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HANDBOOK OF INSTRUCTIONS WITH PARTS CATALOG

FOR

HYDRAULICALLY OPERATED PROPELLERS

MODELS

A642S-E1 and A642S-E2

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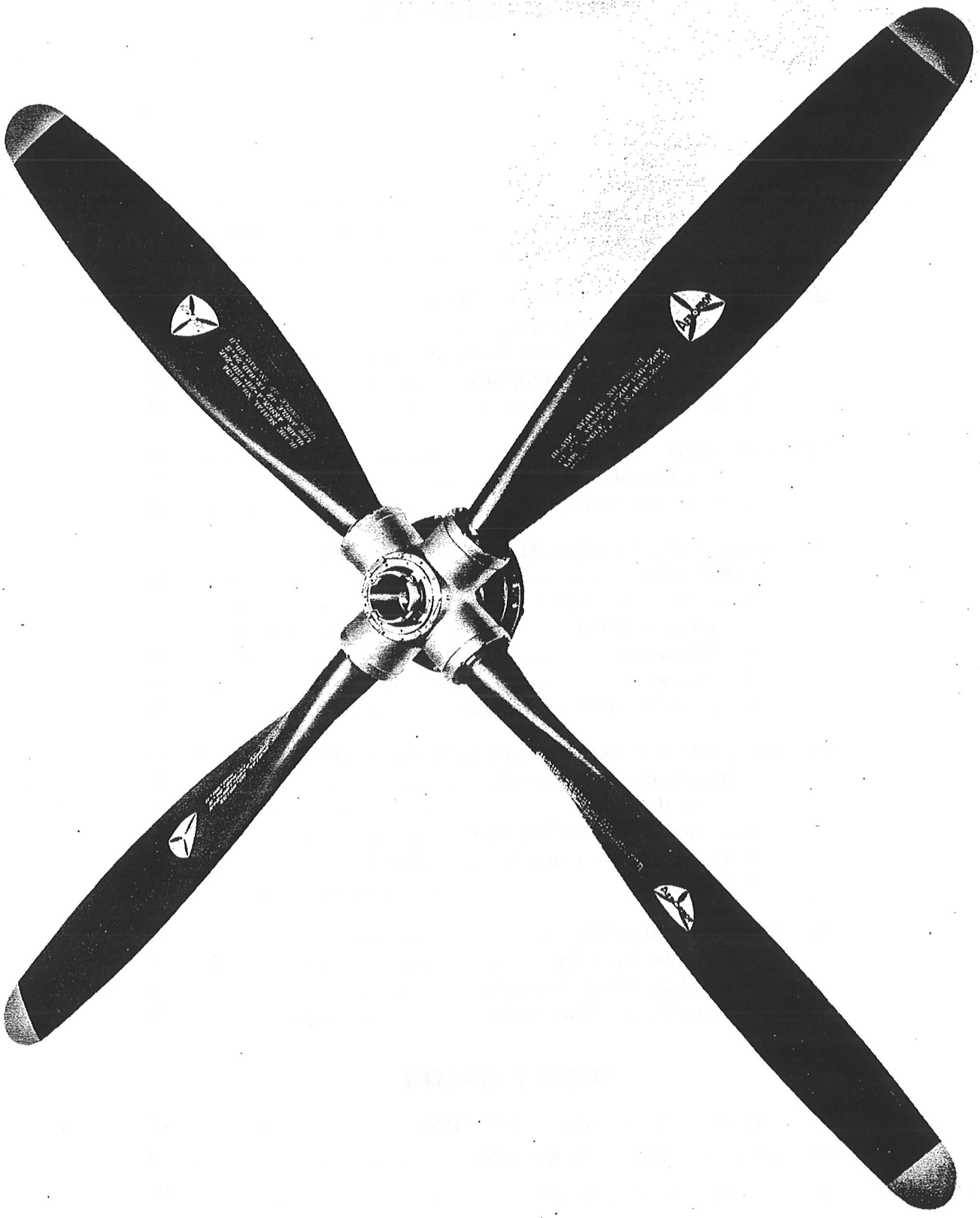


Figure 1—Aeroproducts Propeller Model A642S-E1

SECTION II
DESCRIPTION

1. GENERAL DESCRIPTION.

a. The propellers described in this Handbook are hydraulically operated, and the two models differ in the following respects only.

(1) Model A642S-E1 incorporates Aeroproducts propeller blades, design No. A20-156-24M and regulator assembly No. 6500480, with governor assembly No. 6500665.

(2) Model A642S-E2 incorporates American Propropeller blades, design No. A2891106 and regulator assembly No. 6500765, with governor assembly No. 6500688.

(3) Regulator assembly No. 6500765 may be installed on propeller Model A642S-E1, but regulator assembly No. 6500480 cannot be installed on propeller Model A6425-E2.

(4) Governor assembly No. 6500688 may be used with propeller Model A6425-E1, but governor assembly No. 6500665 cannot be used with propeller Model A642S-E2.

b. Each propeller incorporates four blades, and the hubs are machined to fit a No. 60 spline short propeller shaft.

c. These propellers provide controllable, automatic blade angle change by which the desired engine rpm can be selected and varied by the pilot from the cockpit.

Key to Figure 2

1. Blade
2. Camber Side
3. Thrust Face
4. Balance Cup
5. Balance Washers
6. Cylinder Head Retaining Plate
7. Torque Cylinder
8. Blade Retaining Nut
9. Blade Retaining Nut Seal
10. Blade Bearings
11. Blade Nut
12. Blade Nut Lock
13. Blade Gear
14. Master Gear Retaining Plate
15. Master Gear
16. Spinner Adapter
17. Shaft Nut
18. Torque Piston
19. Fixed Spline Bolt and Tube
20. Fixed Spline
21. Cylinder Seal
22. Preload Bearing
23. Blade Dowel
24. Decrease Blade Angle Tube
25. Increase Blade Angle Tube
26. Transfer Tube
27. Housing Seal
28. Housing Cord Seal
29. Regulator Housing
30. Pump
31. Pump Power Gear
32. Cover Bearing
33. Cover Seal
34. Control Screw
35. Control Gear
36. Hub
37. Adapter Plate
38. Regulator Cover
39. Stop Pin
40. Regulator Nut
41. Control Ring
42. Adapter Ring
43. Pressure Relief Valve
44. Regulator Filler Plug
45. Governor
46. Governor Shoe
47. Balance Weights
48. Housing Bearing
49. Pressure Control Valve
50. External Filter

d. PROPELLER TERMINOLOGY.—The following definitions are offered to enable the reader to better understand the text as these terms are presented in this handbook.

(1) PROPELLER DIAMETER.—The diameter of the circle swept by the blade tips, or the distance between two opposed tips.

(2) LEADING EDGE.—The edge of the rotating blade which first strikes the air. *(See figure 3.)*

(3) TRAILING EDGE.—Opposite to leading edge. *(See figure 3.)*

(4) THRUST FACE.—The flat surface of the blade which first strikes the air. *(See figure 3.)*

(5) CAMBERED SIDE.—The surface of the blade opposite the thrust face. *(See figure 3.)*

(6) TRACK.—The relationship of like points on all blades of a propeller to follow in the same plane perpendicular to the axis of rotation.

(7) BLADE ANGLE.—The angle between the chord of the propeller blade and the plane of rotation. *(See figure 3.)* Where a flat surface on the thrust face is encountered, this surface is accepted as being parallel with the chord. Otherwise, a template is used on the thrust face at a selected station, to measure the blade angle.

(8) PROPELLER PITCH.

(a) GEOMETRIC PITCH.—The distance the propeller would advance in 1 revolution if it were moving in a solid medium.

(b) EFFECTIVE PITCH.—The actual distance an aircraft advances with 1 revolution of the propeller. *(See figure 4.)*

(9) PITCH ANGLE.—The angle between the helical path of any point on a blade and the plane of rotation. *(See figure 4.)*

(10) ANGLE OF ATTACK.—The angle between a line representing the pitch angle and the blade angle.

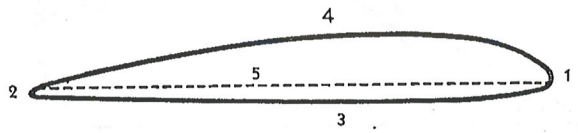


Figure 3—Blade Cross Section

1. Leading Edge
2. Trailing Edge
3. Thrust Face
4. Cambered Side
5. Chord

2. DETAILED DESCRIPTION.

a. BLADE ASSEMBLY.

(1) BLADE CONSTRUCTION.

(a) The blades are of hollow steel construction, incorporating a longitudinal strengthening rib. *(See figures 2 and 5.)* The blade is composed of two members, namely, the thrust member and the camber sheet which are brazed together. The thrust member is a machined steel forging which forms the thrust face, blade shank, longitudinal rib, and leading and trailing edge reinforcements. *(See figure 2.)* This member is completely ground and polished as is also the steel camber sheet which is formed, polished and attached to the thrust member by means of brazing.

(b) On the root of the blade is machined a special buttress-type thread which is designed to adequately absorb the centrifugal load, yet retains the self-centering, load-distributing characteristics of a normal "V" thread.

(2) BLADE BALANCE.—The internal surfaces of the blade are rust proofed and hermetically sealed. Each blade has a balance cup in the shank which has lead added in the proper location to give uniform vertical and horizontal balance. *This lead should never be tampered with in service.* To allow for final balance of blades and hub in the field, a stud is provided in the center of the blade balance cup on which may be mounted balance washers.

(3) BLADE RETENTION.—The blade is retained in the hub by a blade retaining nut, a stack of ball bearings and a blade nut. The bearings are assembled in matched sets to evenly distribute the centrifugal load. The blade nut holds the stack bearings on the blade shank, while the blade retaining nut faces against the stack bearings and screws into the hub socket, holding the entire assembly in place.

(4) GREASE SEAL.—To retain the grease which is used to lubricate the blade bearings and master gear, a spring loaded seal is installed in the blade retaining nut. This seal is of fabric material with a synthetic rubber lip that bears directly on the blade shank.

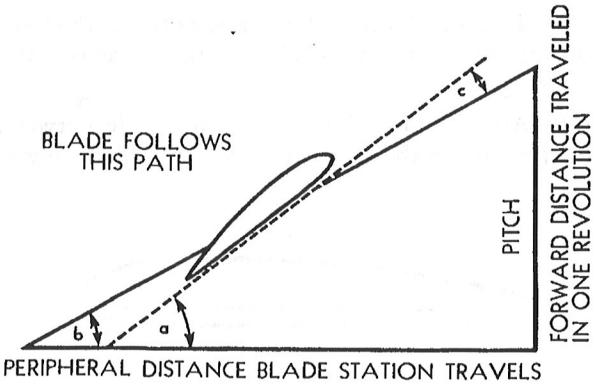


Figure 4—Helical Motion Diagram

a. Blade Angle b. Pitch Angle c. Angle of Attack

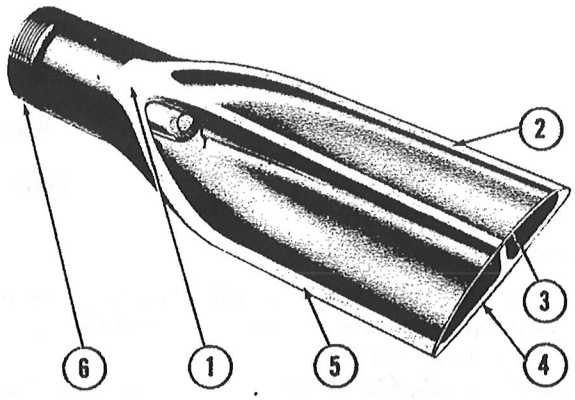


Figure 5—Blade Construction (Phantom View)

1. Brazed Surface
2. Leading Edge
3. Camber Sheet
4. Thrust Face
5. Trailing Edge
6. Buttress Threads

(5) BLADE DOWELS.—Turning action on the blades is accomplished through four steel dowels that are pressed into the blade butt. When the blade is assembled to the hub, the dowels engage in the blade gear and torque cylinder. Turning action on the blades is accomplished by the torque units. The dowels will engage in one position only.

(6) BLADE MARKING.

(a) Between the 18- and 24-inch stations the cambered side of the blades will bear the following markings. The letters and numbers will be ½ inch high.

1. Blade Serial No. (Example, 91720)
2. Assembly No. (Example, A20-156-24M)
3. Low Angle at Reference Station (Example, 24.5° at 42-inch Station)
4. High Angle at Reference Station (Example, 59.5° at 42-inch Station)

(b) The foregoing data will be stenciled with yellow lacquer the same as applied to the tip section. The markings will be protected by a coat of clear lacquer or spar varnish.

b. HUB ASSEMBLY.

(1) HUB.—The hub is a machined alloy steel forging. Torque units are mounted in each hub socket, and transfer passages permit the transfer of hydraulic fluid under pressure from the regulator to the torque units. The exterior surfaces of the hub are treated to provide a corrosion-resistant finish. Splines in the inner diameter of the hub on installation mate with the splines of the propeller shaft. At both ends of the splines in the hub, cone seats provide proper alignment of the propeller on the shaft.

(2) TORQUE UNITS.—A torque unit is incorporated in each hub socket. These units use hydraulic force to change blade angle. The torque units consist of a steel fixed spline, a bronze piston, and a steel torque cylinder. *(See figure 2.)* The fixed spline is attached to the hub by a fixed spline bolt which incorporates a tube that extends outward through the piston head, providing a fluid passage to the outboard side of the torque piston. An offset

SECTION I
INTRODUCTION

1. This Handbook is issued as the basic technical instructions for the equipment involved.

2. This Handbook contains Descriptive Data and Instructions for Installation, Operation, Maintenance, and Overhaul, with Parts Catalog, for propeller models A642S-E1 and A642S-E2. These propellers are manufactured by the Aeroproducts Division, General Motors Corporation, Dayton, Ohio.

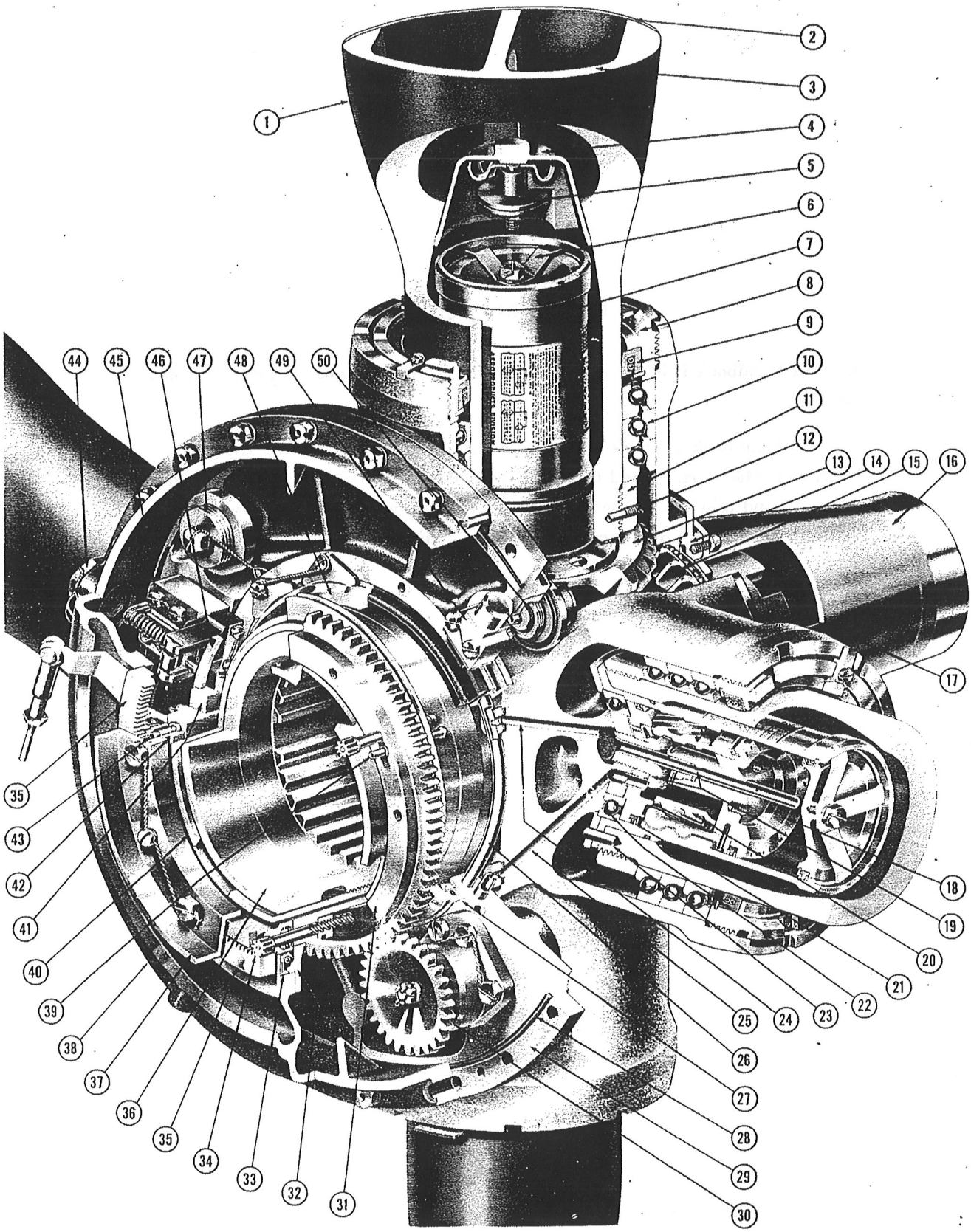


Figure 2—Propeller Cross Section

hole at the base of the fixed spline permits passage of the fluid to the inboard side of the piston.

(3) MASTER GEAR.—So that all blades will change angle to exactly the same degree, it is necessary to use a synchronizing device. Therefore, a master gear in the hub meshes with the blade gears that are doweled to the root of each blade. *(See figure 2.)* The blade gears and master gear function only as synchronizing units. No power is applied to the master gear.

(4) REAR AND FRONT CONES.—The cones are standard AN parts used to properly center the propeller on the shaft.

(5) SHAFT NUT.—The shaft nut retains the propeller on the shaft. A shoulder on the nut engages a groove in the front cone. An internal snap ring on the hub is located immediately forward of the front cone. Loosening the shaft nut moves the front cone against the snap ring, pulling the propeller forward on the shaft. Castellations have been machined in the front of the shaft nut to provide a means of tightening, while tangs have been located on the outer diameter to provide a means of locking the nut.

(6) SPINNER ADAPTER.—The spinner adapter is a steel tube which has a small diameter at the front end and a flange with a large diameter at the rear. Cap screws through the flange secure the adapter to the propeller hub. Slots in the rear diameter engage tangs on the shaft nut, locking the nut. The spinner adapter performs the three-fold function of: (a) locking the shaft nut, (b) providing a blast tube for cannon on military models to prevent damage to the spinner shell, (c) providing a mounting for the nose of the spinner shell.

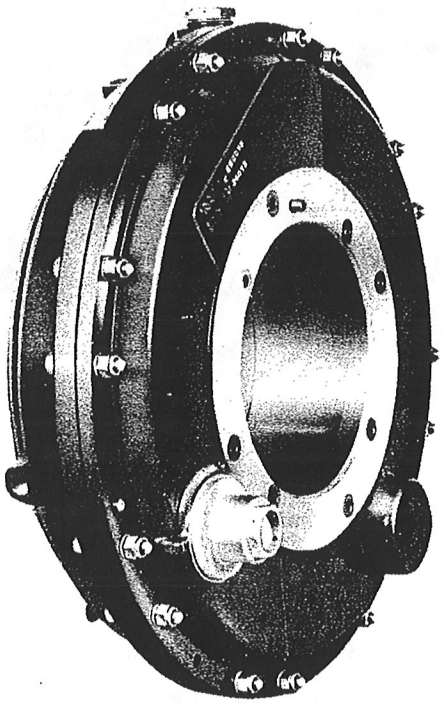


Figure 6—Regulator Assembly

1. Cover
2. Housing

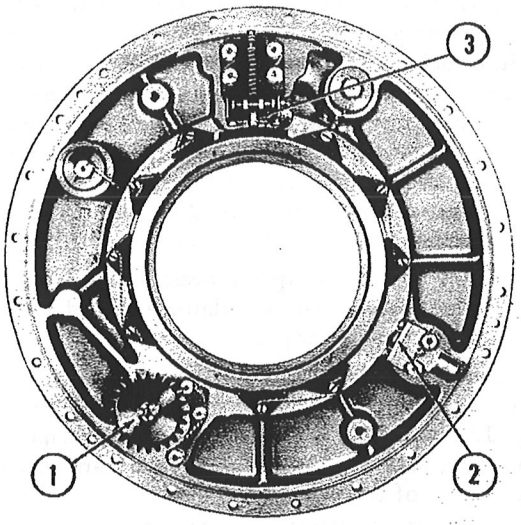


Figure 7—Regulator Housing and Sub Assemblies

1. Pump
2. Pressure Control Valve
3. Governor

c. REGULATOR ASSEMBLY.

(1) GENERAL. — The regulator assembly is a doughnut-shaped unit which serves as a reservoir for the hydraulic fluid and contains a pump, pressure control valve, governor, filter screen and a manual rpm control mechanism. This unit is composed of a cover and a housing. *(See figure 6.)* The housing is a machined, light-weight alloy casting on which are mounted the hydraulic fluid pump, pressure control valve, governor and filter screen. *(See figure 7.)* A removable plug is threaded into the cover to permit the addition and removal of fluid and to permit access to the governor adjusting screw. The regulator assembly is mounted to the rear of the hub by means of a regulator nut having a left-hand thread. The unit provides controlled hydraulic pressure to the torque units located in each hub socket.

(2) REGULATOR FUNCTIONS.

(a) Acts as reservoir for hydraulic fluid and when in operation should be kept half filled with this fluid at all times.

(b) Contains a gear-type pump to create the hydraulic pressure necessary to change the blade angles.

(c) Contains a pressure control valve to both limit the maximum operating pressure and to allow adequate pressure for all operating conditions.

(d) Contains a governor which automatically distributes the supply of fluid under pressure to the torque units.

(e) Contains a control mechanism to permit the

pilot to manually set the governor while the plane is in flight.

(3) TRANSFER TUBES.—Transfer of fluid from the pump to the governor, and then to the torque units in each hub socket, is accomplished through steel tubes which are cast into the regulator housing. These steel tubes are formed in a circular pattern, and brazed to steel pads at the points where the pump, filter, pressure control valve, governor, and increase and decrease blade angle ports are attached. This tube assembly is then cast into the light alloy regulator housing.

(4) PUMP.—The pump is a pressure-loaded, gear-type which rotates with the regulator and is driven by the stationary pump power gear.

(5) FILTER ASSEMBLY.—Fluid from the pump is forced through a filter which is mounted on the housing. The filter is accessible from the external side of the housing and may be removed for cleaning without disassembly of the regulator.

(6) PRESSURE CONTROL VALVE.—The pressure control valve is bolted to the regulator housing on the outlet side of the filter assembly. It controls the maximum operating pressure and will vary the pressure of the hydraulic system accordingly as the resistance to the movement of the blade varies.

(7) GOVERNOR.—The governor assembly mounted on the regulator housing automatically distributes hydraulic fluid to the torque units as required by the operating conditions. A cylinder is mounted in synthetic seals in the governor body. A piston, which is actuated by centrifugal force, moves within the cylinder and distributes the hydraulic fluid under pressure to the torque units. Since the governor revolves at propeller rpm, the piston is thrown outward by centrifugal force. The extent of its outward movement depends on a spring and the position of a governor fulcrum roller. Centrifugal force acting on the piston is opposed by a spring force which acts directly on a lever. One end of the lever engages one end of the governor piston; the other end of the lever is supported by a movable fulcrum roller. The fulcrum roller is mounted on a carriage which may be moved fore or aft on the carriage ways. If the fulcrum is moved toward the piston, correspondingly less and less centrifugal force is required to move the piston outward. At a given position of the fulcrum, it becomes apparent that if the engine rpm increases or decreases, the governor piston will move outward or inward, thereby opening or closing hydraulic ports to the torque units. Mounted on the carriage, opposite the fulcrum roller, is

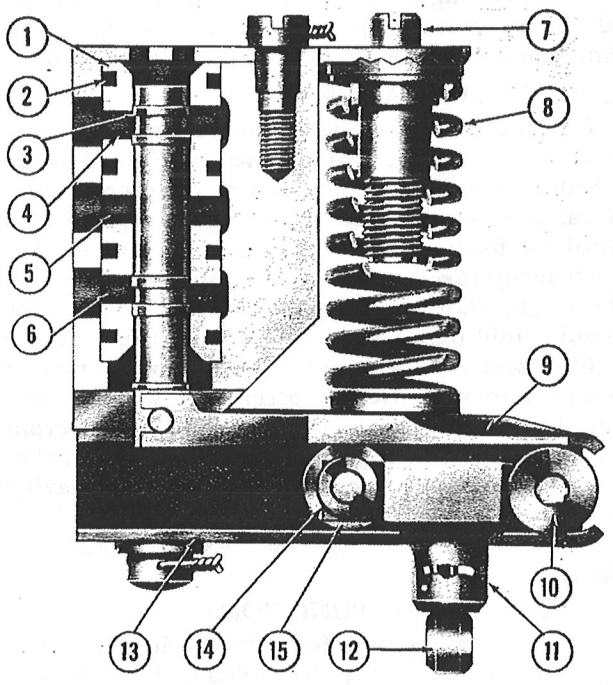


Figure 8—Governor Cross Section

1. Cylinder
2. Seal
3. Piston
4. Increase Blade Angle Port
5. Pump Pressure Port
6. Decrease Blade Angle Port
7. Adjusting Screw
8. Spring
9. Lever
10. Movable Fulcrum
11. Carriage
12. Shoe
13. Carriage Ways
14. Stop Roller
15. Carriage Roller

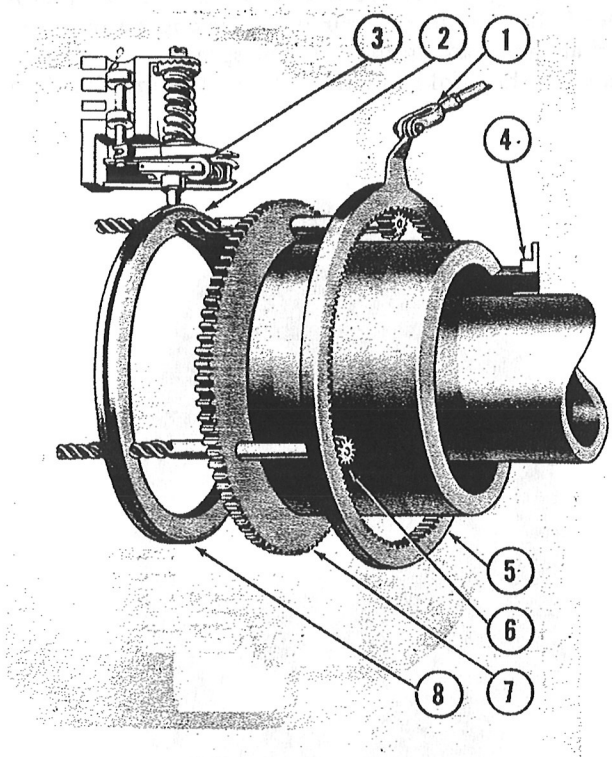


Figure 9—Control Mechanism

1. Cockpit Control Connection
2. Governor Shoe
3. Roller Fulcrum
4. Adapter Stop
5. Control Lever
6. Control Screw
7. Pump Power Gear
8. Control Ring

a governor stop roller. At low propeller rpm, the lever will rest on this roller. A curved steel shoe extends from the carriage and rides in a stationary groove of the control mechanism and provides rpm control from the cockpit. An adjusting screw bearing on the spring permits adjusting the *maximum* governed rpm. *(See figure 8.)*

(8) CONTROL MECHANISM. *(See figure 9.)*—Moving the cockpit control rotates the control lever which is integral with a ring gear having teeth on its internal diameter. These internal teeth mesh with three small pinions which form the head of control screws. Moving the control lever rotates the control screws which transmit a fore and aft movement of the control ring groove and transmits this fore and aft movement of the control ring to the roller fulcrum, thus changing its position. The control mechanism also incorporates a stationary pump power gear which drives the hydraulic fluid pump. The pump rotates about this gear. The stationary pump power gear is positioned by two bearings, one in the cover and one in the housing. Rotation of this assembly is prevented by an adapter stop which is bolted to the reduction gear case. The stop engages a slot machined in the flange of the regulator adapter plate.

(9) RELIEF VALVE ASSEMBLY.—A relief valve assembly *(see figure 2)* installed in the stationary control mechanism is designed to relieve any excess air pressure built up in the regulator at low rpm, before the spring loaded seals have begun to lift off. This valve should not be removed unless replacement is necessary because of damage.

(10) REGULATOR BALANCE. — The rotating section of the regulator is statically balanced. Balance weight bosses are provided in the regulator housing, on which weight may be added to achieve balance.

(11) BEARINGS AND SEALS.—Propeller rotation forces the hydraulic fluid away from the center of the regulator. Seals are provided between the stationary control mechanism and the rotating regulator housing and cover. A ball-loaded spring is incorporated in each seal. When the propeller is stationary, the springs compress the seals against the surface of the control mechanism, retaining the fluid in the regulator. During propeller rotation, centrifugal force causes the ball-loaded springs to release the load from the seals. Since the fluid is forced to the outer diameter of the regulator, the necessity of a running seal between the rotating and non-rotating parts is eliminated. Lifting of the seals during propeller rotation eliminates wear and maintains atmospheric pressure inside the regulator at all altitudes.

d. MODEL IDENTIFICATION.

(1) GENERAL.—The model designation of a propeller is arrived at as follows:

Example, A642S-E1

A	Aeroproducts
6	No. 60 Shaft Size
4	Number of Blades
2	Blade Shank Size
S	Short Propeller Shaft
E	Major Design Specification
1	Minor Design Specification

(2) SPECIFICATIONS.

