughout the entire length of the chain.



Photo #42

Place the safety spacer next to the main rotor shaft and mark where it will be cut for a snug fit.

Note: Make sure the concentric part of the lock ring on the main shaft bearing is seated against the bearing before the aluminum safety spacer is measured. Failure to do this will cause an excessive gap between the main shaft lock ring and the sprocket hub. This must be a snug fit. On final assembly, set the lock ring with a punch and hammer and tighten the set screw.

Photo #43

Check the fit of the safety spacer. It must fit snug between the lock ring and the sprocket hub.



Photo #44

To make a straight line along the length of a tube, lay it on a flat surface. Lay a marker on the surface and slide it from one end of the tube to the other.

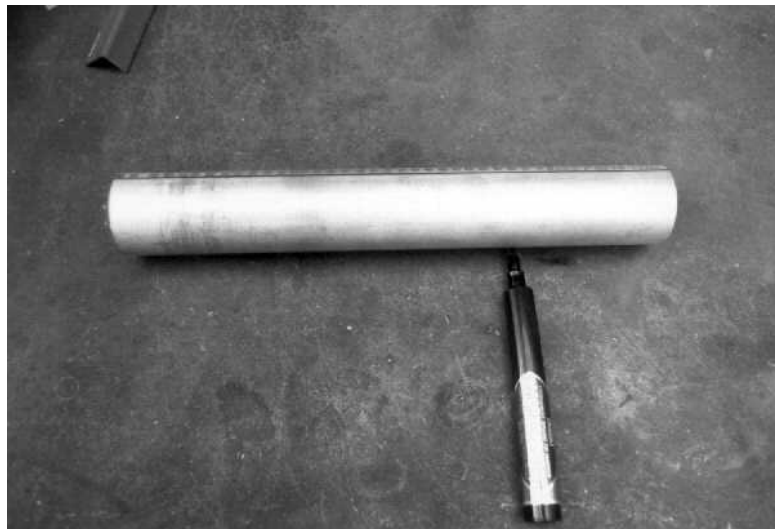


Photo #45

Clamp a board on the band saw table so that when the tube is against the board, the saw blade is centered on the tube. Turn on the saw and slide the tube along the board. The saw blade should stay on the line, cutting the tube in half.





Photo #46

Deburr the edges of the safety spacer and install it on the shaft with hose clamps. Upon final assembly apply a coating of grease to the main rotor shaft to prevent surface rust.

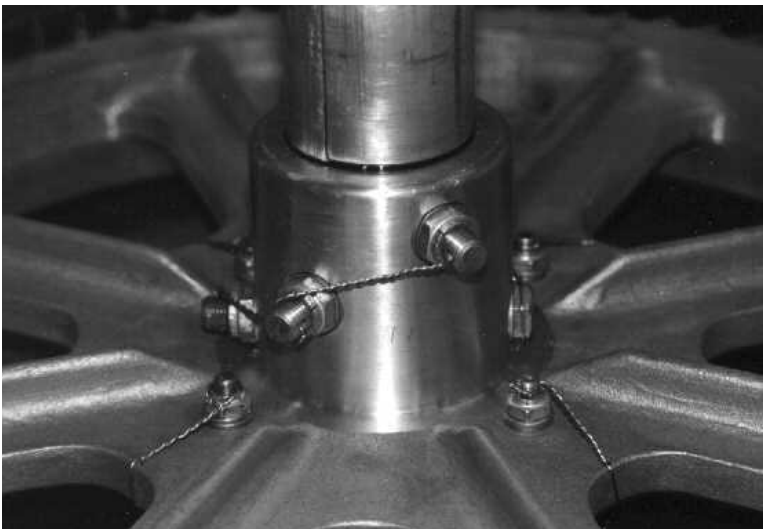


Photo #47

On final installation, make sure that the three bolts that hold the sprocket hub to the main rotor shaft are torqued to 18 ft.lbs. Safety wire the bolts, wiring the heads to each other and the shanks to each other.