(a) Model A642S-E1

Overall Diameter	11 ft 0 in.
Minimum Blade Angle	24.5°
Maximum Blade Angle	59.5°
Blade Angle Range	35.0°
Maximum Propeller rpm	1345

(b) Model A642S-E2

Overall Diameter	11 ft 6 in.
Minimum Blade Angle	20°
Maximum Blade Angle	55°
Blade Angle Range	35.0°
Maximum Propeller rpm	1345

SECTION III
INSTALLATION AND REMOVAL

1. SERVICE TOOLS REQUIRED.

The following tools are necessary for the installation and removal of the propeller.

Part No.	*Nomenclature*	*Application*
6500070	Wrench— Propeller Shaft Nut	Removing and Installing Propeller
6500069	Wrench Assembly— Blade Retaining Nut	Removing and Installing Propeller Blades
6500075	Bleeder Assembly— Hub Blade Socket	Greasing Hub

2. ASSEMBLY OF THE CRATED PROPELLER.

Uncrate and assemble the propeller as follows:

a. Cut the metal bands which hold the cover in place on the crate and remove the cover.

b. Remove the retaining board and the hub core plug from the regulator. *(See figure 10.)*

c. Remove the rear cone.

CAUTION

Use care in handling rear cone. Cone must not be sprung or scratched.

d. Lift the regulator and hub assembly from the crate. Place the assembly on a stake with the regulator down.

e. Wipe the anti-corrosion compound from the rear cone, the hub bore, the exterior of the hub and regulator, using clean rags and approved solvent. Do not remove the grease from the blade sockets of the hub.

CAUTION

Use caution to prevent any dirt or foreign material from entering the hub sockets.

f. Remove the retaining blocks which hold the propeller blades in place in the crate.

g. Remove the blades from the crate. Place the blades on a bench with the stenciled information up, and with the stack bearings and blade retaining nut overhanging the edge of the bench. *(See figure 11.)*

h. Clean the anti-corrosion compound from the blade exterior, but do not remove the grease from the blade bearing stack.

i. Remove the paper covers shown in figure 11, from the root ends of the blades.

j. Remove the wood blade end protecting caps. *(See figure 12.)*

k. Remove the blade retaining nut locks and balance weights from the blade retaining nuts.

Note

The blade retaining nut is marked with purple paint in the slot where the lock is placed, and with red paint where the balance weights are to be replaced.

CAUTION

Keep the blade root and the bearings clean.

l. Apply a light coat of anti-seize compound, Specification No. AN-C-53, (Alternate, 70% white lead, 30% clean engine oil by volume) to the threads of the blade retaining nuts *(see figure 13)* and to the threads in the hub sockets.

m. Install the blades into the hub sockets. Hub sockets and blades are numbered to insure correct blade installation. No. 1 blade goes into No. 1 socket, etc. Blade dowels will engage in only one position since

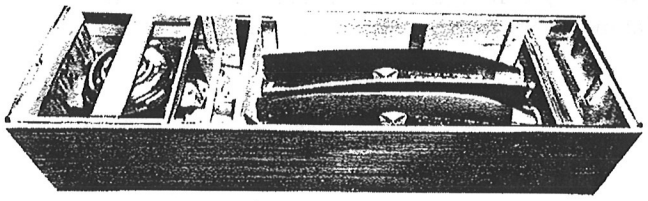


Figure 10—Uncrating the Propeller

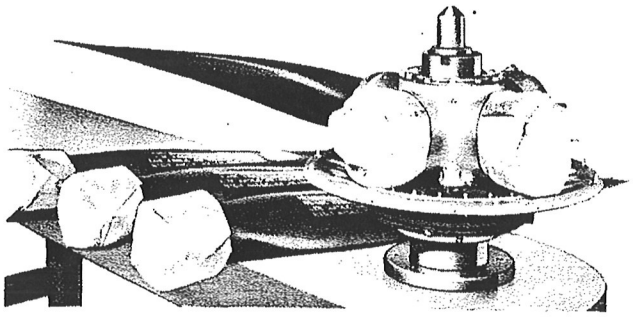


Figure 11—Propeller Properly Placed on Bench

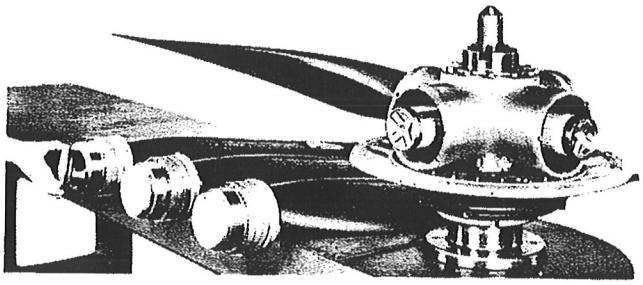


Figure 12—Removing Blade End Protecting Caps

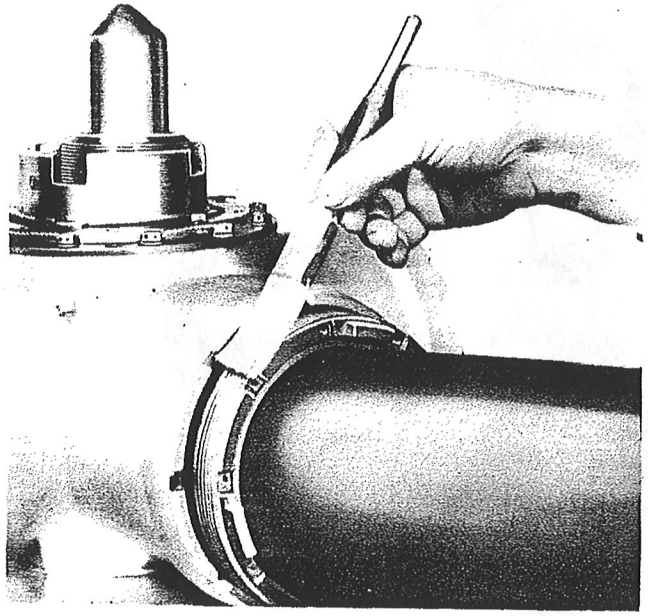


Figure 13—Applying Anti-seize to Blade Retaining Nut

one dowel pin is offset in relation to the spacing of the other dowel pins. Turn the blade in the socket until the dowel pins align with the dowel holes in the cylinder flange and blade gear. Then push the blade in until the dowel pins are engaged in the dowel holes. Keep the bearing stack tight against the blade nut during this procedure. When each blade is correctly installed, the leading edge of the blade will be above the horizontal center line. The numbers stenciled on the blades are used during the initial assembly only. Blades may be replaced by adding the same number of balance washers to the root of the new blade as were in the old blade.

CAUTION

Keep blade bearings clean.

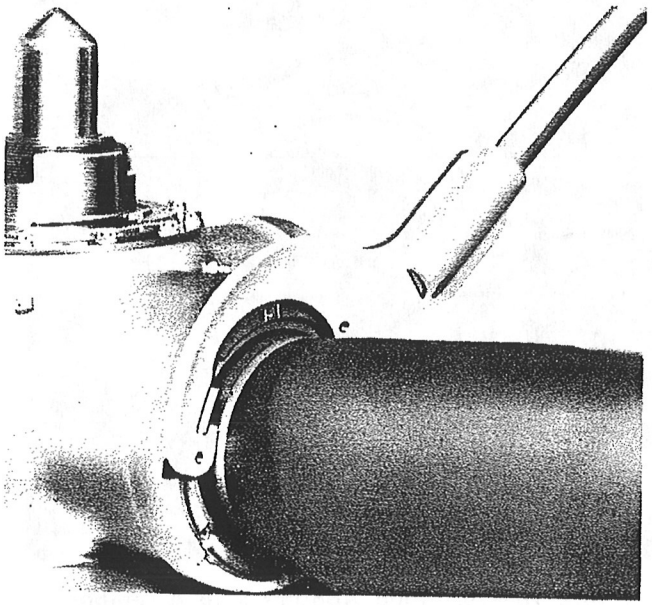


Figure 14—Tightening Blade Retaining Nut

n. Tighten the blade retaining nut snugly by using the blade retaining nut wrench and a bar. Tighten the nut until it is tight and the purple painted lock slot in the blade retaining nut matches the purple painted lock castellation in the hub. *(See figure 14.)*

o. Install the nut lock in the purple painted slot of the blade retaining nut and safety. *(See figure 15.)*

p. Install the balance weights in the red painted slots of the blade retaining nut and safety.

CAUTION

Provide at least .003-inch clearance between the end of the weights and the blade shank.

q. Repeat the foregoing procedure with the remaining three blades.

r. Grease the hub as follows:

(1) To bleed air while greasing, insert bleeder tool between the blade retaining nut and the blade shank of each blade. Take care not to damage the retaining nut seals.

(2) Place the grease gun on the hub grease fitting and apply pressure until the grease appears at bleeder

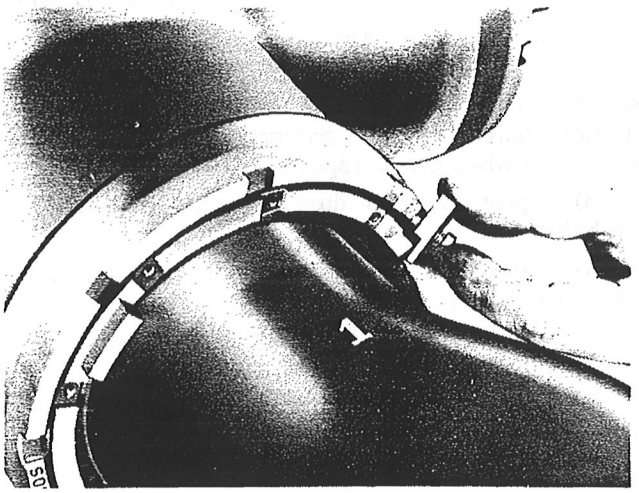


Figure 15—Install Blade Retaining Nut Lock

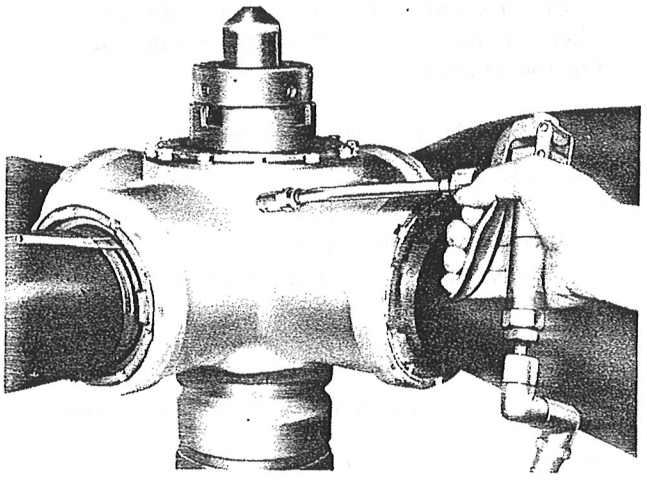


Figure 16—Greasing the Hub

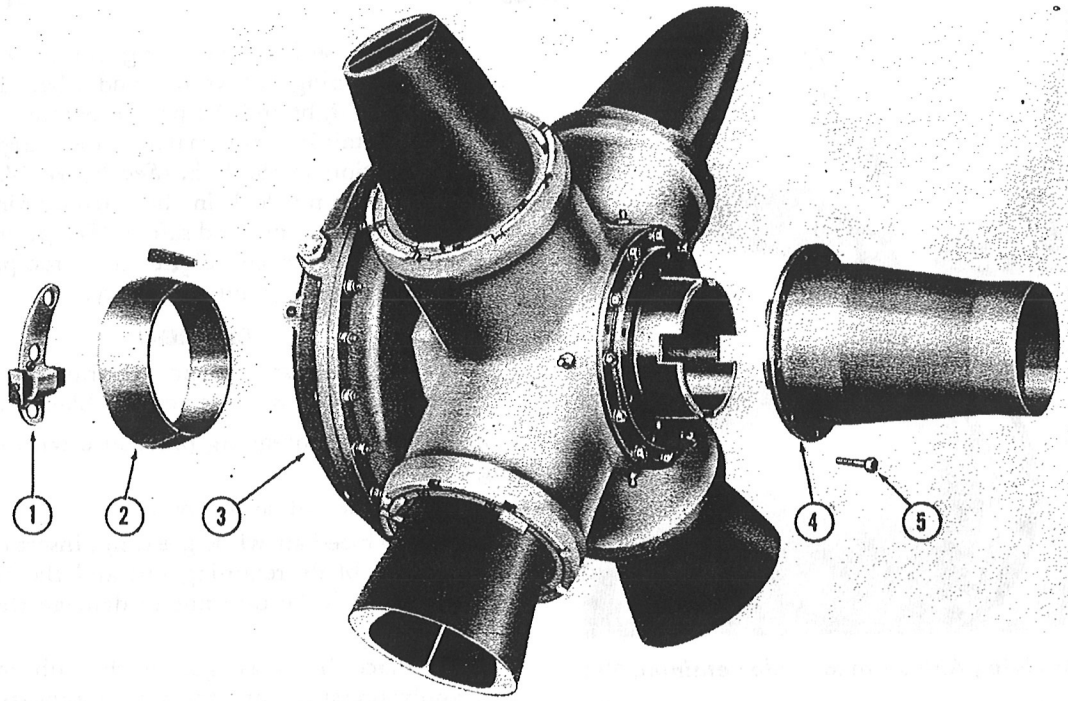


Figure 17—Propeller Installation

1. Adapter Stop Assembly
2. Rear Cone
3. Propeller
4. Spinner Adapter
5. Spinner Adapter Mounting Bolts

tool. *(See figure 16.)* Use specified hub grease. (See lubrication chart, section V, paragraph 4.) Remove the bleeder tool when grease appears.

(3) Repeat this procedure at each fitting and at each hub socket.

(4) Relieve excessive pressure by removing one grease fitting. Replace that fitting.

s. Turn the blades to full low angle.

t. Visually inspect all security fastenings.

u. Remove the spinner shell from the corrugated container in the crate.

CAUTION

When storing propellers, do not allow the weight of the propeller to rest on the regulator. Provide a cushioned surface where the propeller is placed, using a cloth to prevent marring the propeller.

3. INSTALLATION OF THE PROPELLER.

(See figure 17.)

a. Install the adapter stop assembly on the right side of the reduction gear housing as follows:

(1) Remove the nuts and spacers from the thrust plate.

(2) Install the adapter stop assembly. *(See figure 18.)*

(3) Install the spacers supplied with the adapter stop.

(4) Install and safety the nuts.

b. Remove the protective material from the propeller shaft.

c. Make certain the propeller shaft is turned with the master spline downward.

d. Remove the thread protector from the propeller shaft.

e. Clean the shaft and inspect for scratches or burrs on the threads and splines.

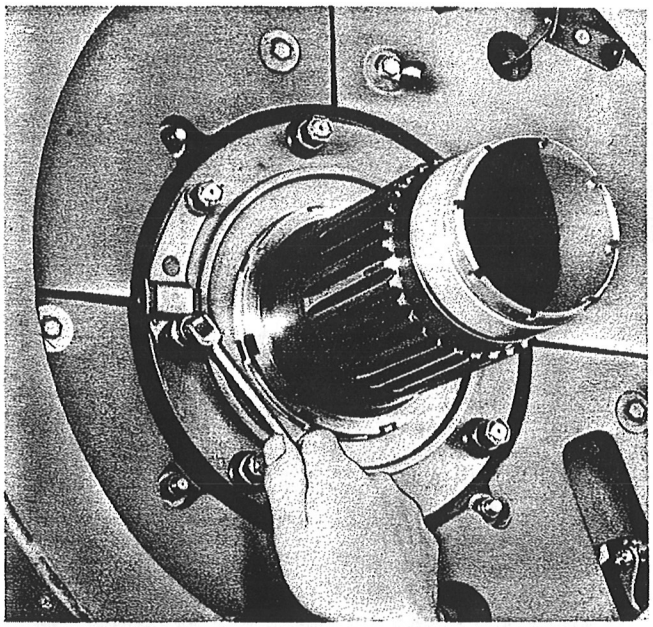


Figure 18—Installing Adapter Stop Assembly

f. Stone out any burrs found and use crocus cloth to remove any scratches.

g. Wipe the shaft clean and dry with a clean cloth.

h. Install the felt insert into the rear cone.

i. Install the rear cone. *(See figure 19.)* Do not apply oil to the shaft or cone when the cone is installed.

j. Apply a thin coat of specified anti-seize compound, Specification No. AN-C-53, to the shaft threads.

k. Apply a light coat of engine oil on the shaft splines only. *Do not apply oil to rear cone during this procedure.*

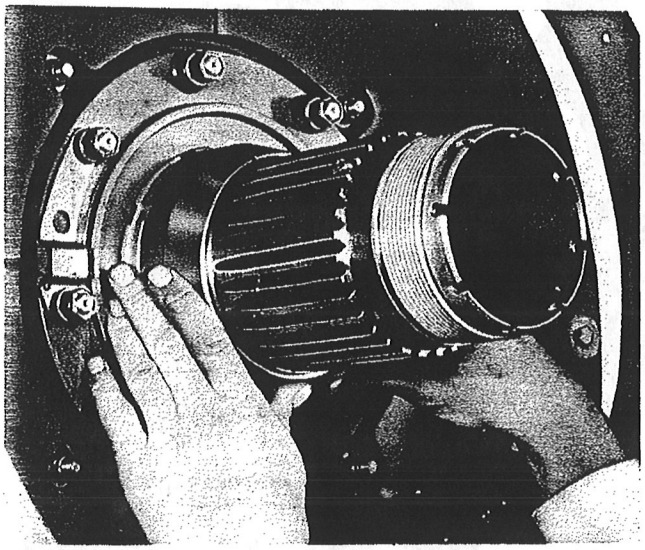


Figure 19—Installing Rear Cone

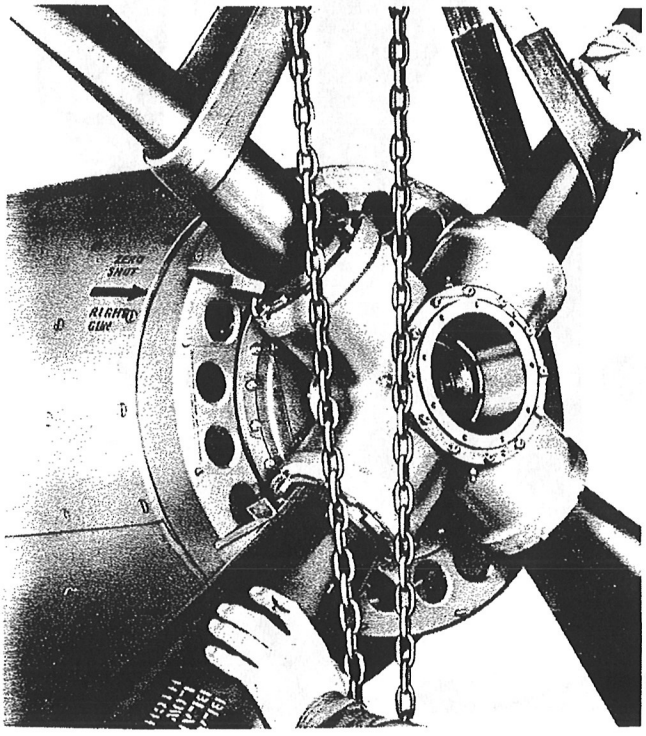


Figure 20—Installing the Propeller

l. Using a hoist, align the propeller with the propeller shaft and guide it over the shaft, *being careful not to damage the cone seal, threads or splines. (See figure 20.)*

CAUTION

Carefully observe that the adapter plate tang aligns with and slides freely into the adapter stop assembly on the engine reduction gear housing. *(See figure 21.)*

m. Start the shaft nut by turning 7 or 8 times. The nut and cone are in the hub.

n. Remove the hoist slings from the propeller.

o. Using a 4-foot bar and the shaft nut wrench, tighten the shaft nut to 1000 foot-pounds. *(See figure 22.)*

p. Install the spinner adapter. Engage the tangs on the spinner adapter with the castellations in the shaft nut in a position which will align the holes of the spinner adapter with the holes of the master gear retaining plate. Install and safety the bolts. *(See figure 23.)*

CAUTION

Do not loosen the shaft nut to secure alignment with spinner adapter. Tighten nut slightly, if necessary, for alignment.

q. Connect the propeller control linkage. *(See figures 24 and 25.)* Make certain that the maximum rpm position of the control lever arm is attained and that at least 1/16 inch (maximum, 1/8 inch) spring-back is obtained at the control quadrant with the control in the

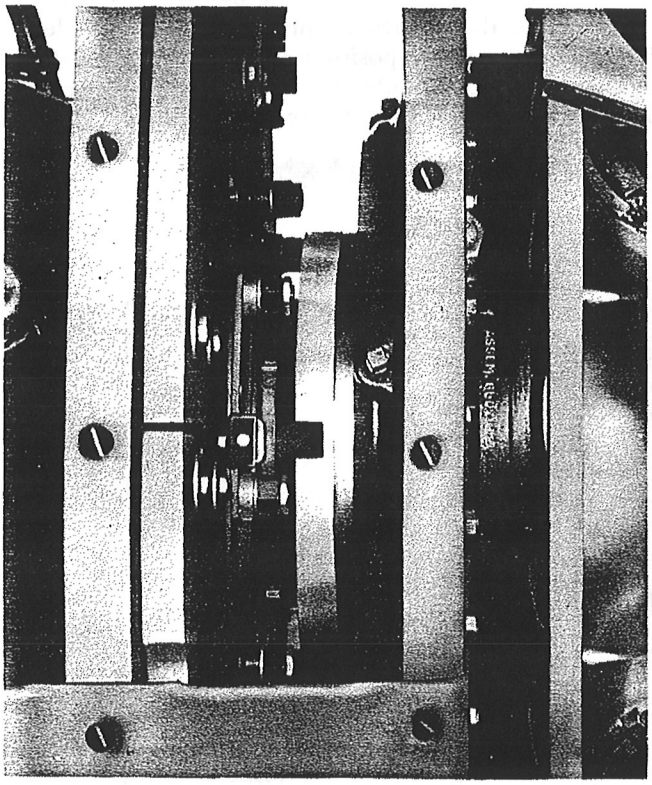


Figure 21—Aligning Adapter Plate Slot with Stop Assembly

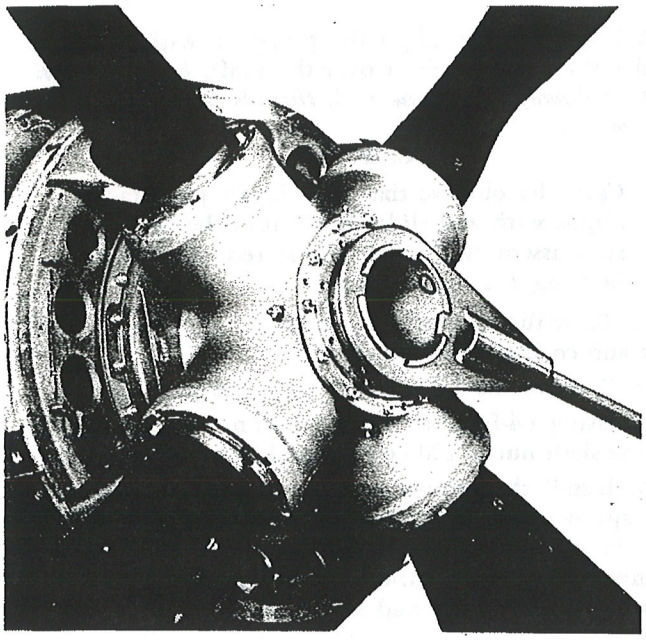


Figure 22—Tightening Shaft Nut

full "INCREASE RPM" position to assure full travel of the propeller control lever.

r. Install the spinner, aligning the dowels in the bulkhead with the dowel holes in the shell. Tap the shell into place, using the hands only. *(See figure 26.)* Install and tighten the attaching screws. *(See figure 27.)*

(1) Tighten the attaching screws.

s. Check the level of fluid in the regulator as follows:

(1) Turn the propeller until the regulator filler plug is in a horizontal position on the left side of the airplane. The No. 1 blade will be a little below horizontal on the left side. *(See figure 28.)*

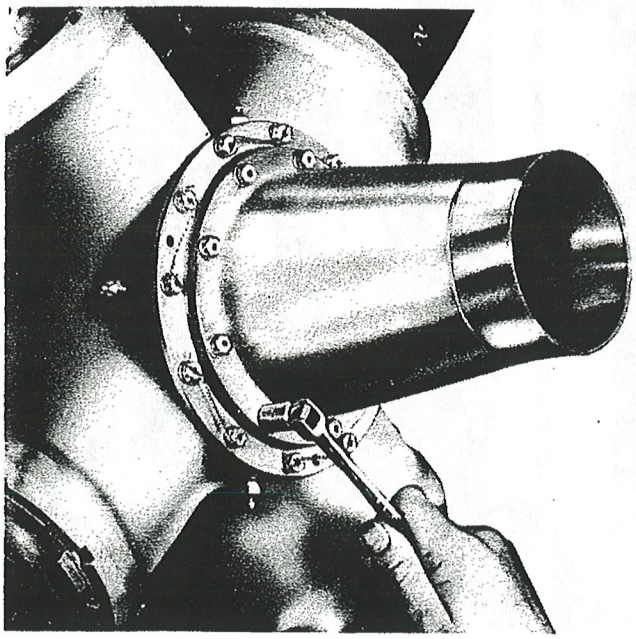


Figure 23—Installing Spinner Adapter

(2) Remove the filler plug.

(3) Add fluid, if necessary (see lubrication chart), until it appears at the filler hole. The regulator must be half full and only half full of fluid.

(4) Replace and safety the filler plug.

(5) Perform preflight inspection and check the governor for maximum rpm setting as directed in section V, paragraph 3. *a.* After the engine is run, recheck the level of the fluid in the regulator.

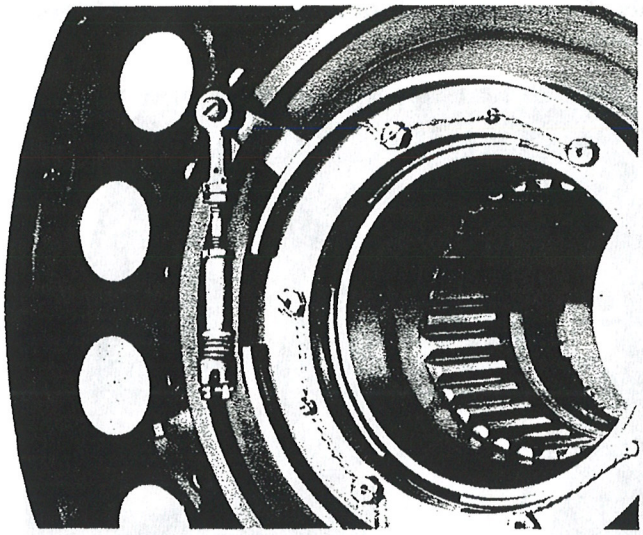


Figure 24—Install Control Linkage

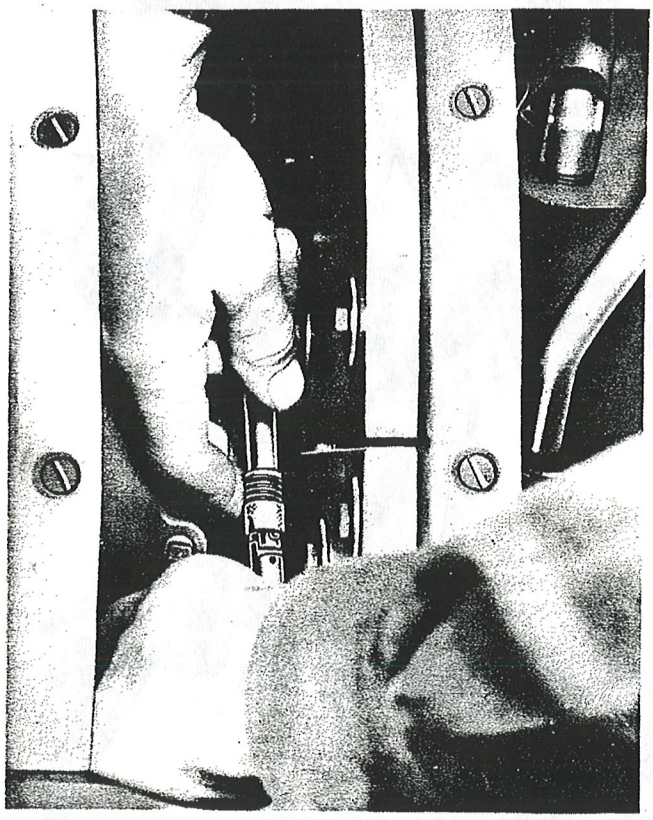


Figure 25—Connecting Control Linkage

4. REMOVAL OF THE PROPELLER.

a. Check the ignition switch for the "OFF" position.

b. Disconnect the propeller control linkage.

c. Remove the spinner shell with the hands only after removing the attaching screws. *(See figure 29.)*

d. Remove the spinner adapter mounting bolts and remove spinner adapter.

e. Attach hoist slings to the two upper blades of the propeller.

f. Using a 4-foot bar and the shaft nut wrench, loosen the shaft nut by turning counterclockwise. Turn until it is free of the threads, using the hoist to gradually relieve the shaft of the propeller weights.

g. Carefully manipulate the hoist to prevent the propeller weight from damaging the shaft or hub. Special care should be exercised to prevent nicking the rear cone seat in the hub. Pull the propeller slowly off the shaft and place on a dolly in such a manner that the regulator is not supporting any of the weight.

h. Remove the rear cone.

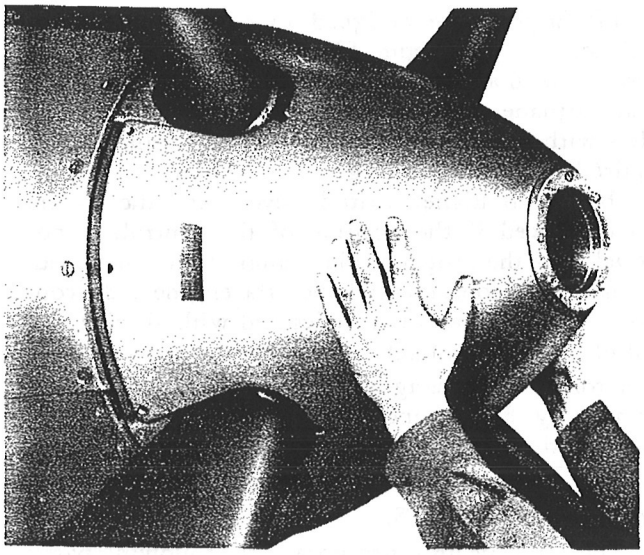


Figure 26—Installing the Spinner

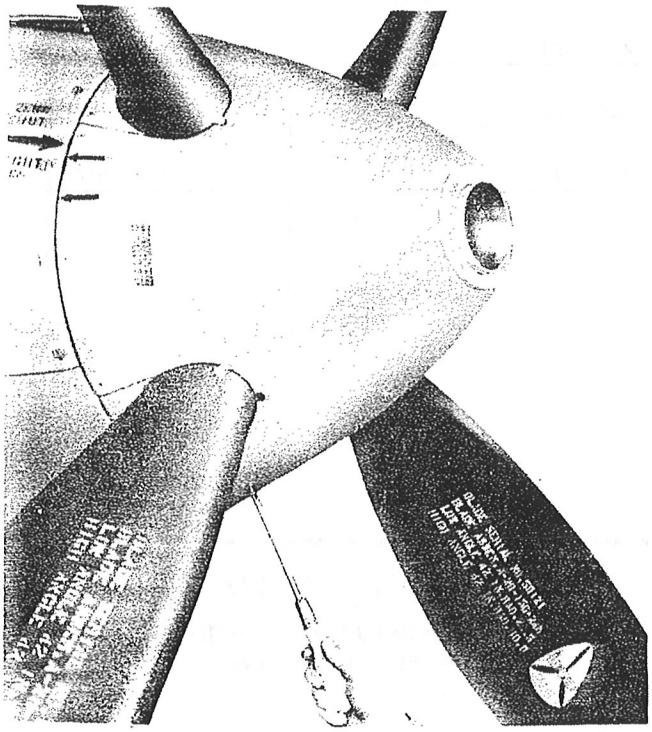


Figure 27—Tightening Spinner Attaching Screws

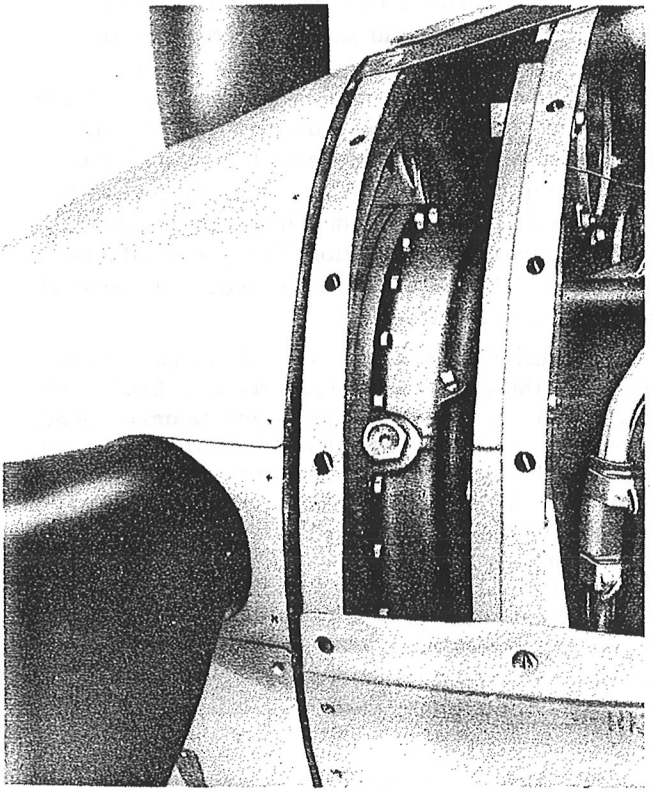


Figure 28—Turning Propeller to Add Fluid to Regulator

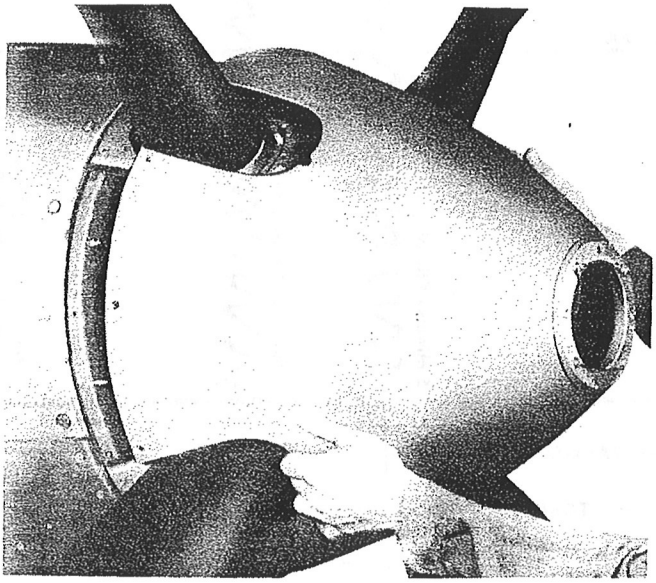


Figure 29—Removing Spinner

SECTION IV
OPERATION

1. PRINCIPLES OF OPERATION.

a. GENERAL.

(1) The airplane propeller screws through the air, advancing as it turns and pulls the aircraft with it. It is the aim of the propeller designer to design an air screw which will efficiently transform engine horsepower into forward thrust under all conditions of flight. The first satisfactory theory for the design of an aircraft propeller was known as the "blade element" theory which divided the blade into stations, assigning a different angle to each station. This produced a twisted blade which resulted in each section of the blade operating at its best efficiency.

(2) Until the last decade, the only propellers available were those with the blades set at a fixed angle. This type of a propeller attained its maximum efficiency under one operation condition only, whether it was a low angle for take-off, a medium angle for optimum cruising, or a higher angle to prevent overspeeding the engine in dives. It could not compensate for changes in air density encountered at different altitude levels, nor for load variations placed upon the engine with changes in the plane's attitude of flight. To compensate for these varying conditions, propeller engineers have developed the constant speed propeller which provides automatic variation of the blade angle necessary to maintain a selected rpm. A comparison among types of propellers is illustrated in figure 30.

(3) The propeller is a controllable propeller with a fast rate of blade angle change. The engine rpm selected by the pilot is maintained by the propeller at all times.

(4) Engines are designed to develop maximum efficiency at a given rpm. Since the density of the air decreases with an increase in altitude, the air resistance on an airplane at any given speed or attitude of flight is less with an increase in altitude. The engine output required to maintain any given conditions will therefore be less at higher altitude levels, and the engine will overspeed if the position of the controls is not altered or if the propeller blade angle is not increased. To maintain a constant load upon the engine and a constant engine rpm at all altitudes and with all altitudes of flight, the controllable, automatic propeller is used. By automatically changing blade angle to compensate for varying flight conditions, an equal resistance is maintained upon the engine and the rpm remains constant.

b. TORQUE UNITS.

(1) A torque unit incorporates the following parts:

(a) Torque cylinder.

(b) Torque piston.

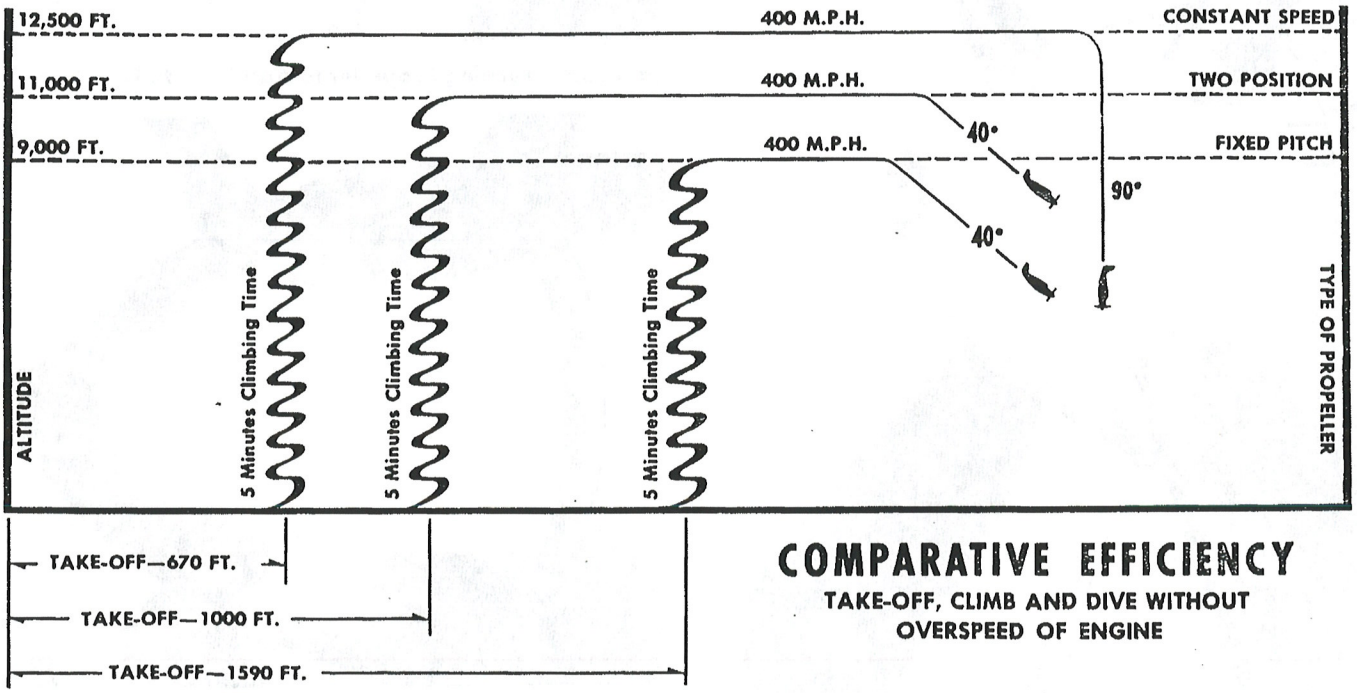


Figure 30—Comparative Propeller Efficiency

(c) Cylinder seals.
(d) Fixed spline.

(2) The torque piston with internal and external helical splines is mounted between the externally splined fixed spline and the internally splined torque cylinder which is connected directly to the blade. The application of hydraulic pressure to either side of the piston will give it axial (up or down) movement along the fixed spline. The combination of the helical spline arrangement between the fixed spline and the piston, and between the piston and the cylinder results in a change of blade angle when the piston is moved.

(3) If, for example, a helically splined piston was arranged to slide along a fixed helical splined shaft, as illustrated in figure 31, it would be given an initial twist of approximately 12 degrees with each lengthwise inch of piston travel. The combination of meshed helical splines between the piston and blade will give the blade an additional turn of 12 degrees, or a total of 24 degrees angle change for each lengthwise inch of piston travel along the fixed spline. *(See figure 31.)*

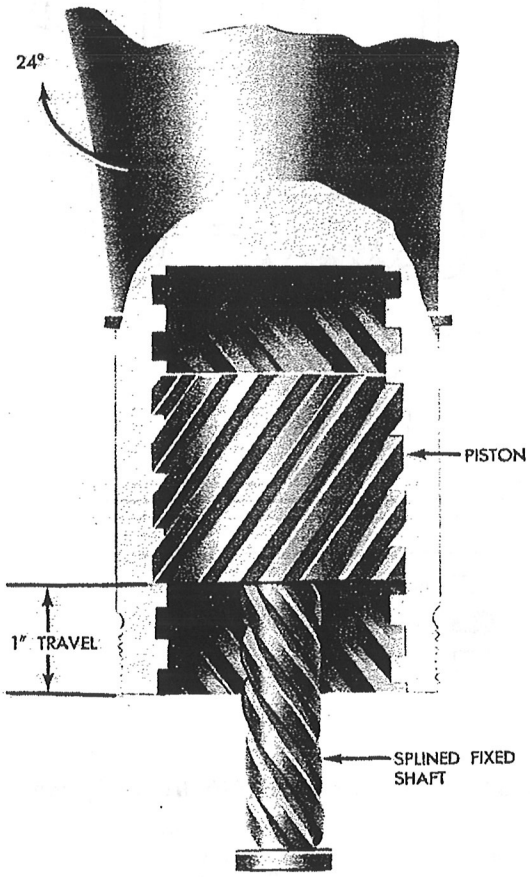


Figure 31—Schematic View of Torque Unit

Note

The degree references given are examples only, and do not represent the actual manufacturing specifications.

c. HYDRAULIC SYSTEM.

(1) Hydraulic pressure for operating the torque units is created by a gear-type hydraulic pump. A pressure control valve controls the required operating pressure of the system. The governor distributes the hydraulic fluid under pressure to the torque units.

(2) The principle of the hydraulic system is explained in the following series of schematic diagrams.

(a) In figure 32, a gear-type pump creates hydraulic pressure, using fluid from the reservoir. From the pump, a hydraulic line is connected to the governor

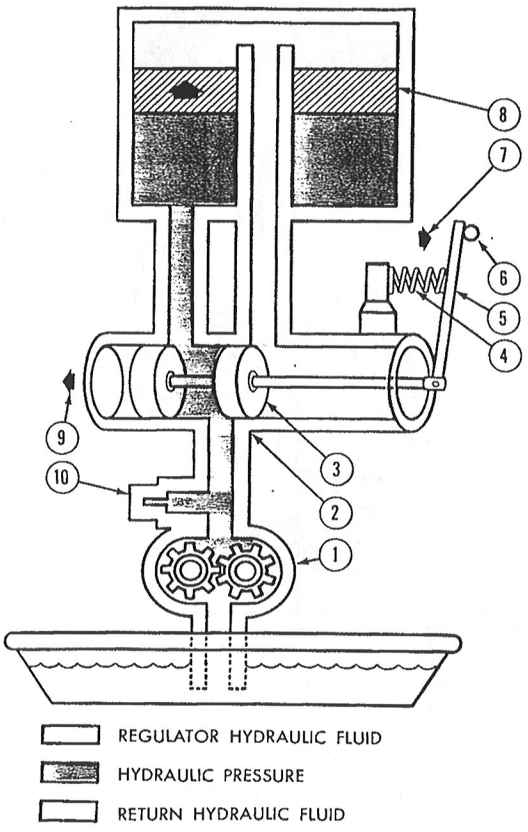


Figure 32—Schematic View of Hydraulic System (Increase Blade Angle)

1. Pump
2. Governor
3. Governor Piston
4. Governor Spring
5. Governor Lever
6. Governor Fulcrum
7. Direction of Spring Force
8. Torque Piston
9. Direction of Centrifugal Force
10. Pressure Control Valve

which functions as a distributing valve. From the governor, two hydraulic lines are connected to the torque unit. As shown in this diagram, the governor is distributing hydraulic fluid under pressure to the inboard side of the torque piston, moving the piston up. Fluid from the outboard side of the torque piston flows out through the hydraulic line to the open port of the governor and back to the reservoir.

(b) As schematically illustrated in figure 33, the governor piston has moved to a position which allows hydraulic pressure to be applied to the outboard side of the torque piston, moving this piston down. Fluid from the inboard side is directed back to the reservoir.

(c) During operation, centrifugal force causes the governor piston to act against the force of the governor spring. Therefore, the position of the governor piston is dependent upon the amount of centrifugal force acting upon this piston and upon the position of the movable fulcrum. The movable governor fulcrum provides a method of changing the amount of centrifugal force necessary to overcome the spring force. If the fulcrum is moved nearer to the spring, less centrifugal force is required to overcome the spring force. If the fulcrum is moved farther from the spring, more centrifugal force is required to overcome the spring force. An increase in rpm increases the centrifugal force on the governor piston. The piston moves out and hydraulic fluid will be directed to the inboard side of the torque piston, moving the piston up. This movement of the torque piston increases the blade angle which in turn results in a decrease in rpm. With a decrease in rpm, less centrifugal force acts on the governor piston, and the spring will force this piston inward.

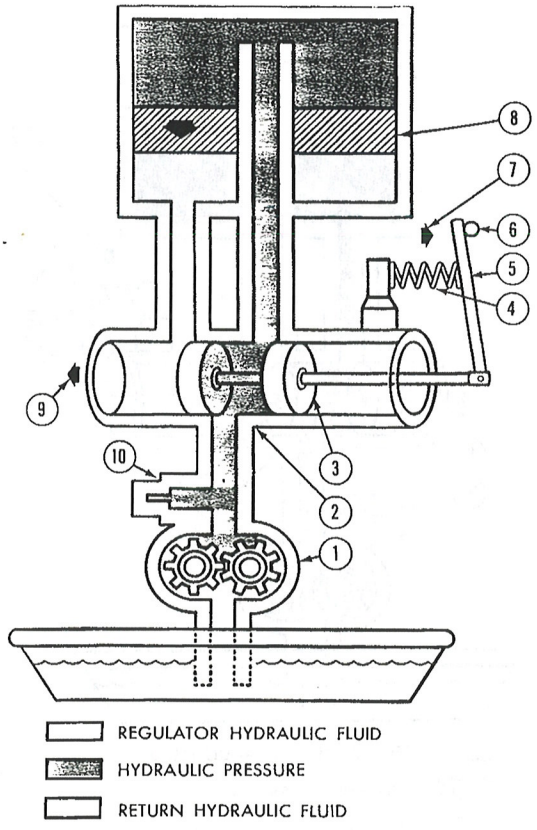


Figure 33—Schematic View of Hydraulic System (Decrease Blade Angle)

1. Pump
2. Governor
3. Governor Piston
4. Governor Spring
5. Governor Lever
6. Governor Fulcrum
7. Direction of Spring Force
8. Torque Piston
9. Direction of Centrifugal Force
10. Pressure Control Valve

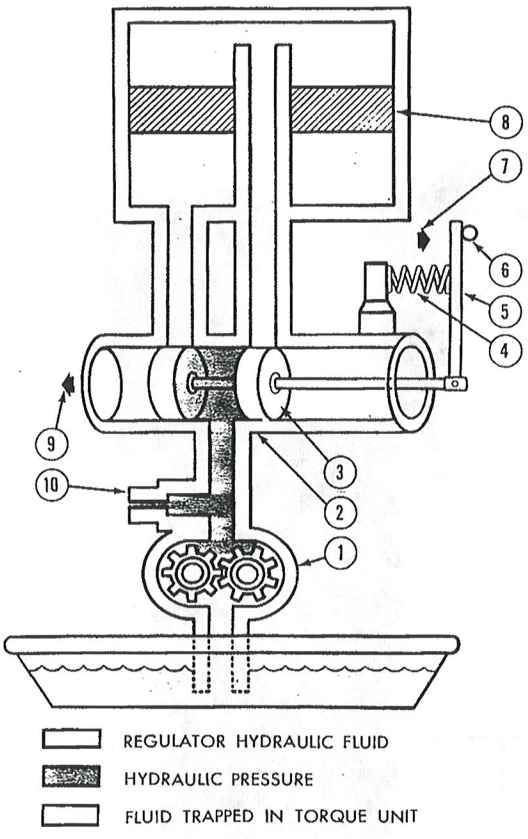


Figure 34—Schematic View of Hydraulic System

1. Pump
2. Governor
3. Governor Piston
4. Governor Spring
5. Governor Lever
6. Governor Fulcrum
7. Direction of Spring Force
8. Torque Piston
9. Direction of Centrifugal Force
10. Pressure Control Valve

(d) As illustrated in figure 34, the governor piston will sometimes be in a position which will prevent hydraulic fluid under pressure from being directed to either side of the torque piston. When this condition exists, the torque piston will remain stationary, and there will be no change in blade angle. To prevent the build-up of excessive pressure, a pressure control valve is provided in the hydraulic line between the pump and governor.

(e) Referring to figure 35, the hydraulic system is illustrated in a circular pattern about an axis of rotation. Hydraulic fluid is pumped through a filter to the governor, where it is distributed to the outboard side of the torque piston, forcing it inward. Hydraulic fluid from the inboard side is relieved through the open port of the governor. An auxiliary hydraulic line connects the lower side of the pressure control valve piston to the hydraulic line between the governor and the inboard side of the torque piston. This auxiliary line provides pressure against the lower side of the pressure control valve piston when the governor is distributing fluid to the inboard side of the torque piston. Therefore, it is impossible to develop a greater amount of pressure when increasing the blade angle than when decreasing blade angle. This is advantageous, since more force is required to increase blade angle. Figure 35 illustrates a condition of "Underspeed" or low rpm and maximum rate of blade angle change. An "Underspeed" condition exists when the engine and propeller rpm decreased to a rate where the centrifugal force on the governor piston is not great enough to hold the piston out against the spring force on the governor lever. When the piston is forced inward, hydraulic pressure is directed to the outboard side of the torque piston. As the torque piston is moved inward, the blade angle decreases, allowing the engine rpm to increase. External forces acting on the propeller blade tend to turn it towards the low angle. Therefore, only low hydraulic pressure will be developed because the torque piston moves easily and rapidly. The pressure control valve remains closed because only low pressure is developed.

(f) An "Overspeed" condition is illustrated in figure 36. Centrifugal force has caused the governor piston to move farther from the axis of rotation. Hydraulic fluid under pressure is being distributed by the governor to the inboard side of the torque piston, forc-

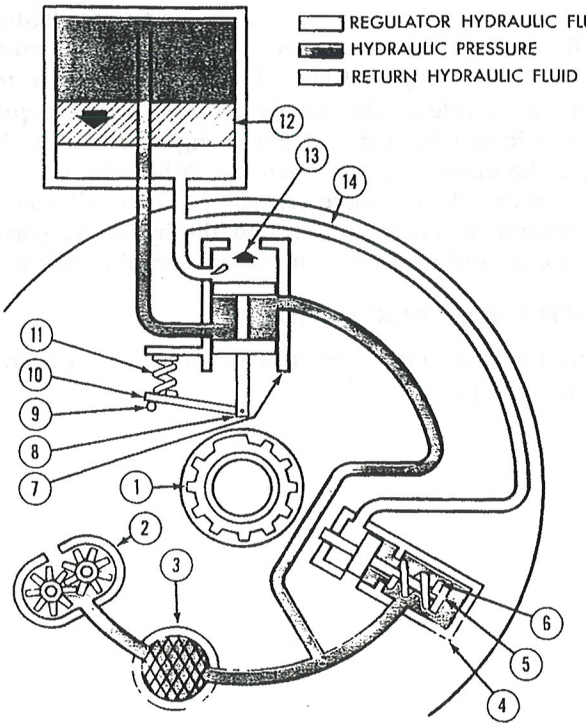


Figure 35—Schematic View of Hydraulic System Underspeed

1. Propeller Shaft
2. Pump
3. Filter
4. Pressure Control Valve
5. Pressure Control Valve Piston
6. Pressure Control Valve Spring
7. Governor
8. Governor Piston
9. Governor Fulcrum
10. Governor Lever
11. Governor Spring
12. Torque Piston
13. Direction of Centrifugal Force
14. Auxiliary Hydraulic Line

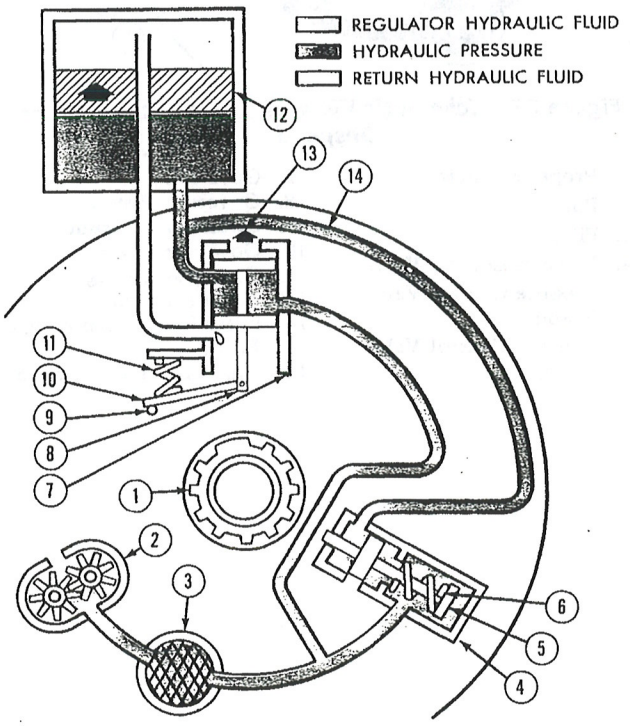


Figure 36—Schematic View of Hydraulic System—Overspeed

1. Propeller Shaft
2. Pump
3. Filter
4. Pressure Control Valve
5. Pressure Control Valve Piston
6. Pressure Control Valve Spring
7. Governor
8. Governor Piston
9. Governor Fulcrum
10. Governor Lever
11. Governor Spring
12. Torque Piston
13. Direction of Centrifugal Force
14. Auxiliary Hydraulic Line

ing it outward. Hydraulic fluid from the outboard side of the piston is relieved through the open port of the governor. As the torque piston moves outward, the blade angle of the propeller increases, causing the engine rpm to decrease. External forces resist increasing the blade angle, and therefore, greater pressure is required to increase than to decrease blade angle. Since the auxiliary hydraulic line connects the lower side of the pressure control valve piston to the increase blade angle hydraulic line, the pressure control valve will not open during the maximum rate of blade angle change. As illustrated in figure 36, a high pressure is developed in the hydraulic system to the inboard side of this torque piston and also to the pressure control valve.

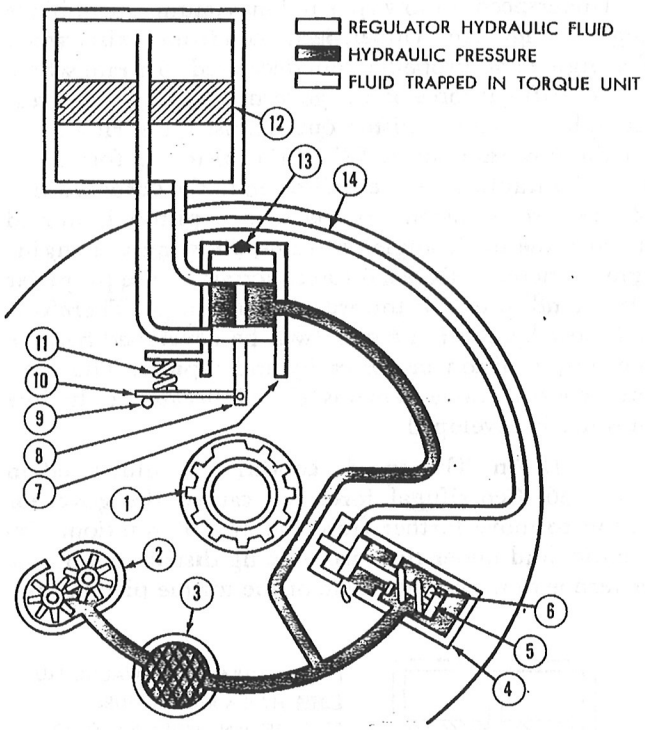


Figure 37—Schematic View of Hydraulic System—Onspeed

1. Propeller shaft
2. Pump
3. Filter
4. Pressure Control Valve
5. Pressure Control Valve Piston
6. Pressure Control Valve Spring
7. Governor
8. Governor Piston
9. Governor Fulcrum
10. Governor Lever
11. Governor Spring
12. Torque Piston
13. Direction of Centrifugal Force
14. Auxiliary Hydraulic Line

(g) The term "Onspeed" is used to indicate the condition which exists when the propeller is governing the engine at a selected rpm. As illustrated in figure 37, there is a greater pressure between the pump and governor than that which is required on the inboard side of the torque piston. The pressure in the increase blade angle line controls the operating pressure of the pump, because the pressure control valve will open as soon as the pressure between the pump and the governor exceeds the pressure on the inboard side of the torque piston. This action prevents an excessive load on the hydraulic pump.

(h) The schematic operational diagram, figure 38, illustrates an "Underspeed" condition. The governor is distributing hydraulic fluid under pressure to the outboard side of the torque piston. As the torque piston is forced inward, the blade angle decreases, allowing the engine rpm to increase. When the engine rpm increases, the increased centrifugal force will cause the governor to move out, closing the hydraulic ports to the torque units, establishing an "Onspeed" condition.

2. OPERATION INSTRUCTIONS.

For the operation of the cockpit control, refer to the applicable airplane handbook.

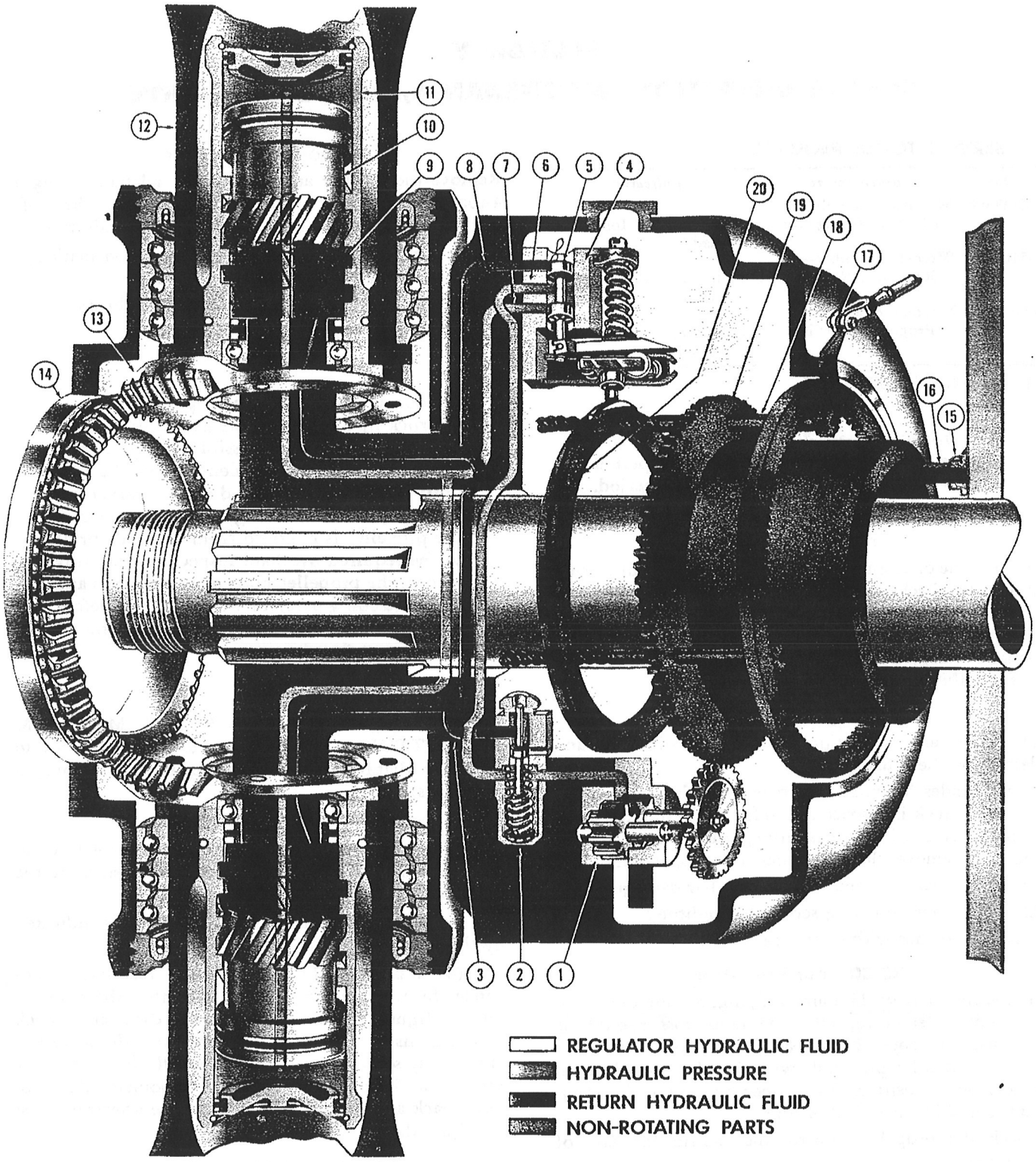


Figure 38—Schematic Operational Diagram

1. Pump
2. Pressure Control Valve
3. Auxiliary Hydraulic Line
4. Governor
5. Governor Piston
6. Pump Pressure Line
7. Decrease Blade Angle Line
8. Increase Blade Angle Line
9. Fixed Spline
10. Torque Piston
11. Torque Cylinder
12. Blade
13. Blade Gear
14. Master Gear
15. Adapter Stop
16. Adapter Plate Tang
17. Control Lever
18. Control Screw
19. Pump Power Gear
20. Control Ring

SECTION V
SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION

1. SERVICE TOOLS REQUIRED.

Part No.	*Nomenclature*	*Application*
6500069	Wrench Assembly—Blade Retaining Nut	Removing and Installing Blades
6510105	Wrench Assembly—Regulator Nut	Removing and Installing Regulator
6500070	Wrench Assembly—Propeller Shaft Nut	Removing and Installing Propeller

2. SERVICE INSPECTION.

Note

The inspection periods are designated by two figures; first, by the Army Air Forces period and, second, by the comparable Navy period.

PROPELLER AND ACCESSORIES

Preflight Instruction

At the time of engine warm-up, the propeller operation should be checked as follows: With the propeller control at the full "INCREASE RPM" position, set the throttle control to give 2300 rpm; then move the propeller control back to give a 300 rpm drop, then forward to full "INCREASE RPM" position.

Daily Inspection

Check for any indication of grease or oil leaks and determine the source.

Check blades for nicks, scratches, or other damage. If a flaw or crack is suspected, carefully examine the questionable area with a magnifying glass. If any doubt remains, remove blades for magnetic inspection.

Check spinner for dents, cracks or other damage.

Check spinner attaching screws for tightness.

Wipe the blades with clean engine oil.

25-30 Hour Inspection

At the end of every 25 hours of flying, or after one week or more of standing idle, the regulators should be checked for proper fluid level. Fluid should be at the level of the filler plug hole with the filler plug hole in a horizontal position. For proper operation, the regulator should be half full of fluid.

Check the propeller control mechanism for ease of operation.

Check the control lever connection for security.

Remove the external filter from the regulator. Clean, replace, and safety.

Check adapter stop block for wear.

Check all external safety wire for tightness and for breaks. Replace where necessary.

50-60 Hour Inspection

Remove the spinner and the spinner adapter. Using a 4-foot bar, check the shaft nut for tightness. The shaft nut should be tightened to 1000 foot-pounds torque.

Check for deterioration of the identification markings on both the blades and hub.

Check the blade retaining nut locks for tightness.

Check the hub for proper amount of grease.

Note

As soon as possible after a propeller strikes, or is struck by any object, the propeller must be carefully examined for possible damage. A propeller involved in an accident will not be used until it is first disassembled and all parts carefully inspected for damage. If, for any reason, the propeller is removed from the shaft prior to the required overhaul inspection, carefully inspect the propeller hub cone seat, cones and other attaching parts for wear, gall, etc. Before reinstallation, all damaged parts must be repaired or replaced.

3. MAINTENANCE.

a. CHECKING GOVERNOR FOR MAXIMUM RPM SETTING.—Before flight, test the governor to make sure that it is properly adjusted for maximum rpm as follows:

(1) Securely harness the airplane.

(2) Move the propeller governor control lever to the full "INCREASE RPM" position, then start the engine.

(3) Open the throttle until 2800 rpm is indicated by the tachometer.

(4) While closely observing the tachometer, advance the throttle rapidly and note that the rpm increases slightly beyond 3000 rpm and then settles back and remains at 3000 rpm. This indicates the governor is properly set. *Do not hold the throttle fully open for more than 5 or 6 seconds.* If the tachometer does not settle back and remain at 3000 rpm, the governor must be adjusted.

b. GOVERNOR ADJUSTMENT.

(1) Turn the propeller by hand until the regulator filler plug is above the horizontal center line. This will prevent fluid from spilling out of the regulator when the plug is removed.

(2) Remove the filler plug and insert a screw driver in the governor adjusting screw. *(See figure 39.)*

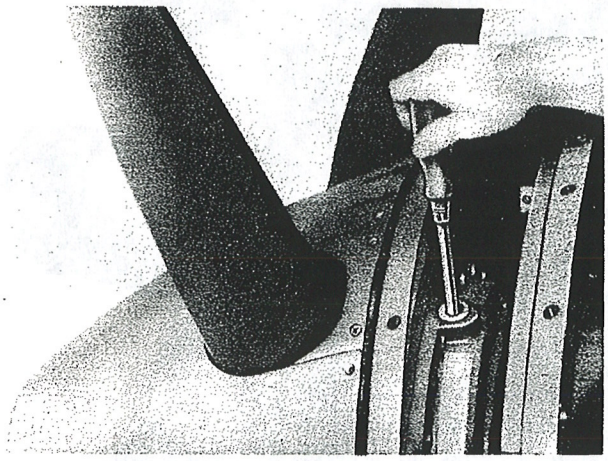


Figure 39—Adjusting the Governor

(3) Turn the adjusting screw counterclockwise to increase rpm; clockwise to decrease rpm. Each notch of the adjustment will make a change of approximately 15 to 20 engine rpm.

(4) Replace the filler plug and safety.

(5) Start the engine and note the maximum rpm. If further adjustment is necessary, repeat the above steps.

c. REPLACING THE REGULATOR.

(1) Remove the propeller as directed in section III, paragraph 4.

(2) Support the propeller in a dolly or place on a padded floor with the regulator side up.

(3) Insert the regulator nut wrench in the regulator nut.

(4) Loosen the regulator nut. The nut has a *left hand thread.* Use a 4-foot bar through the wrench and *turn clockwise to loosen.*

(5) Lift the regulator off the hub. The regulator has a close fit to the hub and will bind if cocked or tilted. If the regulator binds, tap it back in place, using the hands or a soft-faced mallet. *Do not pry the regulator.*

(6) Remove the transfer seals from the transfer-ports of the hub.

(7) Install new transfer seals in the hub.

(8) Assemble the replacement regulator on the hub. *Make certain there is no masking tape covering the transfer ports of the regulator.* Align the dowel in the regulator housing with the dowel hole in the hub.

(9) Apply anti-seize compound, Specification No. AN-C-53, on the regulator nut and start the nut by hand, turning counter-clockwise. The nut has a *left hand thread.* Tighten the nut with the regulator nut wrench and a 4-foot bar. Tighten to 500 to 600 foot-pounds torque, using hands only on the bar.

(10) Check the clearance between the regulator housing and the hub. It should not be possible to insert a .002-inch feeler gauge at any point.

d. CLEANING THE FILTER.—At 25-hour intervals, clean the filter as follows:

(1) Remove the spinner.

(2) Cut the safety wire and turn the filter assembly counterclockwise with a 1-inch socket wrench until free of the regulator housing.

(3) Release the snap ring from the filter assembly.

(4) Remove the filter cartridge and spring.

(5) Remove the spring from the filter cartridge.

(6) Remove the small "O" ring seal from the end of the filter cartridge.

(7) Remove the "O" ring gasket from the filter cap.

(8) Thoroughly clean all parts with dry cleaning fluid, Federal Specification No. P-S-661. Dry with compressed air.

(9) Assemble the filter, installing new "O" ring gaskets.

(10) Install and safety the filter.

(11) Replace the spinner.

d. CHECKING BLADE ANGLE.—To check the angle of the blades on a propeller installed on an airplane, proceed as follows:

(1) Turn the propeller until one blade is in the horizontal position on the left side of the airplane.

(2) Using a universal propeller protractor and a blade template, check the angle of the blade at the reference mark which is located at the 42-inch station.

(3) Repeat this procedure for each blade of the propeller.

e. BLADE REPAIR.

(1) Make a thorough inspection of the blades and *remove from service* any blade showing any evidence of the following:

(a) Dents, or dimples in camber sheet, .015-inch or deeper.

(b) Bent blades.

(c) Deep cuts.

(d) Scratches or damage likely to induce a crack.

(e) Bullet holes.

(f) Nicks which require the removal of an excessive amount of material.

(2) In deciding on the repair of nicks and scratches, make note of the location and seriousness of the damage. Consideration must be given to any previous repair

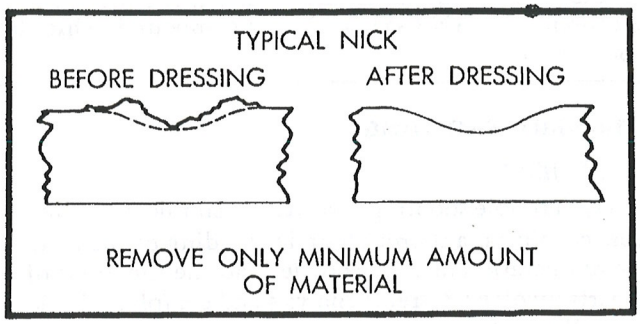


Figure 40—Blade Repair

which has been made on any blade, as additional repairs in the same area might impair the safety of a blade. The blade record should indicate the amount of metal which has been removed in previous repairs. This will enable one to decide upon the extent of further repairs. Enter on Form 61B the amount and the location of any metal removed in making blade repair.

(3) When removing metal, a fine stone should be used and as little metal as possible should be removed. Sharp edges concentrate stresses and may eventually lead to cracks. After dressing with a stone, the surface should be smoothed with crocus cloth. Raised edges of nicks, scratches and cuts may be removed as shown in figure 40. The minimum allowable amount of metal which may be removed is shown in figures 41 and 43.

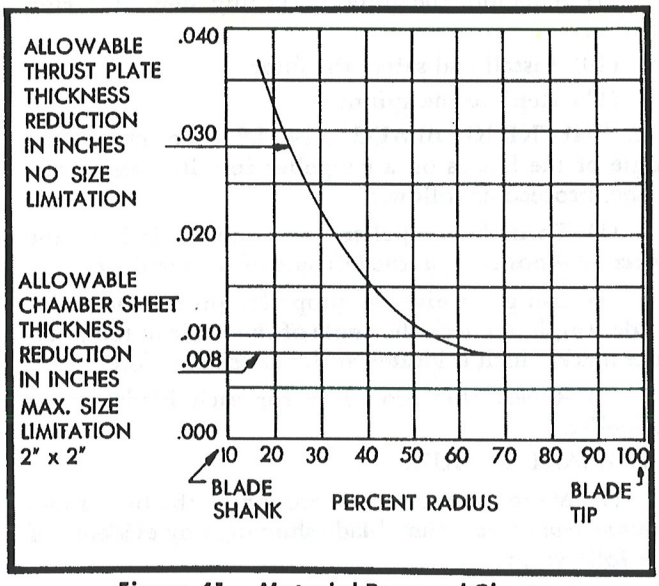


Figure 41—Material Removal Chart

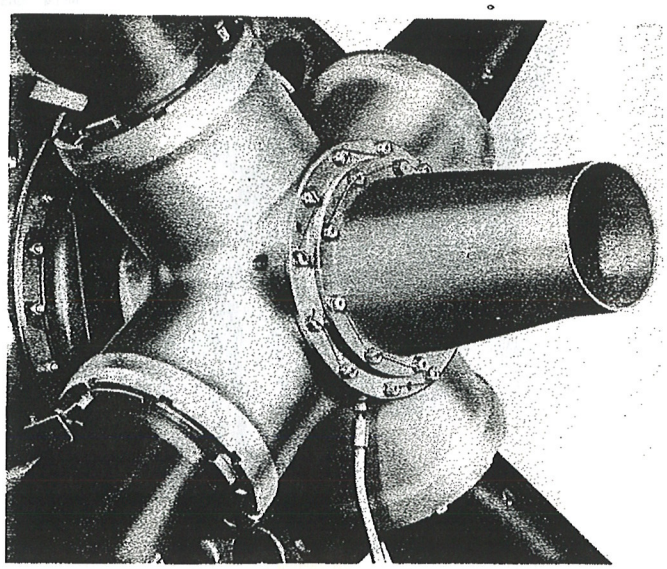


Figure 42—Greasing the Hub

4. LUBRICATION.

At 50-hour intervals, lubricate the hub with a recommended lubricant. (See following lubrication chart.) A power or hand grease gun may be used as follows:

a. Remove the two upper grease fittings in the hub.

b. Apply the grease gun to one of the lower fittings until grease appears at one of the open fitting holes. *(See figure 42.)*

c. Reinstall the fitting in the hole where grease appeared.

d. Apply grease gun to that fitting until grease shows at the remaining fitting hole.

e. Reinstall the remaining grease fitting.

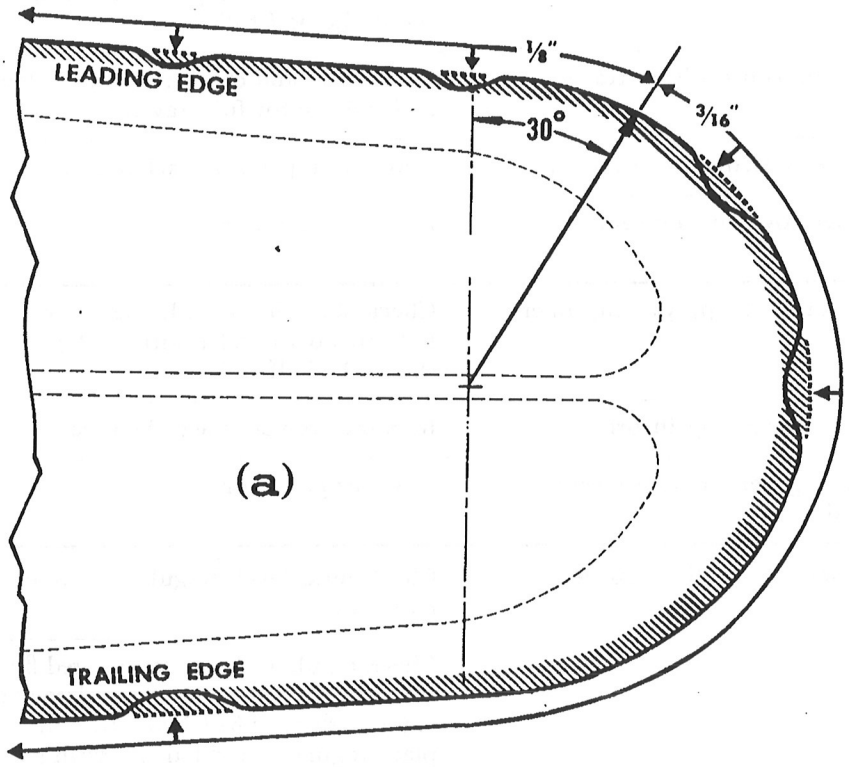
LUBRICATION CHART

Location	*Lubricant*	
Regulator	Temp. Constantly Above 0° F. (–17° C.) AAF Specification 3582 AN-O-3 Grade L, low temperature lubricating oil AN-O-3 Grade M, low temperature lubricating oil SAE 10 or 20	Temp. Con. Below 40° F. (4.4° C.) AAF Specification 3582 AN-O-3 Grade L AN-VV-O-366, hydraulic oil, petroleum base
Hub	AN-G-4 Grade AA, Aluminum soap grease	
Anti-seize on threads	AN-C-53, anti-seize compound, white lead base, for thread fittings.	

5. TROUBLE SHOOTING.

a. GENERAL.

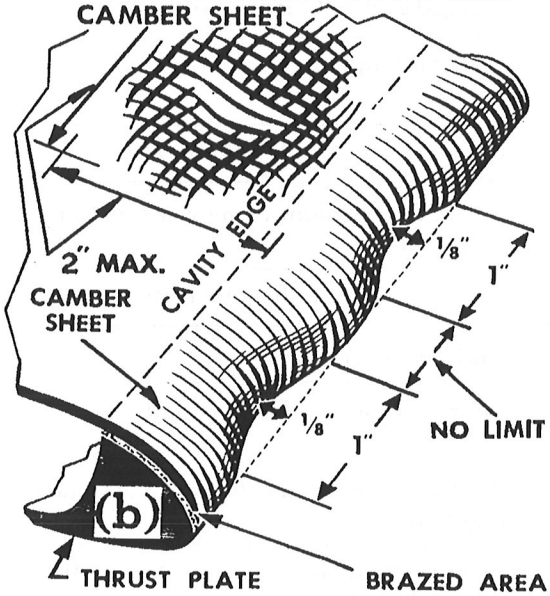
(1) Trouble shooting is relatively simple providing the mechanic has a thorough understanding of the principle of operation of the propeller and the functions of the parts involved. Careful analysis and complete checking of all details before attempting to draw conclusions will result in accuracy when trouble shooting. The following table outlines the troubles, causes, and corrections applicable to maintenance operations. A careful study and thorough understanding of this information coupled with practical experience will result in a fast and accurate determination and correction of difficulties encountered.



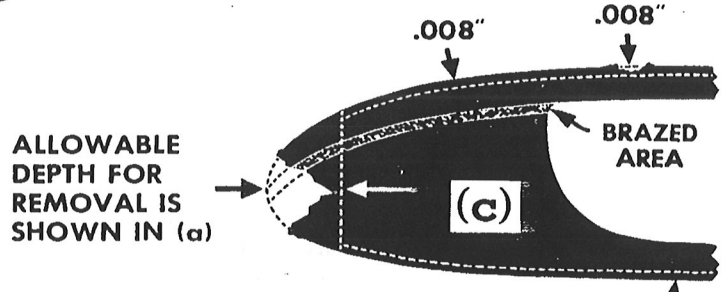
DIMENSIONS IN (a) INDICATE THE MAXIMUM DEPTH TO WHICH MATERIAL MAY BE REMOVED AT VARIOUS POINTS ALONG EDGES AND TIP OF BLADE. MATERIAL REMOVED FOR INDIVIDUAL NICKS MUST NOT EXCEED 1 INCH IN LENGTH. SEE (b). TOTAL LENGTH OF MATERIAL REMOVED TO 1/8 INCH DEPTH MUST NOT EXCEED 2 INCHES WITHOUT REBALANCING THE PROPELLER.

NOTE: DIMENSIONS GIVEN ARE FOR MAXIMUM REMOVAL AT POINTS SHOWN.

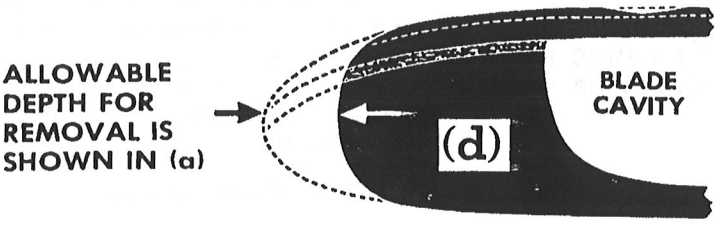
SEE MATERIAL REMOVAL CHART FOR MATERIAL REMOVAL DIMENSIONS ON THRUST PLATE AND CAMBER SHEET



(b) ENLARGED VIEW OF PROPERLY FAIRED OUT NICKS IN EDGE OF BLADE



(c) ENLARGED VIEW OF BLADE CROSS-SECTION SHOWS NICKS WHICH MIGHT OCCUR AT ANY POINT ALONG EDGES, AT TIP, OR ON THE THRUST PLATE OR CAMBER SHEET OF BLADE



(d) ENLARGED VIEW OF BLADE CROSS-SECTION SHOWS NICKS AFTER THEY HAVE BEEN FAIRED OUT TO MAXIMUM ALLOWABLE DEPTH

Figure 43—Blade Removal Limits

TROUBLE	PROBABLE CAUSE	REMEDY
MAXIMUM GOVERNING RPM TOO LOW	Insufficient engine power.	See engine handbook.
	Regulator fluid supply at improper level.	Check fluid level with the filler plug hole in horizontal position. Regulator should be half full.
	Insufficient control lever travel.	Disconnect and check the control lever and linkage for full travel.
	Tachometer reading incorrectly.	Repair or replace the tachometer.
	Propeller governor improperly adjusted.	Readjust governor.
MAXIMUM GOVERNING RPM TOO HIGH	Regulator fluid supply at improper level.	Check fluid level with the filler plug hole in horizontal position. Regulator should be half full.
	Tachometer reading incorrectly.	Repair or replace the tachometer.
	Propeller governor improperly adjusted.	Readjust governor.
SLUGGISH PROPELLER RESPONSE, HUNTING CONDITION, OVER-SPEEDING OR UNDER-SPEEDING	Insufficient hydraulic pressure.	Check fluid level. Regulator should be half full.
		Check regulator for contaminated fluid. If contaminated, remove regulator and rinse with specified hydraulic oil. Replace regulator and half fill with specified hydraulic oil.
		Remove external filter and check for clogged screen. Clean the screen.
	Blown pump or pressure control valve seals.	Remove propeller for overhaul.
	Governor not functioning properly.	Remove propeller for overhaul.
BINDING PROPELLER CONTROL LINKAGE	Control jammed or binding due to corrosion or heavy oil.	Check for freedom of movement. Correct trouble.
	Regulator control lever binding.	Remove propeller for overhaul.
HYDRAULIC FLUID ON BLADES OR SPINNER	Loose cover bolts.	Tighten cover bolts.
	Damaged or improperly installed cord seal.	Remove propeller for overhaul.
	Defective transfer seals.	Replace transfer seals between hub and regulator.
	Excessive clearance between hub and regulator.	Remove regulator and replace transfer seals in hub. Replace regulator, making certain clearance does not exceed .001-inch between hub and regulator.
	Leakage at filler plug.	Check and replace seals, if necessary.

TROUBLE	PROBABLE CAUSE	REMEDY
HYDRAULIC FLUID OR OIL ON REGULATOR COVER, AROUND ADAPTER PLATE, ON AIRPLANE NOSE COWLING OR SPINNER BULKHEAD	Engine reduction gear leak.	Repair reduction gear leak.
	Regulator fluid level too high.	Check regulator fluid level.
	Regulator housing or cover seals damaged.	Remove propeller for overhaul.
LEAKAGE WHEN PROPELLER IS STATIONARY BUT NOT IN FLIGHT	Regulator seals holding off, or cut.	Remove propeller for overhaul.
	Hydraulic fluid level above position of relief valve assembly.	Check regulator fluid level.
ROUGH OPERATION, EXCESSIVE VIBRATION	Engine operation unsatisfactory or loose engine mount bolts.	Check engine mount bolts.
	Propeller unbalanced.	Remove propeller for overhaul.
	Loose shaft nut.	Tighten shaft nut.
	Blade angles not same on all blades.	Check blades for uniformity of angle.
GREASE OR REGULATOR FLUID APPEARS AT HUB RELIEF FITTING	Defective torque unit seals.	Remove propeller for overhaul.
	Leak at fixed spline gasket caused by loose fixed spline bolt, or damaged fixed spline gasket.	Remove propeller for overhaul.
FAILURE TO CHANGE BLADE ANGLE	Lack of fluid in regulator.	Check fluid level. Regulator must be half-full.
	Insufficient hydraulic pressure.	Remove propeller for overhaul.
	Governor not functioning.	Remove propeller for overhaul.

SECTION VI

DISASSEMBLY, CLEANING, INSPECTION, REPAIR AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED.

The following is a list of tools required in connection with the work described in this section. *(See figure 44.)*

Part No.	*Nomenclature*	*Application*
6500668	Wrench Assembly—Fixed Spline Bolt	Removing and Installing Fixed Spline Bolt
6500674	Indicator—Piston Aligner	Indexing of Torque Piston to Cylinder
6511021	Aligner—Torque Cylinder	Aligning Cylinder to Blade Gear
6500591	Wrench Assembly—Control Screw	Removing and Installing Control Screw
6500075	Bleeder Assembly—Hub Socket Air	Relieve Trapped Air from the Hub when Greasing
6500069	Wrench Assembly—Blade Retaining Nut	Removing and Installing Blade Retaining Nut
6510105	Wrench—Regulator Nut	Removing and Installing Regulator Nut
6500601	Fixture Assembly—Piston Head Assembly	Disassembling and Reassembling Blade Piston Assembly
6500523	Puller Assembly—Piston	Removing and Installing Blade Piston Assembly
6510600	Template—A20 Blade	Measuring Blade Angles

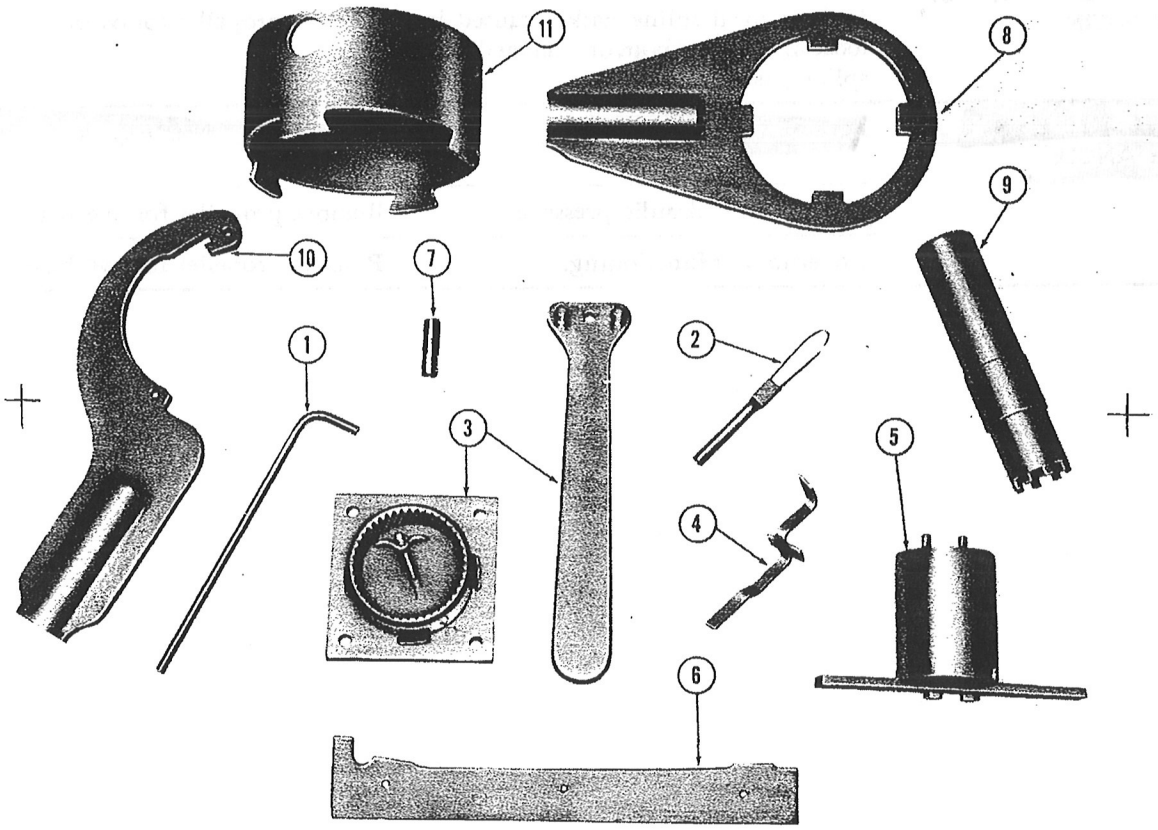


Figure 44—Overhaul Tools

1. Cylinder Assembly Aligner
2. Hub Socket Bleeder Assembly
3. Piston Head Assembling Fixture Assembly
4. Cylinder Aligner Indicator Assembly
5. Piston Puller Assembly
6. Blade Template
7. Control Screw Wrench
8. Propeller Shaft Nut Wrench Assembly
9. Fixed Spline Bolt Wrench Assembly
10. Blade Retaining Nut Wrench Assembly
11. Regulator Nut Wrench Assembly

2. GENERAL.

a. The following pages relating to the disassembly, cleaning, inspection, repair and reassembly of the various propeller parts are subdivided into these major sections.

(1) Regulator unit.

(2) Hub and blade assemblies.

b. Proper equipment should be available and made ready before actual disassembly is started. Such equipment includes a hoist and lifting slings for the complete propeller, proper hand tools and special tools, receptacles for parts, work bench or table, compressed air and cleaning fluid.

c. While handling any part of an aircraft propeller, extreme care must be used to prevent damage. The slightest nicks, dents, or cracks may very easily be the cause of operational failure. Any part so damaged must be replaced, or undergo repair and rigid inspection before reuse.

d. To guard against such damage, as well as to save time and prevent loss, suitable containers must be available in which to place small parts, nuts, bolts, etc. during the disassembly operation.

e. Other important rules to observe are as follows:

(1) Dispose of all safety devices as they are removed. Never use safety wire or cotter pins a second time; always replace with new.

(2) Always use the proper tool and one that best fits the job.

(3) Use special tools where they are required.

(4) When cleaning interior parts of the propeller, never use cleaning rags that may leave a deposit of lint or other foreign material. Always wash parts with approved cleaning fluid and dry with compressed air.

(5) Never use gasket compound on any sealing surface of the propeller or regulator.

(6) Replace all gaskets and seals with new ones.

3. DISASSEMBLY.

a. REMOVAL OF REGULATOR.

(1) Support the propeller in a dolly or place on a padded floor with the regulator side up.

(2) Insert the regulator nut wrench in the regulator nut. *(See figure 45.)* Set the dovetail lobes of the wrench into the regulator nut.

(3) Loosen the regulator nut. The regulator nut has a *left-hand thread.* Use a 4-foot bar through the wrench and turn clockwise to loosen. *(See figure 46.)* Hold the wrench securely in the dovetails so that the

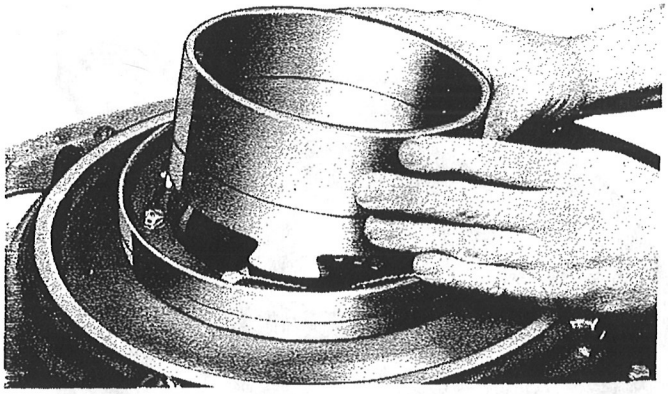


Figure 45—Installing Regulator Nut Wrench

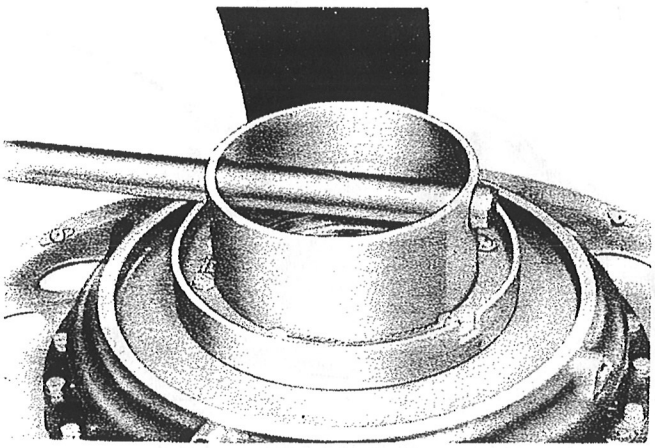


Figure 46—Loosening Regulator Nut

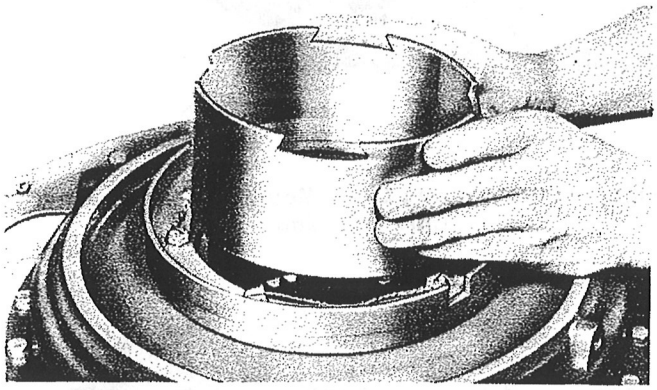


Figure 47—Removing Regulator Nut

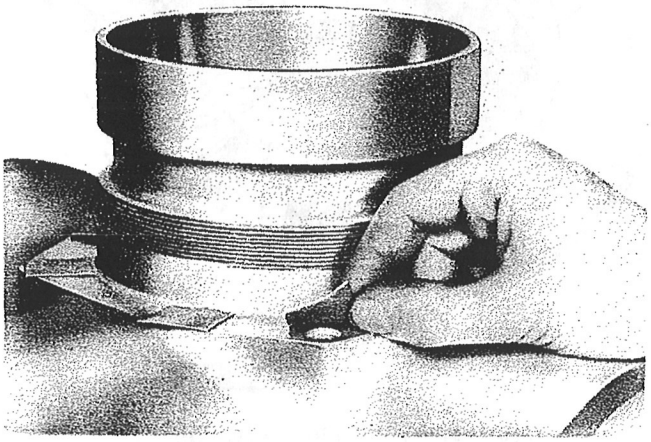


Figure 48—Covering Hub Transfer Ports

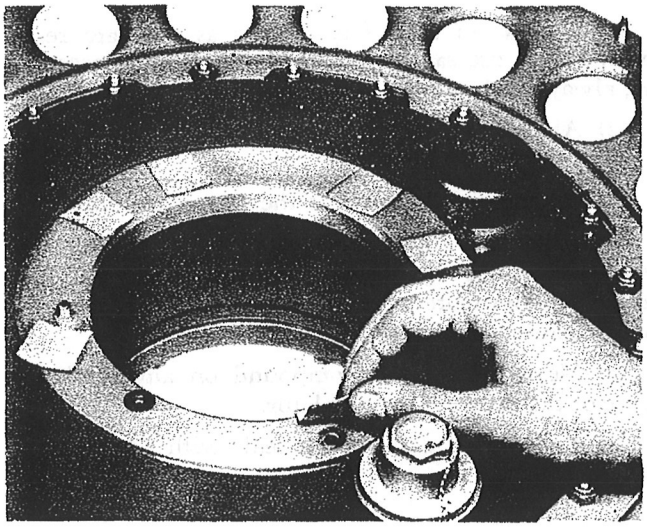


Figure 49—Covering Regulator Transfer Ports

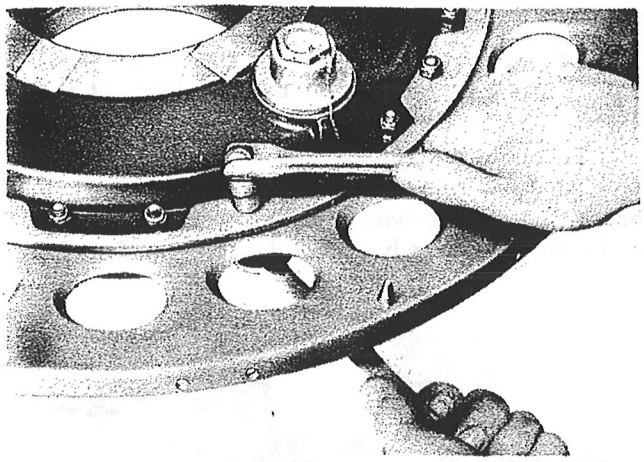


Figure 50—Removing Cover Mounting Bolts which Hold Bulkhead

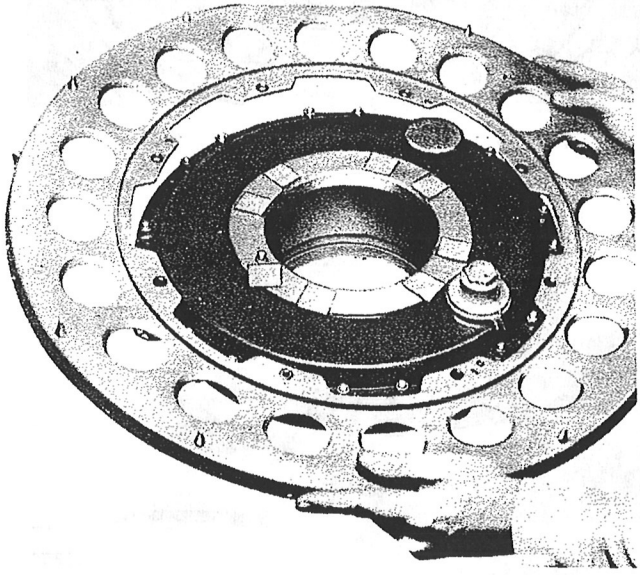


Figure 51—Removing Bulkhead

wrench will not slip out of place. Lift the regulator nut out when free of the hub threads. *(See figure 47.)*

(4) Lift the regulator off the hub of the propeller. The regulator has a close fit to the hub and will bind if cocked or tilted. If the regulator binds, tap it back in place, using the hands or a soft-faced mallet. Do not pry the regulator.

(5) Remove the transfer seals from the hub.

(6) Cover the transfer ports of both the hub and regulator with masking tape. *(See figures 48 and 49.)* This is done to prevent dirt from entering the hydraulic system.

b. DISASSEMBLY OF THE REGULATOR.

(1) Remove the eight cover mounting bolts and nuts which retain the spinner bulkhead in place. *(See figure 50.)*

(2) Remove the spinner bulkhead. *(See figure 51.)*

(3) Remove the safety wire and remove the six adapter plate bolts. *(See figure 52.)*

(4) Remove the regulator adapter plate. *(See figure 53.)*

(5) Remove the control lever. *(See figure 54.)*

(6) Remove the control screws. Turn the control screws counterclockwise until they are clear of the control ring. *(See figure 55.)*

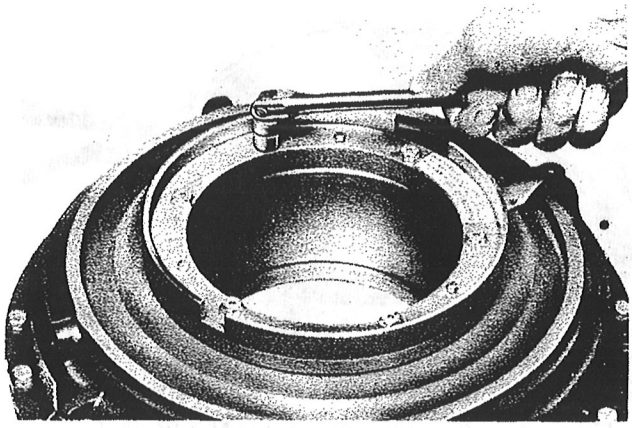


Figure 52—Removing Adapter Plate Bolts

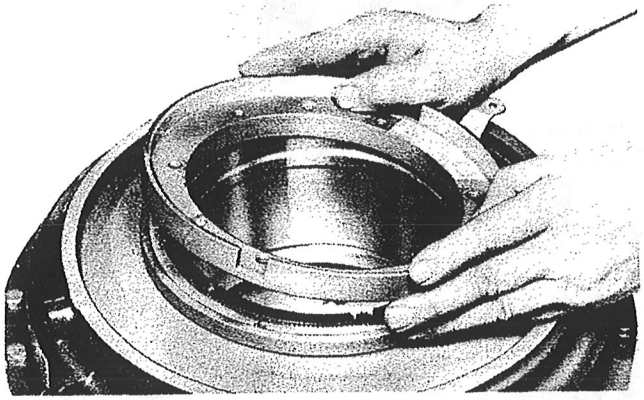


Figure 53—Removing Adapter Plate

(7) Remove the adapter ring assembly *(figure 56)* and adapter gasket.

(8) Disassemble the adapter ring by removing the cup washer, spring, flat washer and "O" ring seal from each of the control screw holes. *(See figure 57.)*

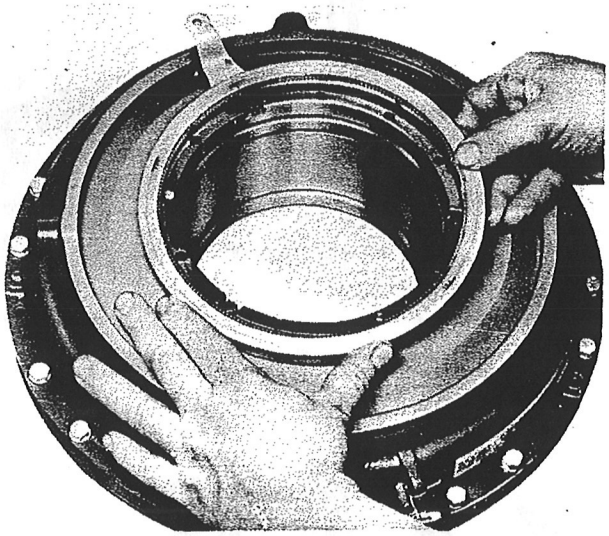


Figure 54—Removing Control Lever

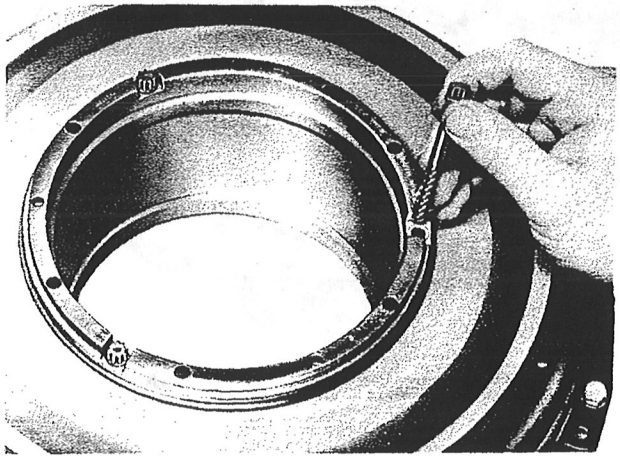


Figure 55—Removing Control Screws

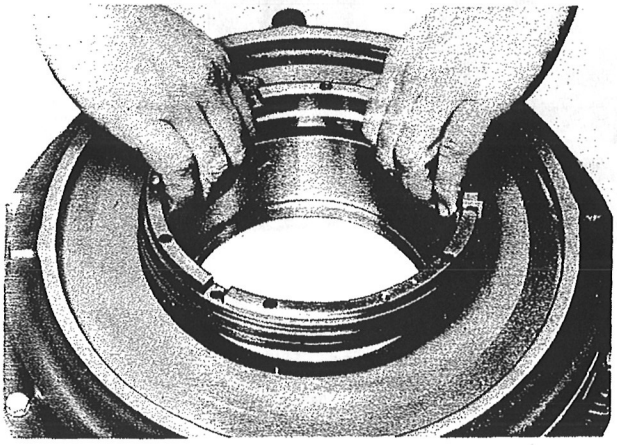


Figure 56—Removing Adapter Ring

CAUTION

The relief valve assembly may be removed from the adapter ring by tapping with a punch if replacement is necessary. *Do not remove unless replacement is necessary.*

(9) Remove the remaining cover bolts, nuts, and washers. *(See figure 58.)*

(10) While holding the regulator, tap the dowel with a soft-faced mallet to loosen the regulator cover from the housing. *(See figure 59.)*

(11) Lift the cover from the housing. *(See figure 60.)*

(12) Cut the safety wire and remove the cover bearing mounting screws. *(See figure 61.)*

(13) Lift the cover bearing from the cover. *(See figure 62.)* Thoroughly clean, dry and inspect for possible damage and defects.

(14) Remove the regulator cover seal and spring. Use the hands only. Do not distort the seal. *(See figure 63.)*

(15) Remove the spring from the cover seal.

(16) Remove the cord seal from the groove in the regulator housing. *(See figure 64.)*

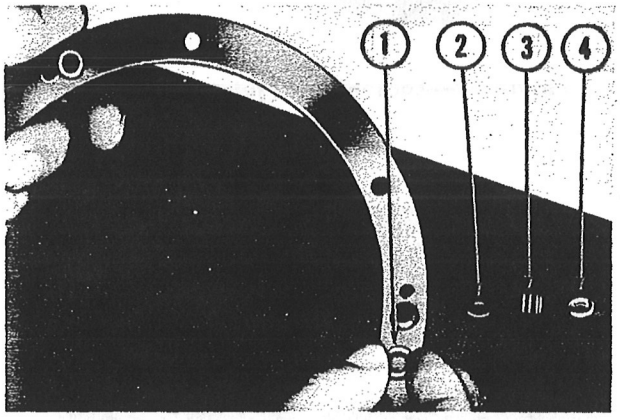


Figure 57—Removing Control Screw Seals

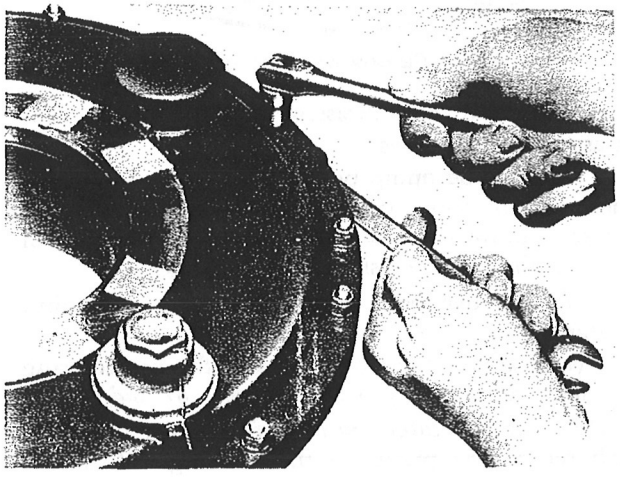


Figure 58—Removing Cover Bolts

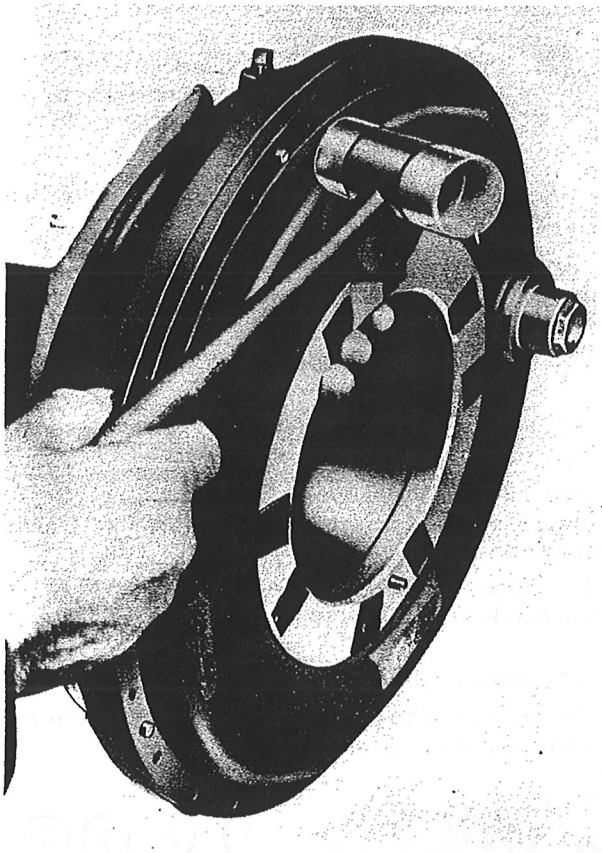


Figure 59—Loosening Regulator Cover

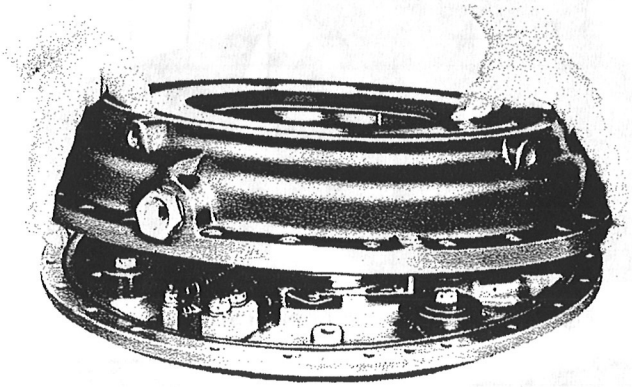


Figure 60—Removing Regulator Cover

(17) Remove and disassemble the pump power gear assembly as follows:

(a) Lift the pump power gear assembly until it is clear of the regulator housing bearing and pump gear; then move it sideways to disengage the control ring from the governor shoe. *(See figure 65.)*

(b) Remove the "C" washers from the stop pins. *(See figure 66.)*

(c) Remove the stop pins and the control ring from the pump power gear. *(See figures 67 and 68.)*

(18) Cut the safety wire and remove the bolts which secure the pump to the housing. Withdraw the pump. *(See figure 69.)*

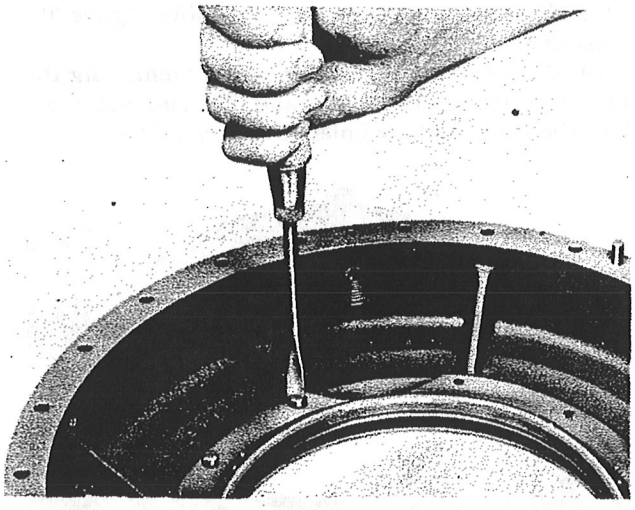


Figure 61—Removing Cover Bearing Screws

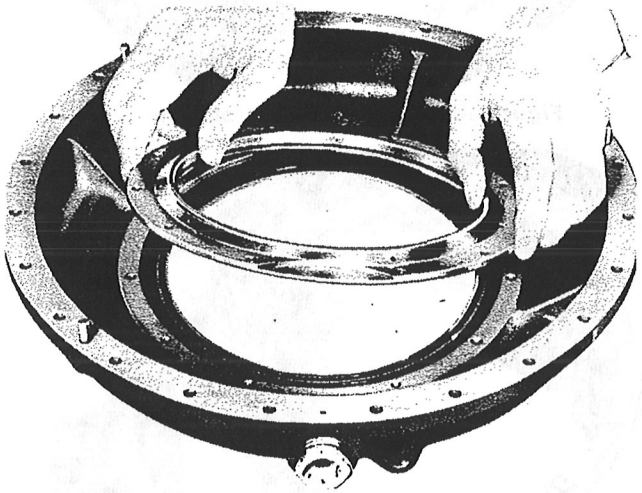


Figure 62—Removing Cover Bearing

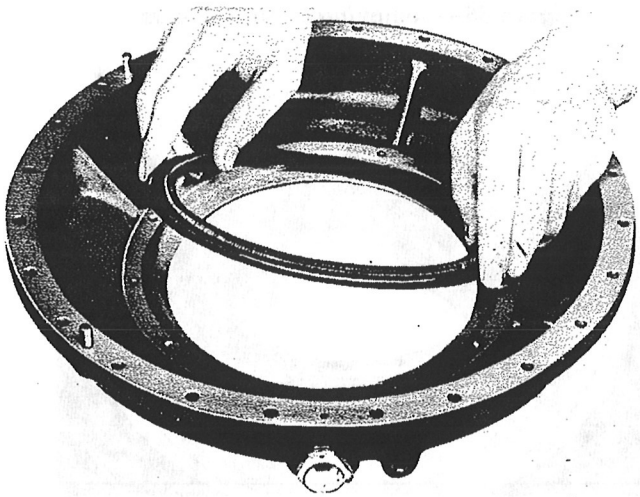


Figure 63—Removing Cover Seal

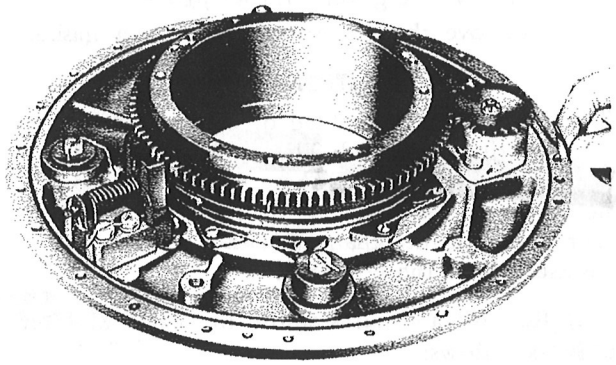


Figure 64—Removing Cord Seal

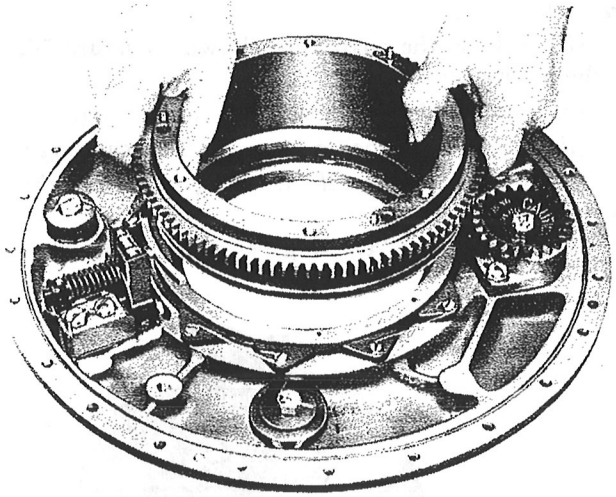


Figure 65—Removing Pump Power Gear

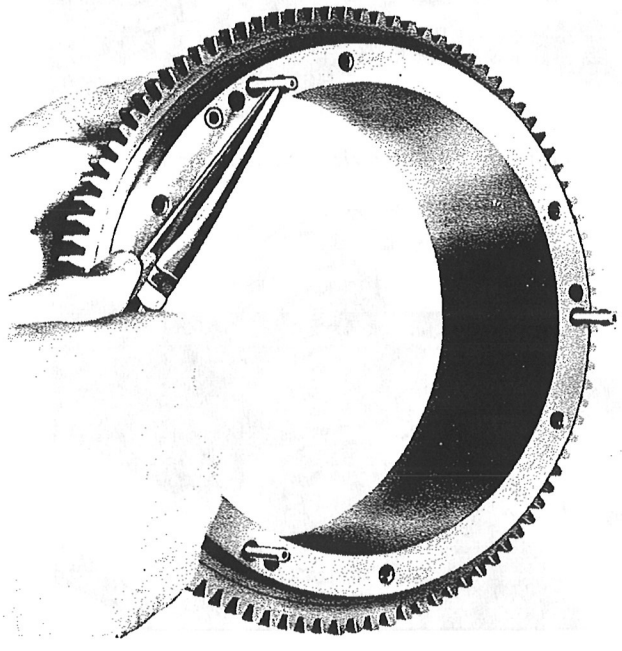


Figure 66—Removing "C" Washers

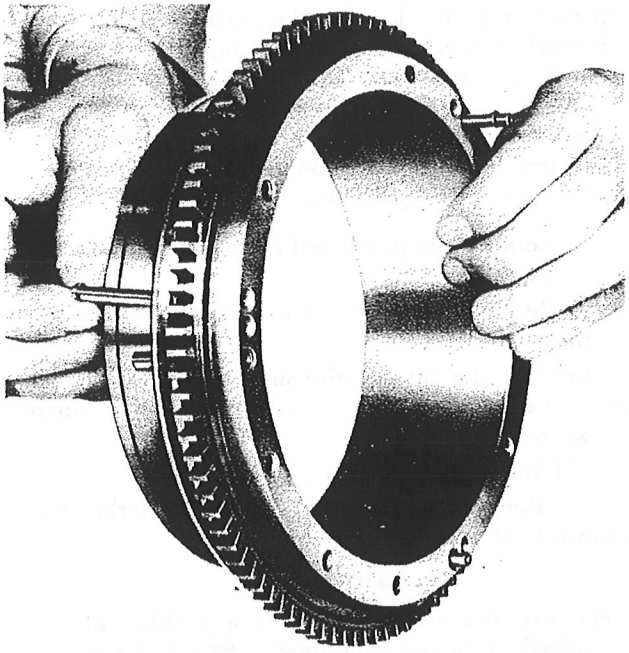


Figure 67—Removing Stop Pins

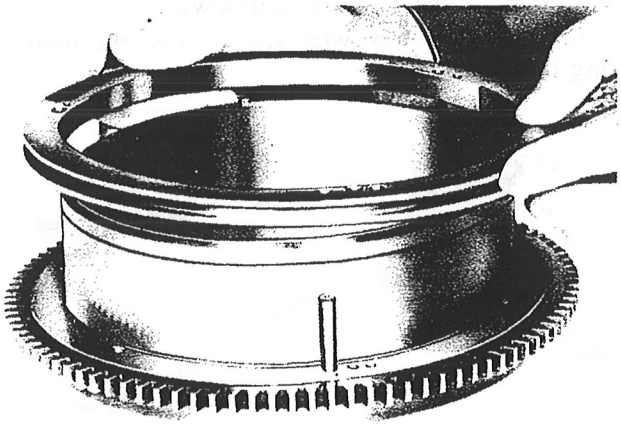


Figure 68—Removing Control Ring

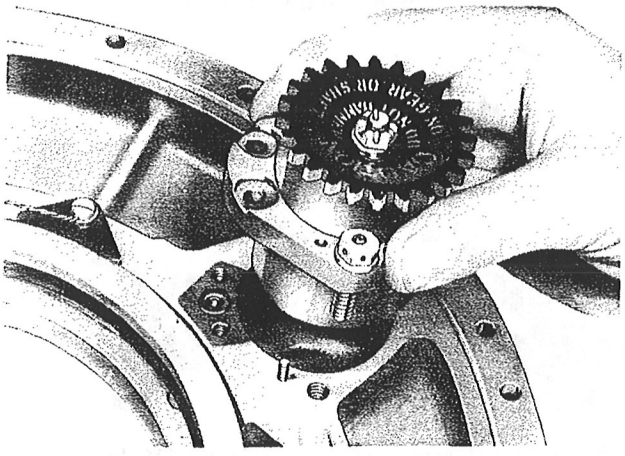


Figure 69—Removing the Pump

CAUTION

In case of pump damage, the entire assembly should be replaced. In case the pump drive gear only is damaged, the pump drive gear should be replaced. *Do not hammer on the gear or pump drive shaft.* A screw driver may be used as a pry beneath the shoulder of the pump drive gear. *(See figure 70.)*

(19) Remove the pump seal from the recess in the regulator housing.

(20) Remove the pressure control valve as follows: *(See figure 71.)*

(a) Cut the safety wire and remove the bolts securing the pressure control valve, using a 7/16-inch socket wrench.

(b) Remove the pressure control valve.

(c) Remove the "O" ring packings from the pressure control valve housing.

CAUTION

The pressure control valve is assembled of matched parts and functionally tested; therefore, the pressure control valve must not be disassembled.

(21) Remove the governor as follows:

(a) Cut the safety wire and remove the bolts securing the governor.

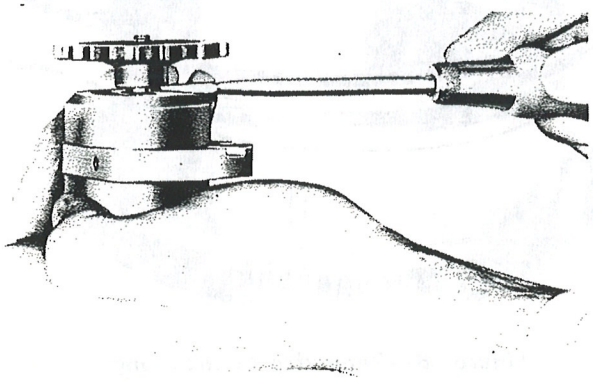


Figure 70—Removing Pump Gear

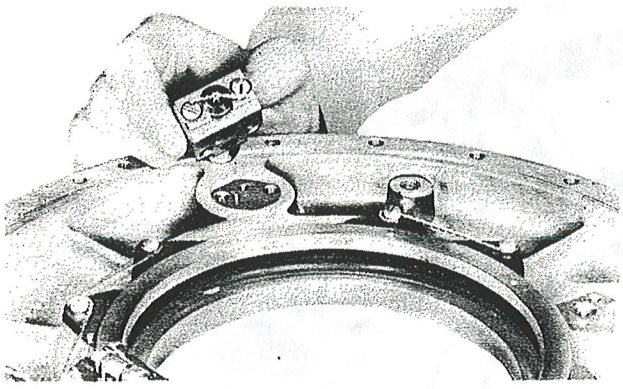


Figure 71—Removing Pressure Control Valve

(b) Remove the governor. *(See figure 72.)*

(c) Remove the governor filter screen gasket.

CAUTION

The governor is assembled of matched parts and functionally tested. The governor should never be disassembled. These stipulations do not apply to the governor spring which may be replaced or interchanged without complete disassembly of the governor.

(22) Remove and disassemble the external filter assembly as follows:

(a) Cut the safety wire and turn the filter assembly counterclockwise with a 1-inch socket wrench until free of the regulator housing. Remove the filter. *(See figure 73.)*

(b) Release the snap ring shown in figure 74, from the filter assembly.

(c) Remove the filter cartridge and spring.

(d) Remove the spring from the filter cartridge.

(e) Remove the small "O" ring seal from the end of the filter cartridge.

(f) Remove the "O" ring gasket from the filter cap.

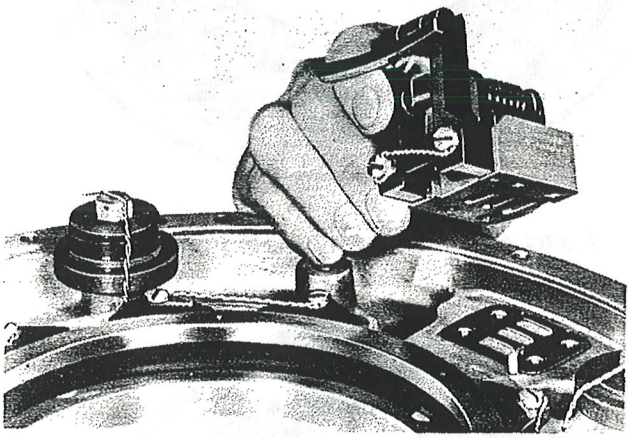


Figure 72—Removing the Governor

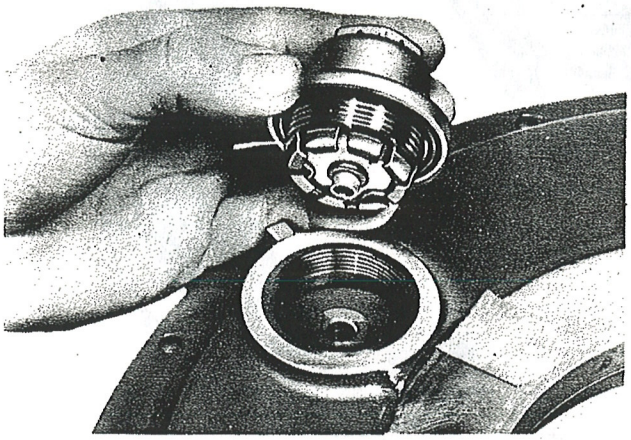


Figure 73—Removing Filter Assembly

(23) Remove the housing bearing as follows:

(a) Cut the safety wire and unscrew the bearing mounting screws holding the housing bearing retention plates to the housing.

(b) Remove the housing bearing retention plates. *(See figure 75.)*

(c) Remove the housing bearing. *(See figure 76.)*

(d) Remove the housing seal and spring and the regulator washer, using the hands only. *(See figure 77.)*

(e) Remove the spring from the seal.

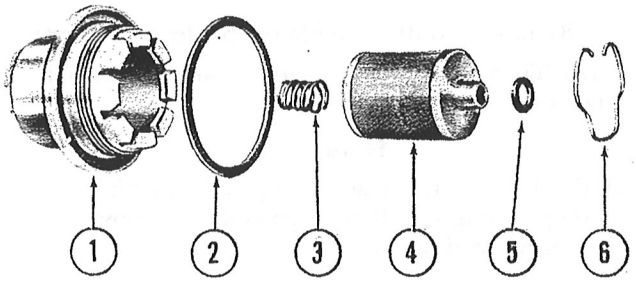


Figure 74—Cartridge Filter Assembly

1. Filter Cap
2. "O" Ring Hydraulic Gasket
3. Spring
4. Filter Cartridge
5. Seal
6. Snap Ring

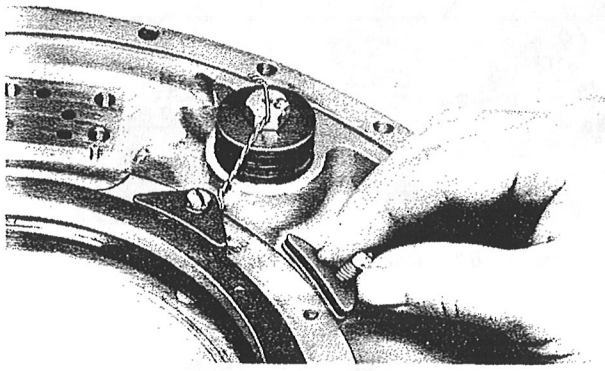


Figure 75—Removing Housing Bearing Retention Plates

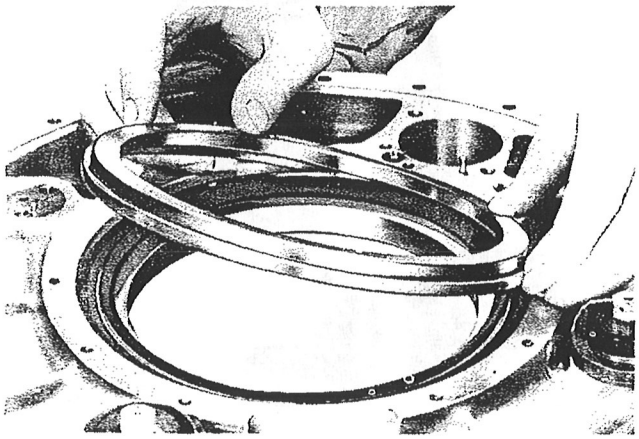


Figure 76—Removing Housing Bearing

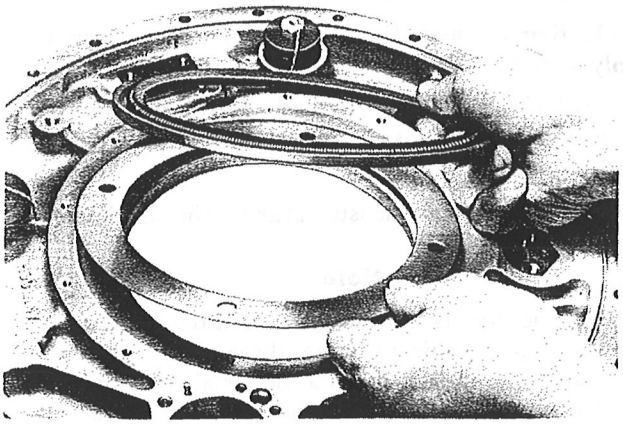


Figure 77—Removing Housing Seal and Washer

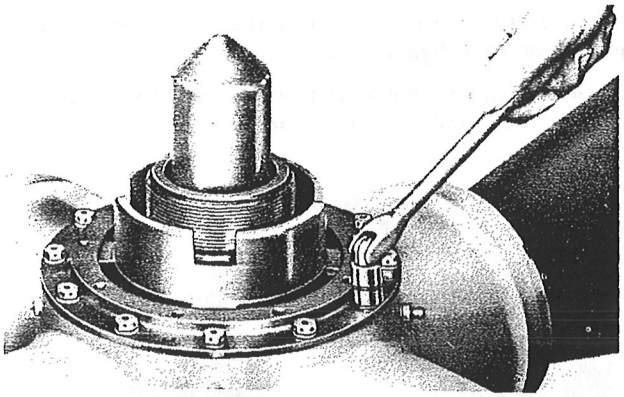


Figure 78—Removing Master Gear Retaining Plate Bolts

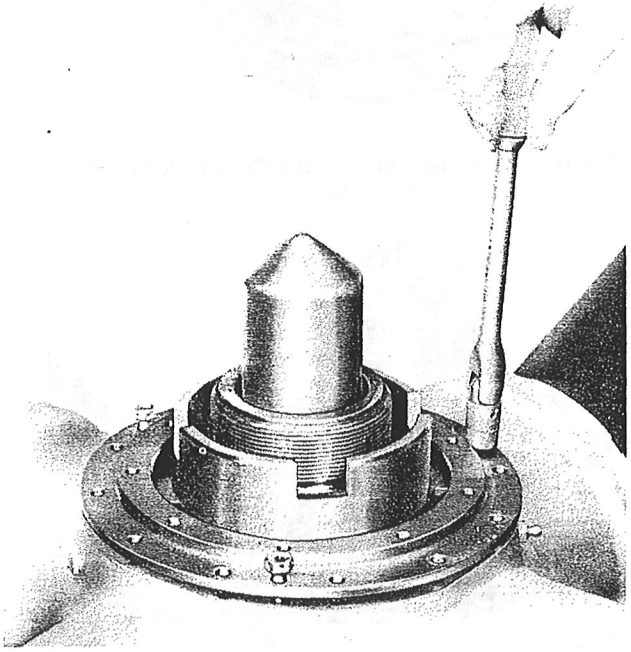


Figure 79—Removing Master Gear Retaining Plate (Using Bolts as Pullers)

c. DISASSEMBLY OF THE HUB AND BLADES.

(1) Remove and disassemble the master gear assembly as follows:

(a) Cut the safety wire and remove the bolts and washers holding the master gear retaining plate in place. *(See figure 78.)*

(b) Remove the master gear retaining plate.

Note

If difficulty is encountered removing the master gear retaining plate, three master gear retaining plate bolts should be installed in the threaded puller holes in the master gear retaining plate. Draw evenly on the bolts to remove the plate. *(See figure 79.)*

(c) Remove the seal from the master gear retaining plate. *(See figure 80.)*

(d) Remove the master gear and the master gear shim. Do not discard this shim. *(See figures 81 and 82.)*

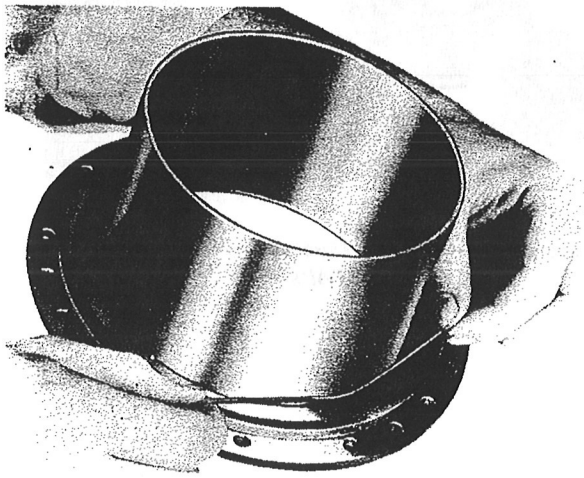


Figure 80—Removing Master Gear Retaining Plate Seal

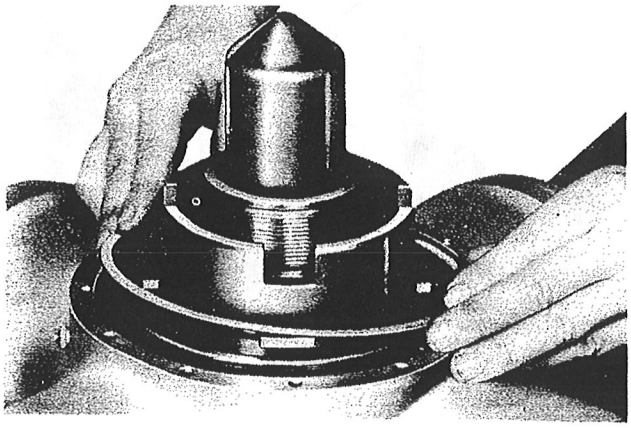


Figure 81—Removing Master Gear Shim

Note

Do not remove the snap ring from the master gear unless it is necesary to replace the master gear bearing balls or bearing race. The bearing balls are not retained in a cage. Removal of the snap ring will allow the balls to fall free from the bearing race.

(2) Remove the front cone snap ring.

(3) Withdraw the propeller shaft nut, using caution not to drop or damage the cone halves. *(See figure 83.)*

(4) Remove and disassemble the blades as follows:

(a) Turn the propeller blades to an intermediate angle position.

Note

If the blades are turned completely to high angle position, it will be impossible to remove the torque cylinder head.

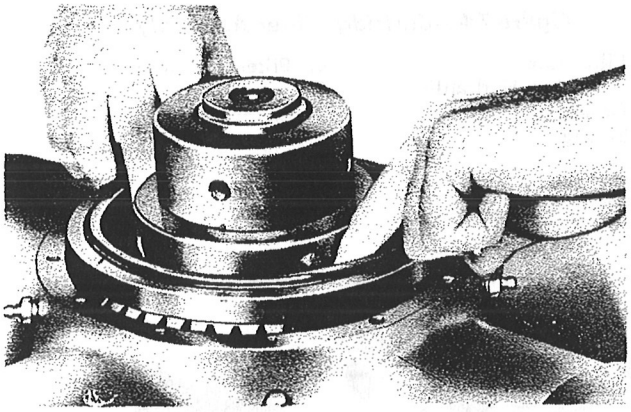


Figure 82—Removing Master Gear

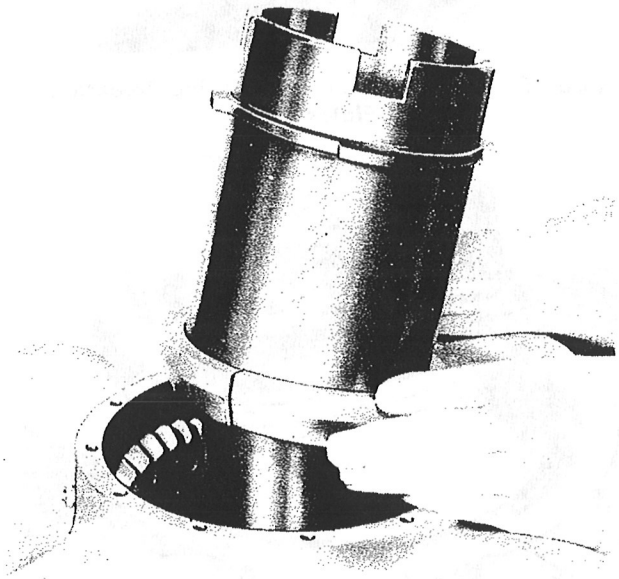


Figure 83—Removing Shaft Nut and Front Cone

(b) Cut the safety wire and remove the blade retaining nut lock and the balance weights. *(See figure 84.)* Mark the castellations of both the blade retaining nut and the hub socket so that the blade retaining nut lock and the balance weights may be returned to their proper place.

(c) Unscrew the blade retaining nut. Use a 4-foot bar in the blade retaining nut wrench and turn counterclockwise until the nut is clear of the socket threads. *(See figure 85.)*

(d) Withdraw the propeller blade from the socket. Use the hands only. Shake the propeller blade to loosen the dowels. Use caution to prevent the root of the propeller blade from damaging the torque cylinder of the hub socket threads.

(e) Place the blade on a bench with the thrust side down so that the blade will lie firmly. Be sure that the stack bearings and the blade retaining nut are over the edge of the bench to protect the blade retaining nut threads from being burred, and keep dirt from the stack bearings.

(f) Remove the cotter pin and unscrew the blade nut lock. *(See figure 86.)*

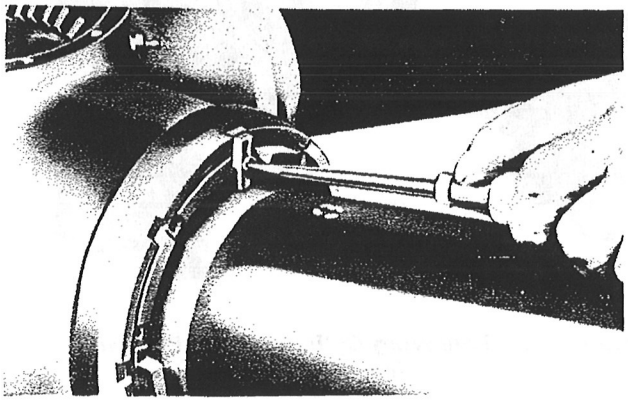


Figure 84—Removing Blade Retaining Nut Lock

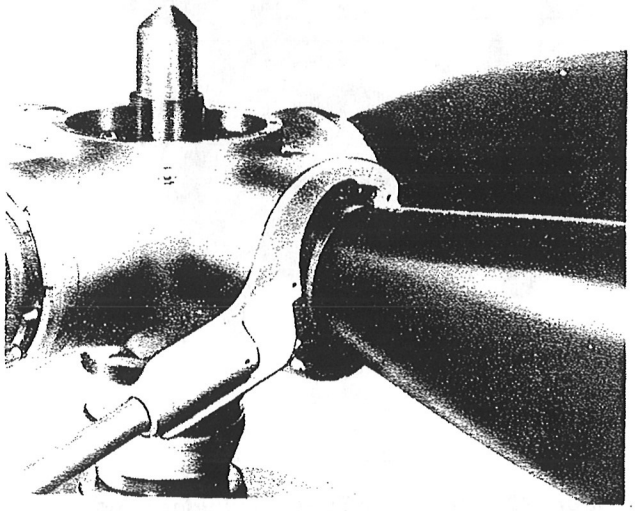


Figure 85—Removing Blade Retaining Nut

(g) Remove the blade nut. Turn with the hands.

(h) Slide the stack bearings off the blade. *(See figure 87.)* Tap the inner race with a mallet and fiber drift if the bearings are tight.

(i) Slide the blade retaining nut off the blade. Use caution to prevent damage to the grease seal.

(j) Remove the snap ring from the blade retaining nut.

(k) Remove the blade retaining nut seal.

(l) Remove the springs from the seal.

(5) Remove and disassemble the torque units as follows:

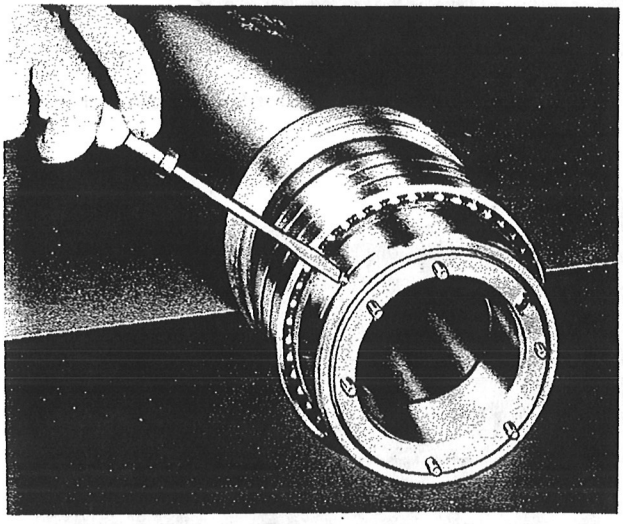


Figure 86—Removing Blade Nut Lock

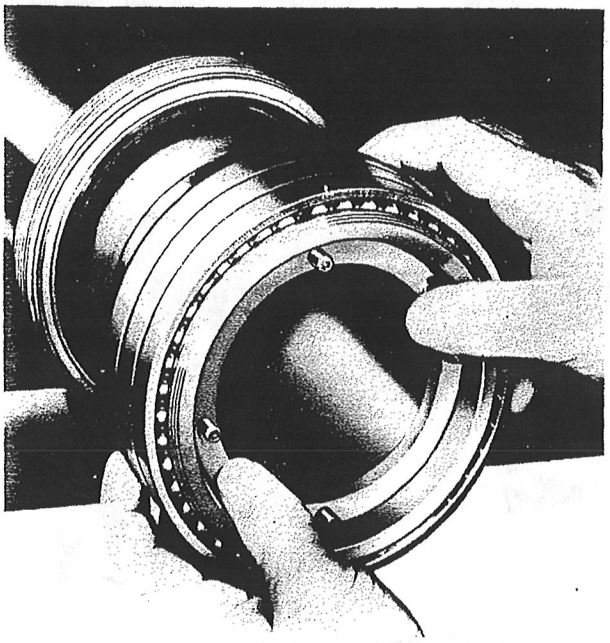


Figure 87—Removing Blade Bearings

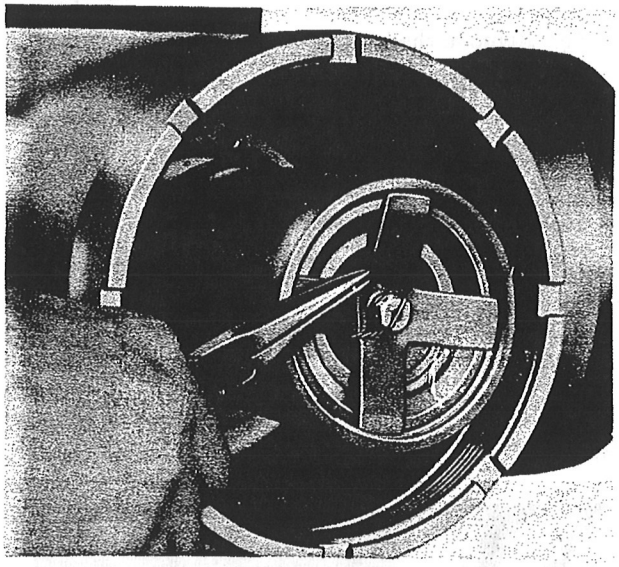


Figure 88—Removing Cylinder Head Retainer

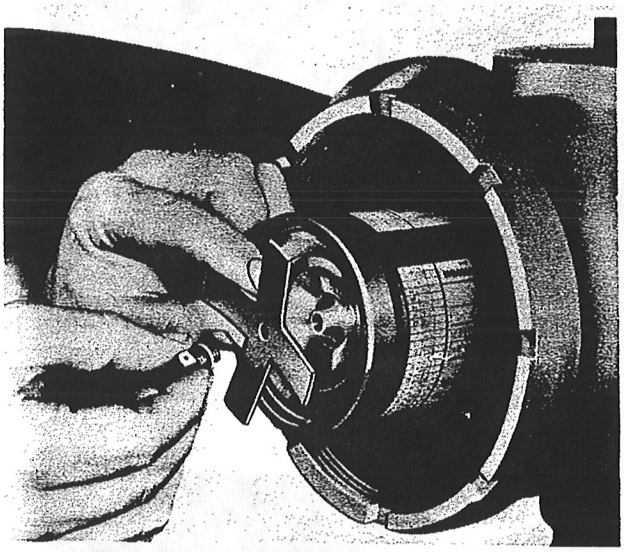


Figure 89—Removing Cylinder Head Retainer

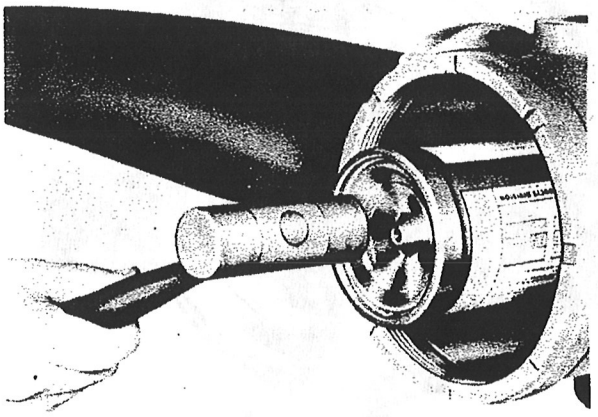


Figure 90—Removing Cylinder Head

(a) Cut the safety wire and remove the ¼-inch x 28 bolt which secures the torque cylinder head retainer on the cylinder head. *(See figure 88.)*

(b) Remove the cylinder head retainer from the cylinder head. *(See figure 89.)*

(c) To facilitate the torque cylinder head removal, tap the torque cylinder head away from the head retaining snap ring with a soft-faced mallet. *(See figure 90.)* Do not move inward more than ⅛ inch to avoid damage to fixed spline bolt tube.

(d) Remove the head retaining snap ring. *(See figure 91.)*

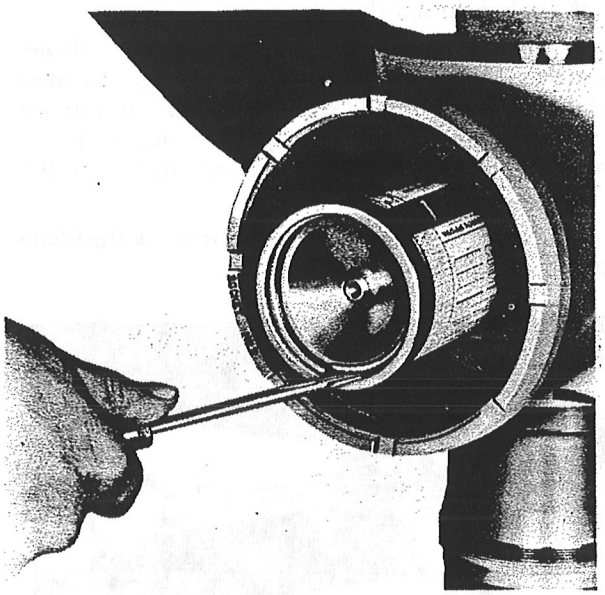


Figure 91—Removing Cylinder Head Retaining Snap Ring

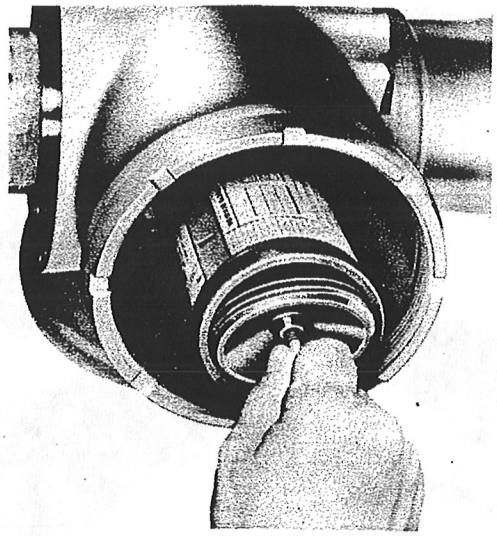


Figure 92—Removing Torque Cylinder Head

(e) Insert a ¼-inch x 28 bolt in the threaded boss of the torque cylinder head and pull out the torque cylinder head, using the hand. *(See figure 92.)*

(f) Remove the seal retaining snap ring from the torque cylinder head and remove the torque unit seal. *(See figure 93.)*

CAUTION

Use caution in removing the seal from the cylinder head to prevent breaking the phenolic rings of the torque unit seal.

(g) To prevent the piston from coming out past the end of the torque cylinder, install the head retaining snap ring. Install piston puller assembly as shown in figure 94, and pull the piston out against the retaining ring. Note and record the piston index markings. Piston teeth are numbered on the piston head. *(See figure 95.)* Note the tooth number which lines up with the torque cylinder index mark. Check one number against the other. Remove the head retaining snap ring from the cylinder.

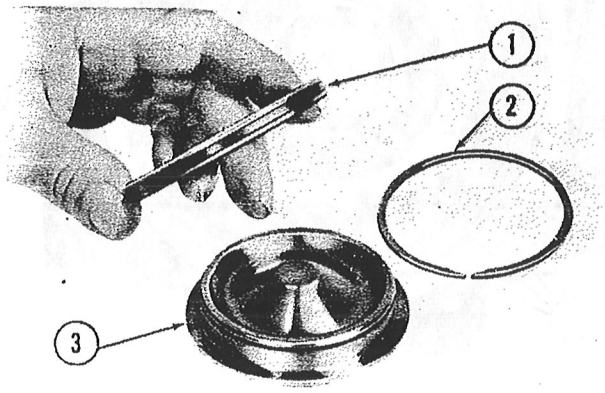


Figure 93—Disassembly of Torque Cylinder Head

1. Torque Unit Seal
2. Snap Ring
3. Cylinder Head

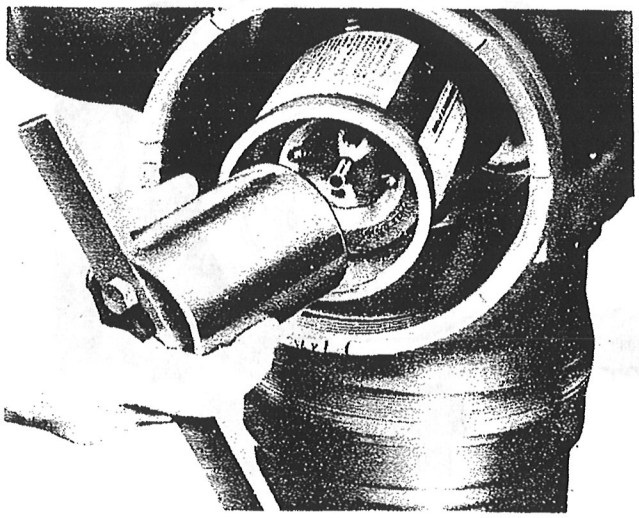


Figure 94—Installing Piston Puller Assembly

Note

For proper identification, socket numbers are stamped on the piston head.

(h) Remove and disassemble the torque piston.

1. Remove the piston pin. *(See figure 96.)*

2. Unscrew the head of the piston from the piston skirt. *(See figure 97.)*

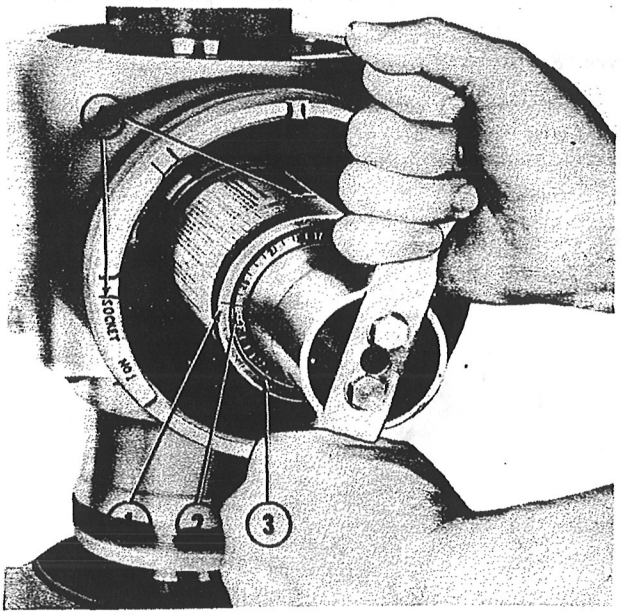


Figure 95—Removing Torque Piston

1. Note Index Mark on Cylinder
2. Note Tooth Number on Piston Head
3. Snap Ring Installed
4. Note Socket Number Identification

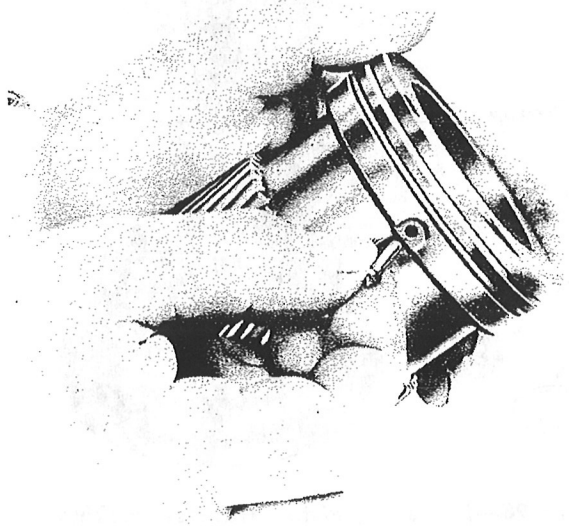


Figure 96—Removing Piston Pin

3. Remove cylinder seal assembly from the piston head.

CAUTION

Use caution in removing the seal from the torque piston head to prevent breaking the phenolic rings of the torque unit seal.

4. Remove the transfer gland snap ring from the piston.

5. Unscrew piston transfer packing gland.

6. Remove the piston transfer packing. *(See figure 98.)*

(i) Remove the four fillister headed screws and carefully remove the torque cylinder. *(See figure 99.)* Note the socket number stenciled on the cylinder.

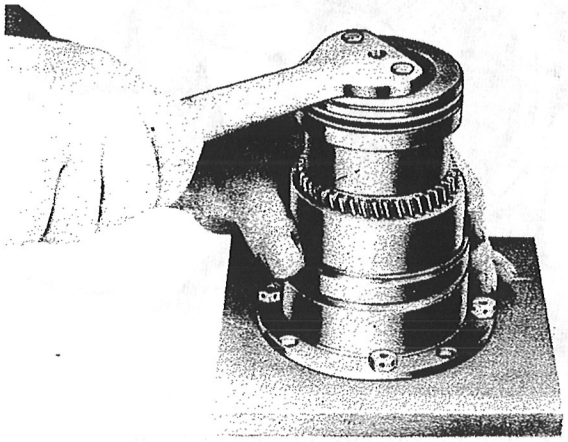


Figure 97—Removing Piston Head

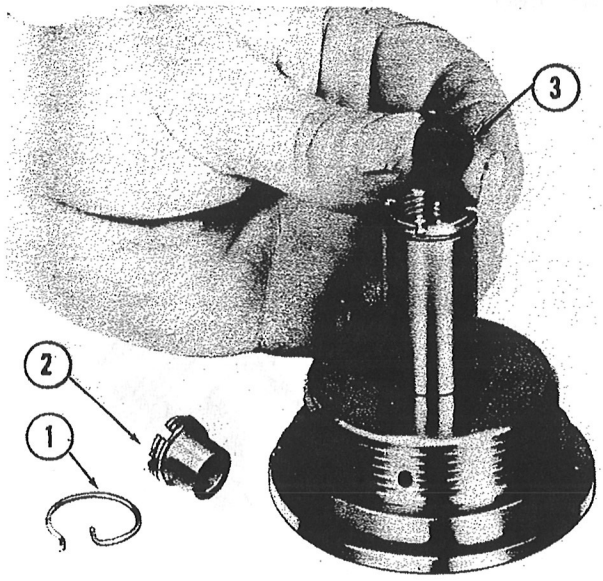


Figure 98—Removing Piston Transfer Packing

1. Snap Ring
2. Transfer Packing Gland
3. Transfer Packing

(j) Remove the torque unit seal and the seal retaining washer from the fixed spline. *(See figure 100.)*

CAUTION

To prevent breaking the phenolic rings of the cylinder seal assembly, use caution in removing the seal from the fixed spline.

(k) Remove the "O" ring gasket from the outside of the torque cylinder. *(See figure 101.)*

(l) Unlock the fixed spline bolt lock by straightening the tang of the fixed spline bolt lock with a narrow-tipped screw driver. *(See figure 102.)*

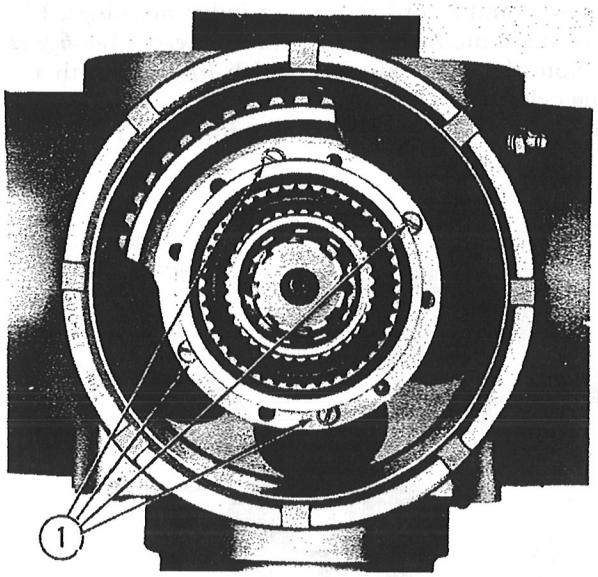


Figure 99—Removal of Torque Cylinder

1. Remove the four screws

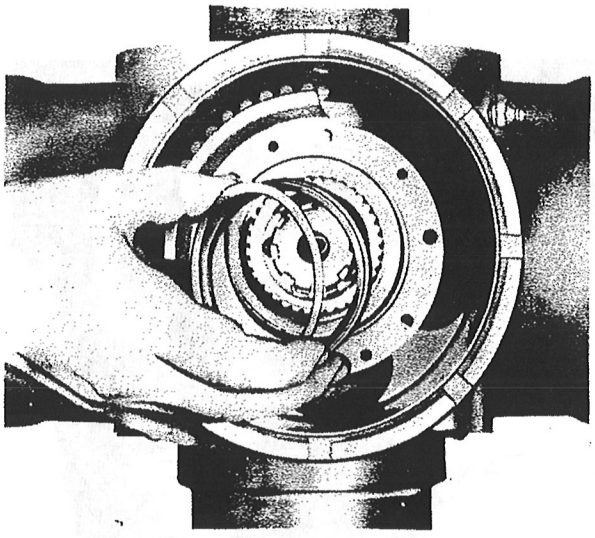


Figure 100—Removing Torque Unit Seal and Washer

(m) Loosen the fixed spline bolt using a special fixed spline bolt wrench and bar. Turn the fixed spline bolt counterclockwise until it is free. *(See figure 103.)*

(n) Withdraw the fixed spline bolt, the fixed spline bolt washer and the fixed spline bolt lock. *(See figure 104.)*

(o) Remove the fixed spline and gasket. *(See figure 105.)* The fixed spline may be loosened from the hub by inserting the handle of a mallet and carefully jarring the fixed spline. Each fixed spline is marked with its proper socket number.

Figure 101—Removing Torque Cylinder "O" Ring Gaskets

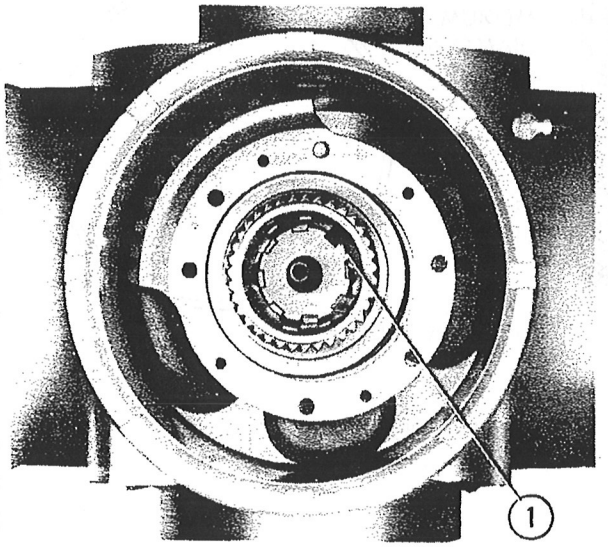


Figure 102—Unlocking the Fixed Spline Bolt

1. Straighten this tang.

(p) Remove the preload bearing. Note that the words "CRANKSHAFT SIDE" which are stamped on the inner race go to the blade gear.

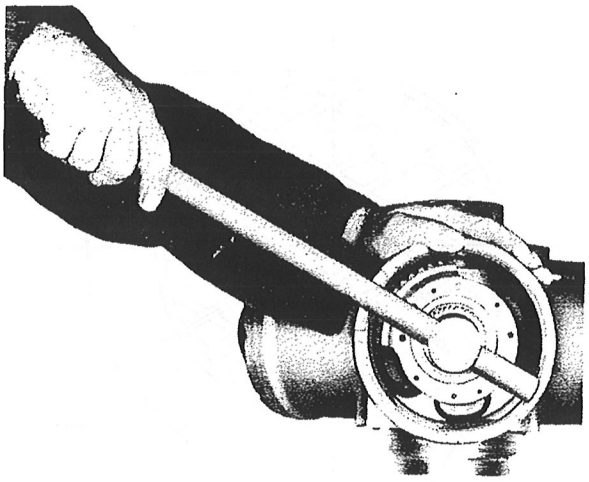


Figure 103—Loosening Fixed Spline Bolt

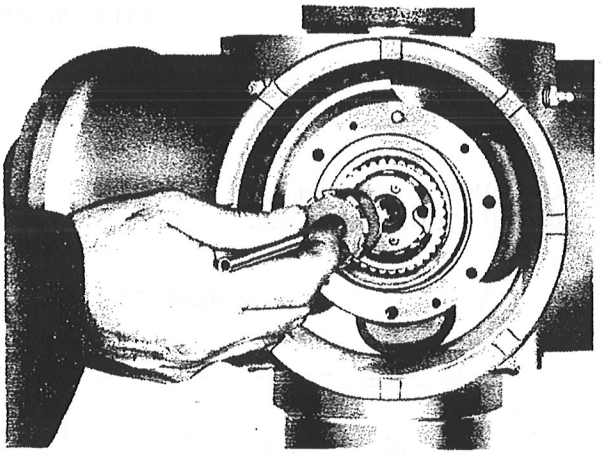


Figure 104—Removing Fixed Spline Bolt

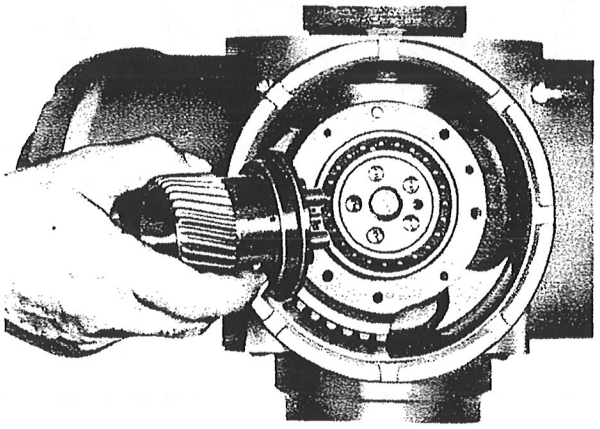


Figure 105—Removing Fixed Spline

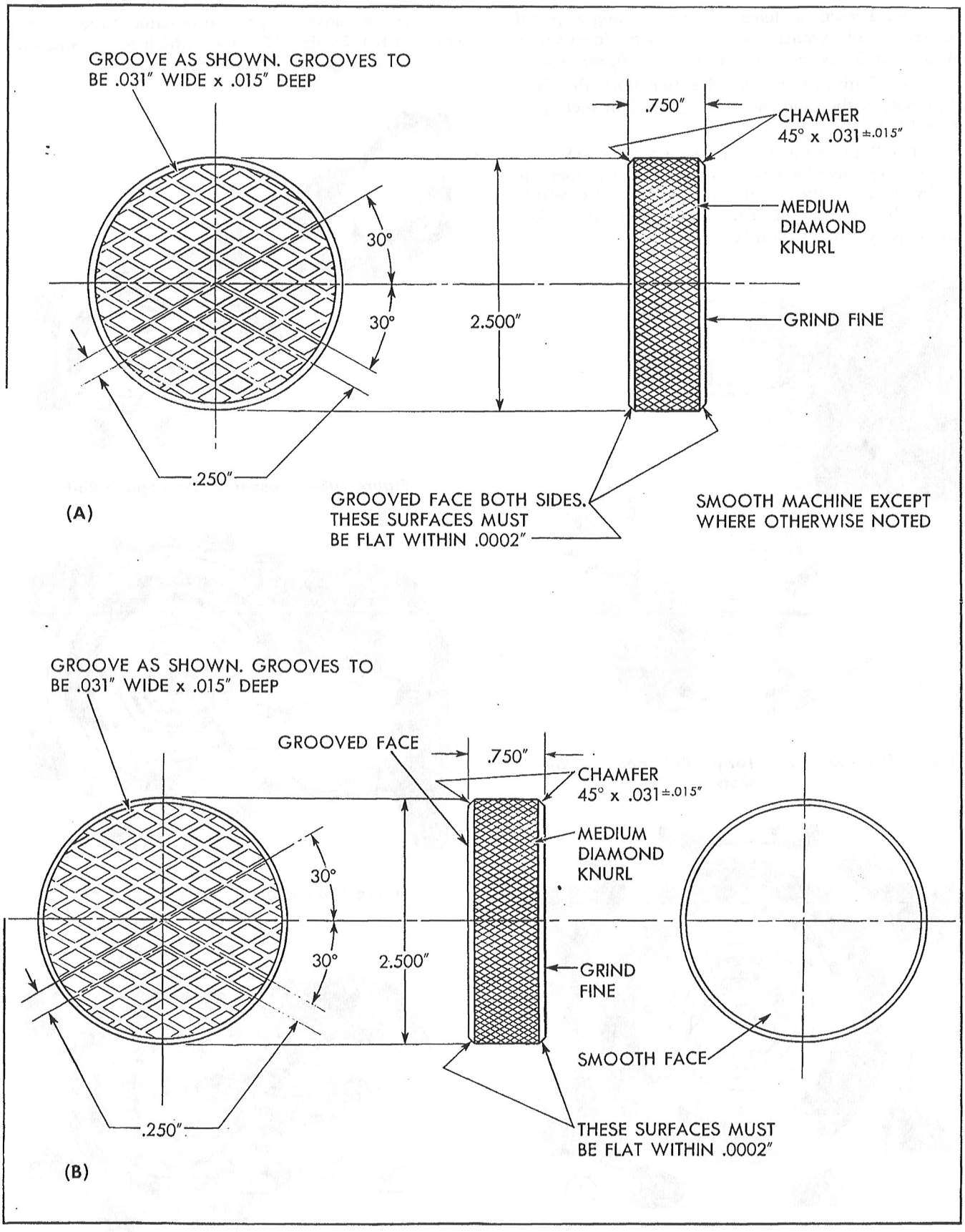


Figure 106—Lapping Blocks

(q) Remove the blade gear.

(r) Remove the preload bearing shim.

Note

Each preload bearing shim is stamped with the socket number in which it was fitted. Do not mix the preload shims, as these are used to properly mesh the blade gears with the master gear and therefore must be returned to their proper socket.

4. CLEANING, INSPECTION, TESTING, AND REPAIR.

a. Thoroughly clean all parts, using cleaning solvent, Federal Specification No. P-S-661.

b. Inspect all parts for corrosion, wear or other damage.

c. Magnetically inspect all steel parts.

CAUTION

When magnetically inspecting parts, attach the magnetizing terminal to the part in such a way that in case of arcing, polished or ground surfaces will not be damaged.

d. Replace any part showing evidence of a crack.

e. Replace all gaskets, seals, and packing.

Note

When replacing the cover or housing seals, remove the spring from the old seal and install in the new seal if the spring is undamaged. Exercise care not to stretch the spring or

f. Inspect the fixed spline bosses for raised edges of the dowel holes. Raised edges are a result of unusually heavy impacts on the propeller blades.

g. Remove raised edges of the dowel holes by lapping the surface of the fixed spline boss as follows:

Note

Lapping blocks for performing the procedure can be made as illustrated in figure 106. One of the blocks has a grooved surface on each side, as illustrated in (A) figure 106. The second block has a grooved surface on one side and a smooth surface on the other, as illustrated in (B) figure 106. The smooth surface is used in checking the fixed spline boss for smoothness by bluing. Specifications for making the laps are given on the drawings. The lapping blocks should be used in pairs so that three lapping surfaces are available for maintaining flatness of the surfaces. This can be done by working the two grooved surfaces of the one lap against the grooved surface of the other lap.

(1) Prepare the laps in the following manner:

(a) Apply No. 2 (medium) lapping compound to the grooved surfaces of the lapping blocks. If this compound is not available, use a mixture of emery abrasive (No. 100 or 120) and lard oil.

(b) Work the compound into the laps by rubbing the two grooved surfaces of the one lap against the grooved surface of the other lap. Continue this operation until all three grooved surfaces show a unifom dull gray surface, with no high or polished spots.

(c) Remove all surplus lapping compound by dipping the lapping blocks in dry cleaning solvent, Federal Specification No. P-S-661. (Do not use brush or rag in this operation.)

(2) Perform the lapping operation as follows:

(a) As illustrated in figure 107, rub the lap against the surface of the fixed spline boss, using just enough pressure to insure constant and uniform contact.

(b) In order to insure the use of the entire face of the lapping surface, the rubbing motion should follow a pattern of the arabic numeral 8, with an occasional rotation of the lap.

(c) Continue the lapping operation until a definite drag is felt. This is an indication that the lap is cutting the entire surface of the fixed spline boss. At this point, lapping should be discontinued and the fixed spline boss washed off carefully with dry cleaning solvent, Federal Specification No. P-S-661.

(d) Check the surface of the fixed spline boss for flatness. First rub the smooth face of the lap illustrated in (B), figure 106 with a very thin, uniform coating of

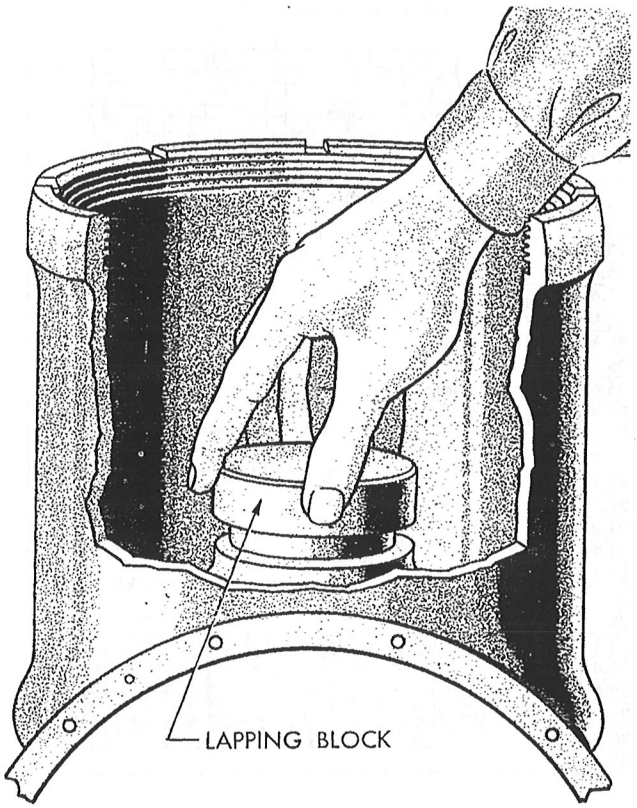


Figure 107—Lapping the Fixed Spline Boss

TABLE I

LOW BLADE ANGLE	EXTERNAL PISTON TOOTH
16.0	42
16.3	37
16.5	32
16.7	27
17.0	22
17.2	17
17.4	12
17.7	7
17.9	2
18.1	41
18.4	36
18.6	31
18.8	26
19.1	21
19.3	16
19.5	11
19.8	6
20.0	1
20.2	40
20.5	35
20.7	30
20.9	25
21.2	20
21.4	15
21.6	10
21.9	5
22.1	44
22.3	39
22.6	34
22.8	29
23.0	24
23.3	19
23.5	14
23.7	9
24.0	4
24.2	43
24.4	38
24.7	33
24.9	28
25.1	23
25.4	18
25.6	13
25.8	8
26.1	3
26.3	42
26.6	37
26.8	32
27.0	27
27.3	22
27.5	17
27.7	12
28.0	7
28.2	2
28.4	41
28.7	36
28.9	31
29.1	26
29.4	21
29.6	16
29.8	11
30.1	6
30.3	1

TO SET AN ORIGINAL BASIC OR LOW BLADE ANGLE

(FOR RIGHT HAND BLADE ONLY)

1. Select desired low blade angle from left hand column.
2. In right hand column opposite the desired angle note tooth number of torque piston to be aligned with index mark on end of cylinder.
3. Insert piston into cylinder aligning the selected piston tooth number with the index mark on end of cylinder.
4. Using the indicator tool over the hub turn cylinder so pointer of tool aligns approximately with desired low angle. Complete assembly of torque unit and blade.
5. Measure low blade angle at 42" station.
6. If, upon measurement, desired low angle is not obtained, count the number of spaces in the left hand column from the desired low angle to the actual measured angle.
7. To obtain the correct tooth number to be aligned with the index mark on end of cylinder, use right hand column and count an equal number of spaces in opposite direction from the tooth number used in step 2. Repeat steps 3, 4, and 5.

EXAMPLE

To Set a Low Blade Angle of 24.4°

1. Refer to 24.4° in the left hand column.
2. In the right hand column opposite 24.4°, note tooth number 38.

22.6	22.8	23.0	23.3	23.5	23.7	24.0	24.2	(24.4	24.7	24.9	25.1	25.4	25.6	25.8	26.1	26.3		
34	29	24	19	14	9	4	43	38)	33	28	23	18	13	8	3	42		

3. Enter piston in cylinder with tooth number 38 aligned with index mark on end of cylinder. Complete the assembly of torque unit and blade.
4. The actual measured low blade angle is found to be 23.7°. This is 3 spaces above (up the column from) the 24.4° desired.
5. Count 3 spaces in the right hand column in the opposite direction (down the column) from tooth number 38, which gives tooth number 23 as correct tooth for 24.4°.

22.6	22.8	23.0	23.3	23.5	(23.7	24.0	24.2	(24.4	24.7	24.9	25.1	25.4	25.6	25.8	26.1	26.3		
34	29	24	19	13	9	4	43	38)	33	28	(23)	18	13	8	3	42		

TO CHANGE LOW BLADE ANGLE

EXAMPLE

Suppose blade angle is to be changed from 24.4° to 28°

1. Low angle measured at 42" station is 24.4°.
2. Suppose piston tooth No. 18 is found to be aligned with mark on end of cylinder.
3. Locate actual measured angle in left hand column and corresponding tooth number in right hand column; in this case low angle 24.4° and tooth number 38.
4. Count the spaces to actual tooth number found in step 2, in this case 4 spaces down the column to tooth number 18.
5. Locate the desired angle in left hand column and corresponding tooth number in right hand column; in this case 28° and tooth number 7.
6. Count the same number of spaces in the same direction as in step 4 to find correct tooth number; in this case 4 spaces down the column to tooth number 31.
7. Complete assembly of torque unit and blade; recheck low blade angle.

23.7	24.0	24.2	(24.4	24.7	24.9	25.1	25.4	25.6	25.8	27.5	27.7	(28.0	28.2	28.4	28.7	28.9	29.1	29.4	29.6
9	4	43	38)	33	28	23	(18)	13	8	17	12	7)	2	41	36	(31)	26	21	16

Prussian blue. Rub this surface of the lap over the fixed spline boss. High spots on the boss will be indicated by the bluing.

(e) Continue the lapping operation *only* until the bluing check indicates a true flat surface on the fixed spline boss. Only a minimum amount of material should be removed.

CAUTION

Do not apply additional lapping compound during the entire lapping operation. If the lap seems to become dry, add a few drops of kerosene to the grooved surfaces of the laps.

(f) To prevent any of the lapping compound from remaining in the hubs, a thorough cleaning operation should be performed after lapping. Use an approved solvent. Give particular attention to flushing the oil transfer holes.

5. REASSEMBLY.

a. ASSEMBLY OF THE HUBS AND BLADES.

(1) Assemble the torque units as follows:

(a) Place the preload bearing shim over the boss of the socket. Be sure that the shim is returned to its proper socket. Check it for the socket number.

Note

Each preload bearing shim is stamped with the socket number in which it was fitted. Do not mix the preload bearing shims, as these are used to properly mesh the blade gears with the master gear and therefore must be returned to their proper socket.

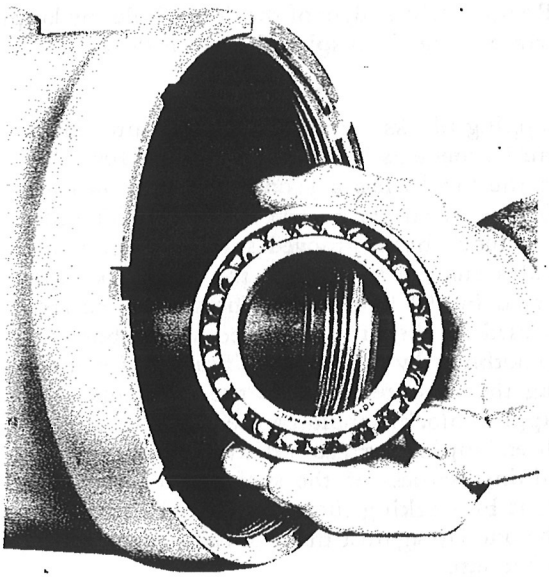


Figure 108—Installing Preload Bearing

(b) Place the blade gear over the boss in the blade socket. The teeth of the blade gear must face the front of the hub.

(c) Place the preload bearing on the boss in the blade socket. The side marked "CRANKSHAFT SIDE" must go toward the blade gear. *(See figure 108.)* The preload bearing is designed to take the thrust load in only one direction.

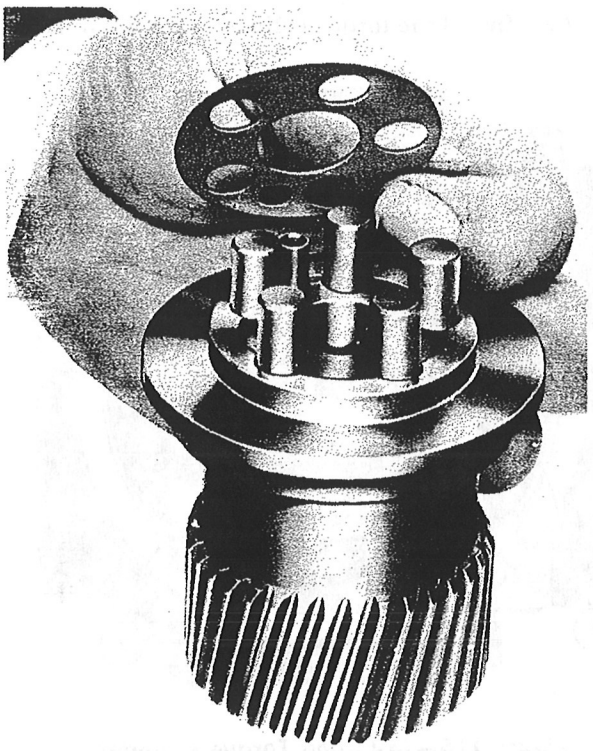


Figure 109—Installing New Fixed Spline Gasket

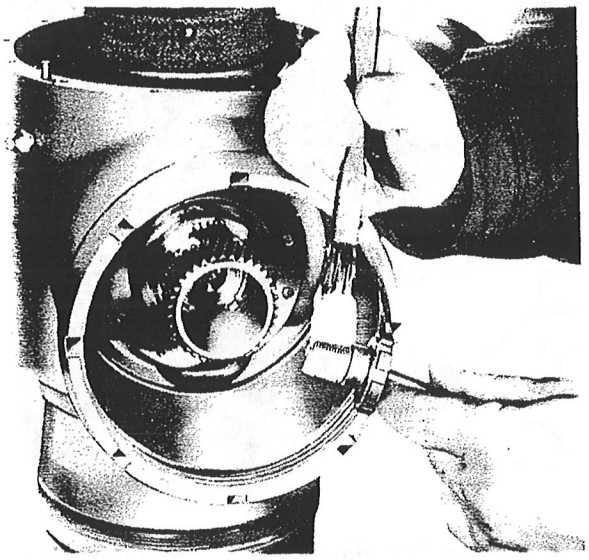


Figure 110—Applying Anti-seize to Fixed Spline Bolt Threads

(d) Install a new fixed spline gasket on the fixed spline. *(See figure 109.)*

(e) Install the fixed spline. The spline is marked with its proper socket number.

(f) Install the fixed spline bolt lock aligning the dowels in the lock with the holes in the fixed spline.

(g) Install the fixed spline bolt and fixed spline bolt washer. Apply a thin coat of anti-seize compound, Specification AN-C-53, to the fixed spline bolt washer and threads of the fixed spline bolt. *(See figure 110.)* Use a torque wrench and tighten the fixed spline bolt to between 220-225 foot-pounds. *(See figure 111.)*

CAUTION

Check the blade gear for freedom of movement while tightening the fixed spline bolt.

(h) Lock the fixed spline bolt. Bend the tang which aligns with the castellation in the bolt. Be sure the tang fits into the notch on the fixed spline bolt.

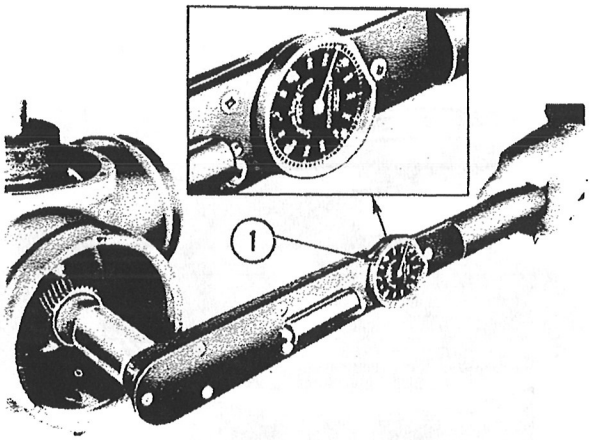


Figure 111—Tightening Fixed Spline Bolt

1. 200-225 foot-pounds

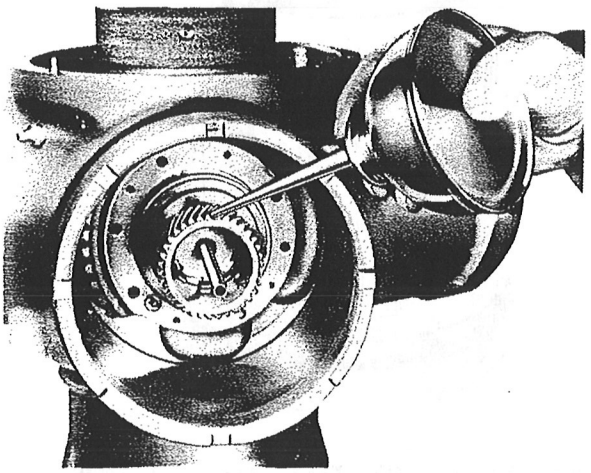


Figure 112—Lubricating the Fixed Spline

Figure 113—Installing New "O" Ring Gasket

Figure 114—Installing Torque Unit Seal and Washer

(i) Lubricate the fixed spline. Use specified regulator fluid. *(See figure 112.)*

(j) Install a new "O" ring gasket in the groove on the outside of the torque cylinder. *(See figure 113.)*

(k) Lubricate the internal splines of the torque cylinder. Use the specified regulator fluid.

(l) Install the seal retaining washer and the torque unit seal in the torque cylinder. *(See figure 114.)*

(m) Install the torque cylinder. *(See figure 115.)*

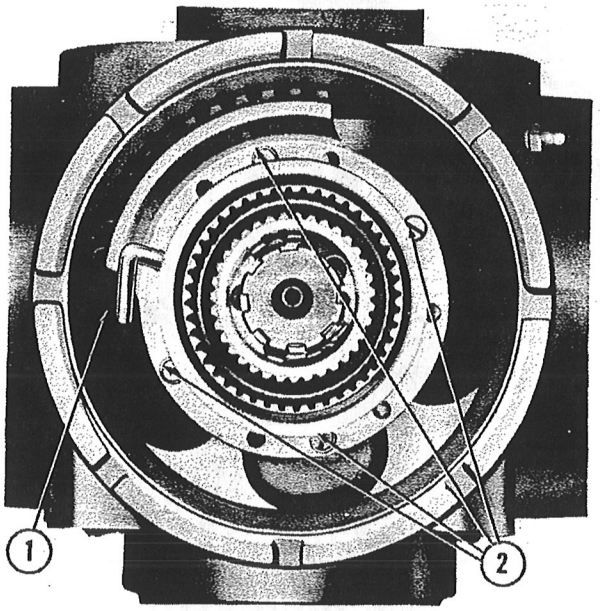


Figure 115—Installing Torque Cylinder

1. Aligning Tool
2. Install Screws

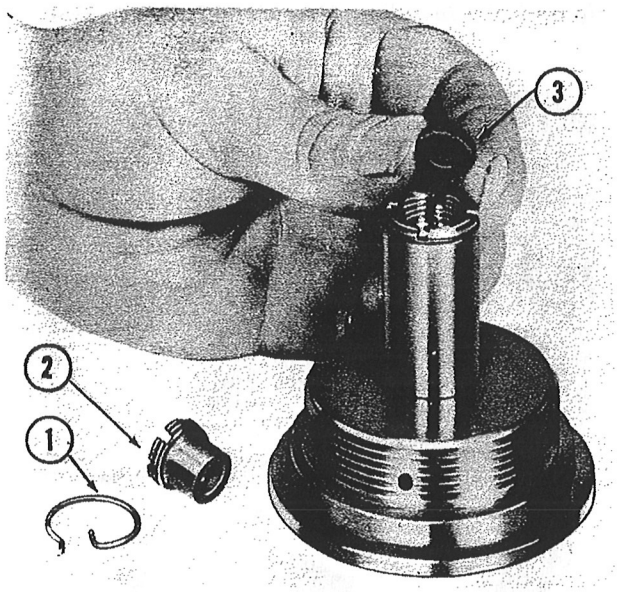


Figure 116—Installing Piston Transfer Packing

1. Snap Ring
2. Transfer Packing Gland
3. Transfer Packing

(n) Attach the torque cylinder to blade gear. Align the dowel holes with the aligning tool or ¼ inch O.D. rod. Install the screws in the blade gear and torque cylinder.

(o) Assemble the piston as follows:

1. Install a new piston transfer packing in the piston head. *(See figure 116.)*

2. Install and tighten the piston transfer packing gland. Turn until the gland contacts the packing. Turn an additional 30 to 60 degrees until a locking slot in the gland is aligned with a slot in the piston. Do not turn less than 30 degrees, nor more than 60 degrees.

3. Install the piston transfer gland snap ring.

4. Install a new torque unit seal on the piston head.

5. Screw the piston head into the piston skirt until the locking holes align. *(See figure 117.)* Serial numbers on the head and skirt must be the same. Insert the piston pin. *(See figure 118.)*

(p) Index the torque piston to the torque cylinder as follows:

Note

If a new piston is to be installed, or if the specified low blade angle is to be changed, index the piston to the cylinder as directed in table I. This information is included in a decalcomania which is placed on the exterior of torque cylinders.

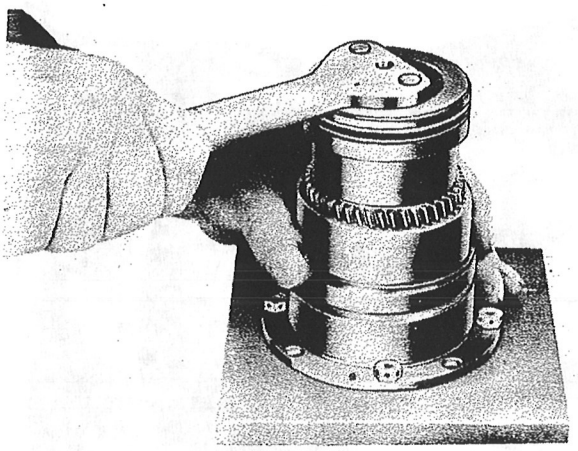


Figure 117—Installing Piston Head

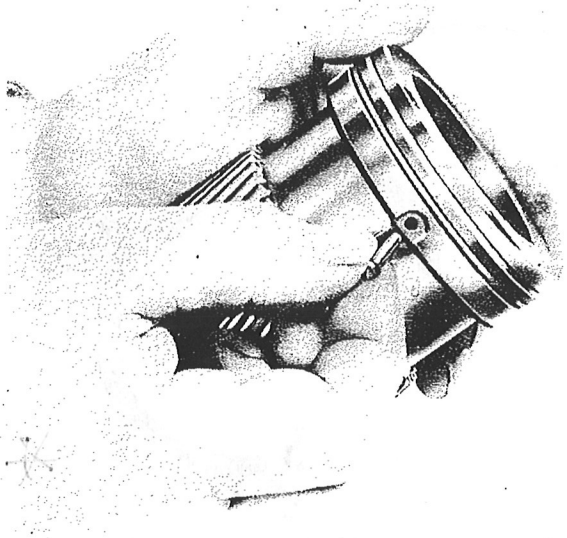


Figure 118—Installing Piston Pin

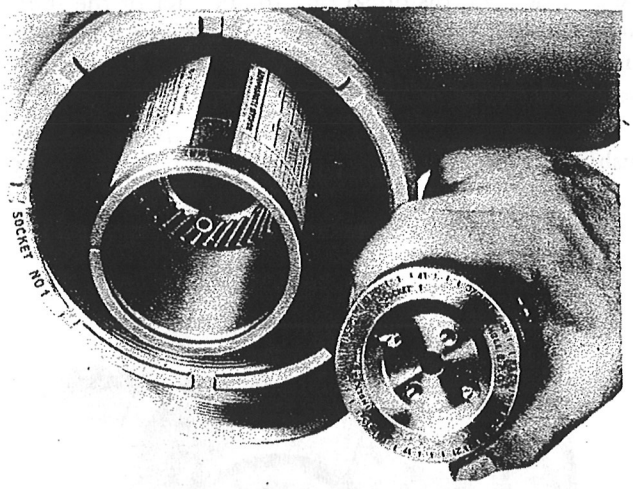


Figure 119—Noting Reference Numbers on Piston Head

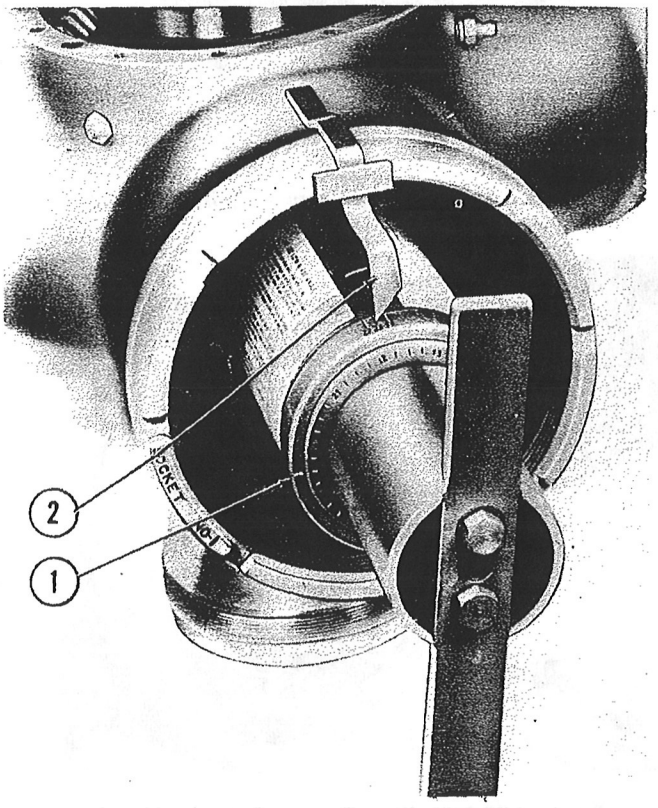


Figure 120—Indexing Piston and Cylinder

1. Index Mark on Cylinder 2. Indicator Tool

1. Each piston must be returned to its proper hub socket. Note the reference numbers stamped on the piston head. *(See figure 119.)*

2. Align the proper piston tooth with the cylinder index mark. Insert the piston until it is just flush with the cylinder.

Note

In this position the piston has not yet engaged the fixed spline. Therefore, the piston and cylinder may be rotated freely.

3. Place the indicator tool over the hub. Turn the cylinder and piston so that the pointer of the indicator aligns approximately with the specified low blade angle. Angles 20°, 25°, and 30° are marked on the cylinder. *(See figure 120.)*

4. Engage the piston with the fixed spline by pushing inward on the piston. Recheck indexing by installing cylinder head retaining snap ring, then pulling piston out against ring to check index number. Remove snap ring after checking.

(q) Install a new torque unit seal on the cylinder head and secure with snap ring.

(r) Install the torque cylinder head. *(See figure 121.)*

(s) Install the head retaining snap ring. *(See figure 122.)* Pull the cylinder head out against the snap ring.

CAUTION

Make certain the snap ring is installed in the groove.

(t) Install the cylinder head retainer on the cylinder head. *(See figure 123.)*

(u) Tighten the cylinder head retainer bolt. Safety with .032-inch safety wire.

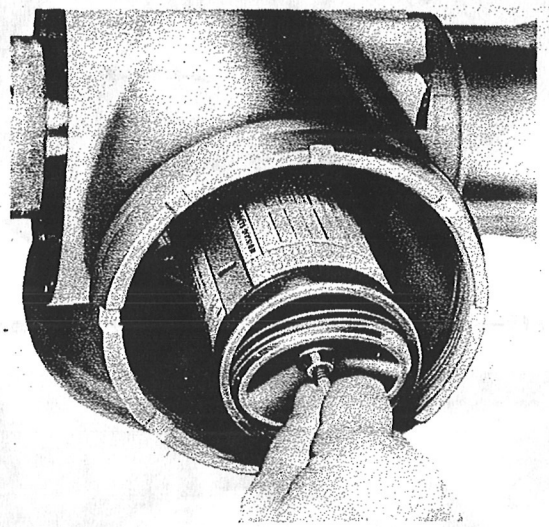


Figure 121—Installing Torque Cylinder Head

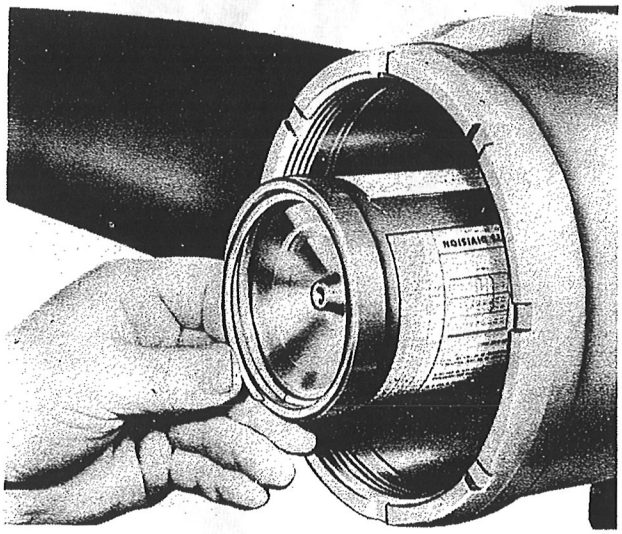


Figure 122 Installing Torque Cylinder Head Retaining Snap Ring

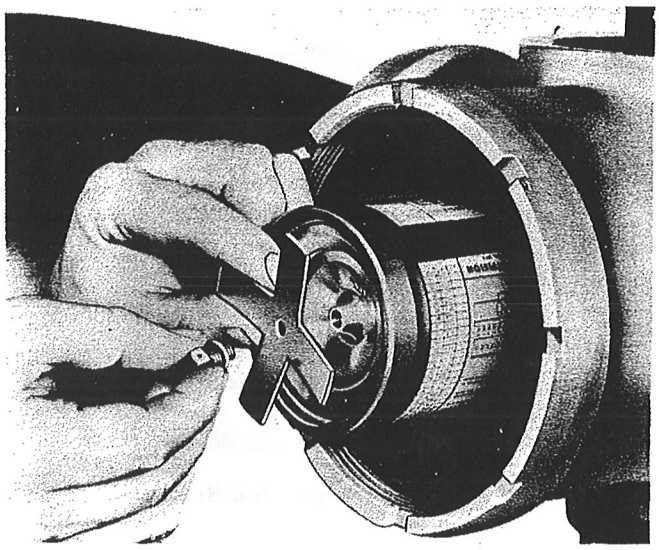


Figure 123—Installing Torque Cylinder Head Retainer

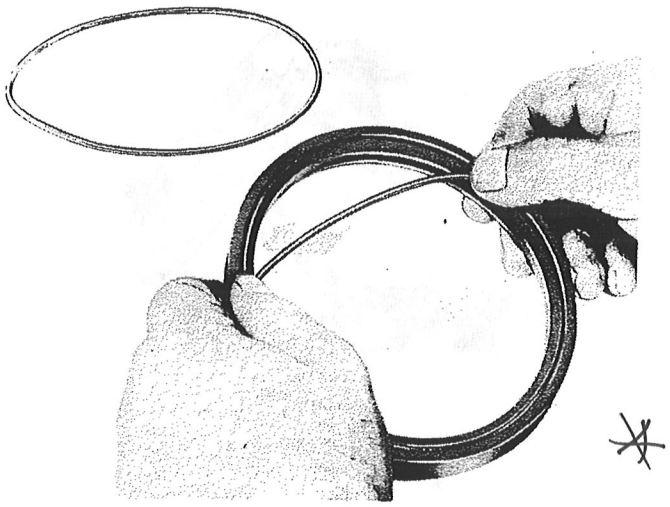


Figure 124—Installing Blade Retaining Nut Seal Springs

(2) Assemble the blades as follows:

(a) Install the two springs into the blade retaining nut seal. *(See figure 124.)*

(b) Install the seal into the blade retaining nut, entering the closed end of the seal first.

(c) Install the blade retaining nut snap ring which holds the seal in place. *(See figure 125.)*

(d) Slide the blade retaining nut on the root of the blade with the castellations towards the tip. Use a light film of engine oil on the blade root so that the grease seal of the nut will slide easily.

(e) Grease the stack bearings, using specified hub grease. (See lubrication chart, section V, paragraph 4.)

(f) Slide the stack bearings over the root of the blade. The outer race of the bearings goes toward the blade retaining nut, and the inner race goes toward the blade nut. *(See figure 126.)*

CAUTION

These sets of bearings which are identified by individually marking each bearing with a serial number followed by a dash number (example, 4430-1) are ground and matched. These are not interchangeable individually and must be used as an assembly and in the proper order. (No. 1 installed first; No. 2 installed next, and No. 3 installed last.) Those sets of bearings which are identified individually by marking the serial numbers only (example, 4520) are interchangeable in position within a set. In both types the stack bearing assembly may be interchanged with another stack bearing assembly.

(g) Spread a thin coat of anti-seize compound, Specification No. AN-C-53, on the blade threads.

(h) Screw the blade nut on the blade threads until the locking holes align. *Make certain the serial number of the nut is the same as the serial number of the blade. The nuts are not interchangeable and cannot be replaced separately.*

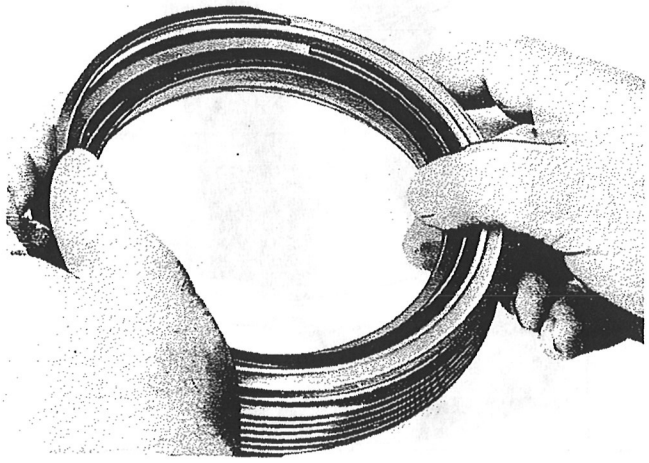


Figure 125—Installing Blade Retaining Nut Seal Snap Ring

(i) Screw the blade nut lock into the nut until it bottoms, then back it out until the cotter pin hole lines up with the slot.

(j) Safety the lock with a cotter pin. The head of the cotter pin should be toward the leading edge of the propeller blade.

(3) Install the blades as follows:

(a) Lubricate the threads of the hub socket with regulator fluid.

(b) Insert the blade in the hub socket, and engage the dowels in the torque cylinder. Keep the bearings tight against the blade nut.

(c) Apply a thin coat of anti-seize compound, Specification No. AN-C-53, to the blade retaining nut threads and to the threads of the hub socket. *(See figure 127.)*

(d) Start the blade retaining nut in the hub socket threads and turn the nut until snug.

CAUTION

Make certain the blade dowels are engaged in the torque cylinder and blade gear before tightening the nut. One dowel is offset in relation to spacing of other dowels.

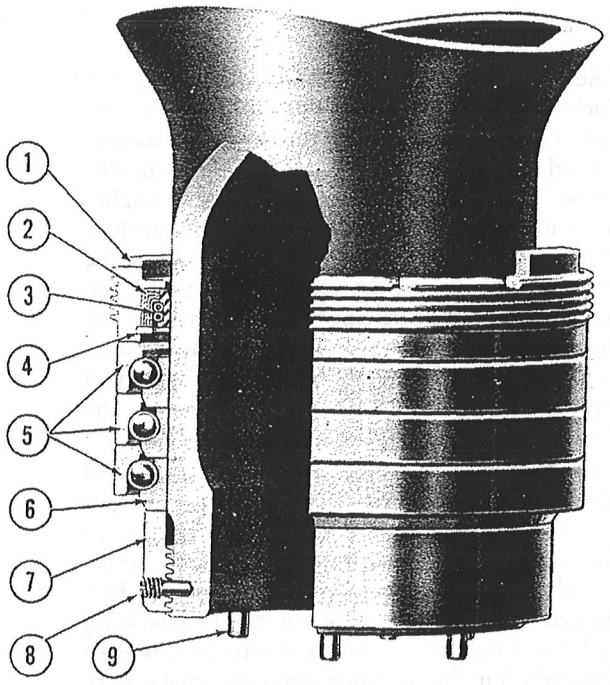


Figure 126—Blade Bearings and Blade Retention

1. Blade Retaining Nut
2. Blade Retaining Nut Seal
3. Seal Springs
4. Snap Ring
5. Blade Bearings, Outer Race
6. Blade Bearing, Inner Race
7. Blade Nut
8. Blade Nut Lock
9. Blade Dowel

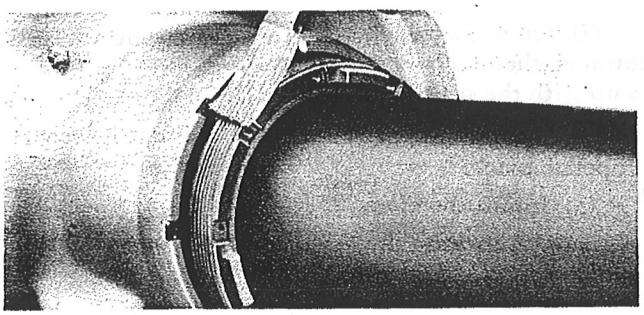


Figure 127—Applying Anti-seize to Blade Retaining Nut

(e) Insert a 4-foot bar into the blade retaining nut wrench and tighten the blade retaining nut, applying 350-400 foot-pounds torque.

(f) Replace the blade retaining nut lock in the proper castellation and safety.

(g) Replace the balance weights in proper locations and safety.

CAUTION

Provide a .003-inch minimum clearance between the balance weights and the blade shank.

(4) Check the angles of the blades as follows:

(a) Turn the blades to low angle.

(b) Check the angle of each blade at the 42-inch station.

Note

The 42-inch station is determined as follows: Each blade has a cross mark etched on the thrust side near the tip. Near the cross mark is etched a number. Subtracting 42 from this etched number will give the distance in inches to be measured inboard from the cross mark to determine the point at which the angle of the propeller blade will be checked. This is commonly referred to as the 42-inch station. For example, the number of A20-156-24M blades at the cross mark is 65. Subtracting 42 from 65 equals 23. Measure 23 inches inboard from the cross mark to locate the 42-inch station. This particular model propeller has a hub and blades of such design that this point known as the 42-inch station is actually 42 inches from the center of the hub. Other models incorporating this same blade design but a different hub design may have the blade angle checking point at a different distance from the center of the hub, but the distance from the cross mark will always be the same on all blades of the same design.

(c) Compare the angles of all blades. The low blade angle of all blades must be within .2 degree of the specified low blade angle. To correct for more than .2 degree variation, the torque piston must be reindexed to the torque cylinder splines. Refer to table I to determine the piston tooth which must be indexed at the mark on the torque cylinder.

(5) Rotate each propeller blade until it is on the low blade angle stop.

(6) Install the front cone, snap ring and shaft nut as follows:

(a) Apply a coating of anti-seize compound, Specification No. AN-C-53 to the groove in the front cone halves.

(b) Place the halves of the front cone on the propeller shaft nut. Be certain that the serial numbers on each of the halves are the same. *(See figure 128.)*

(c) Install the propeller shaft nut and front cone. *(See figure 129.)*

(d) Install the master gear assembly and the master gear shim. *(See figure 130.)* If the shim is lost, replace with one of .040 inch thickness. If damaged, replace with one of the same thickness.

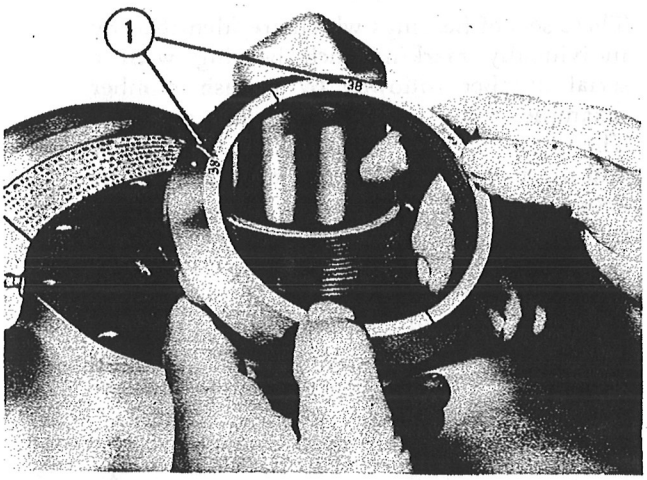


Figure 128—Matching Front Cone Halves
1. These Numbers Must Match

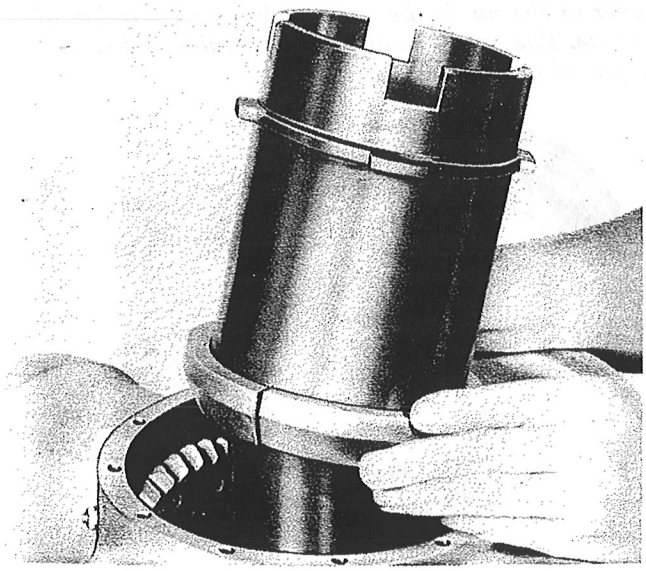


Figure 129—Installing Shaft Nut and Front Cone

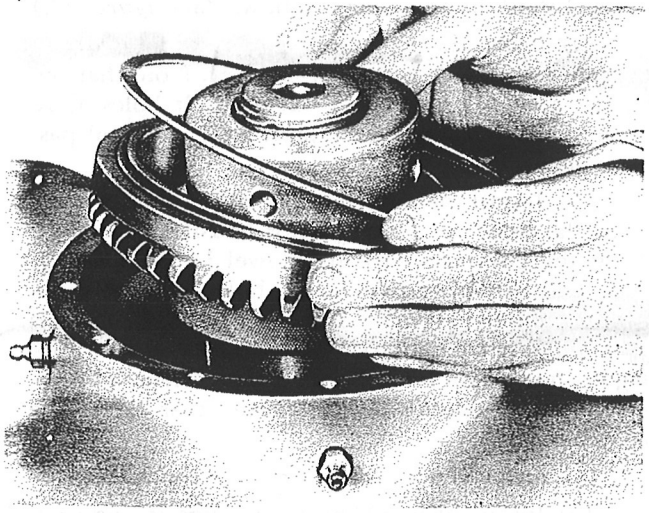


Figure 130—Installing Master Gear and Shim

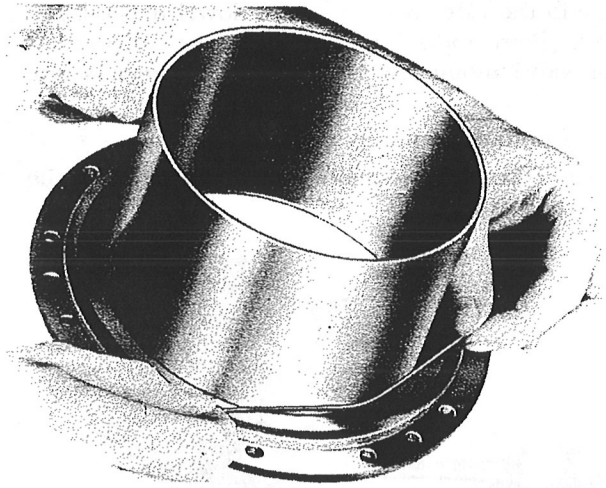


Figure 131—Installing Seal on Master Gear Retaining Plate

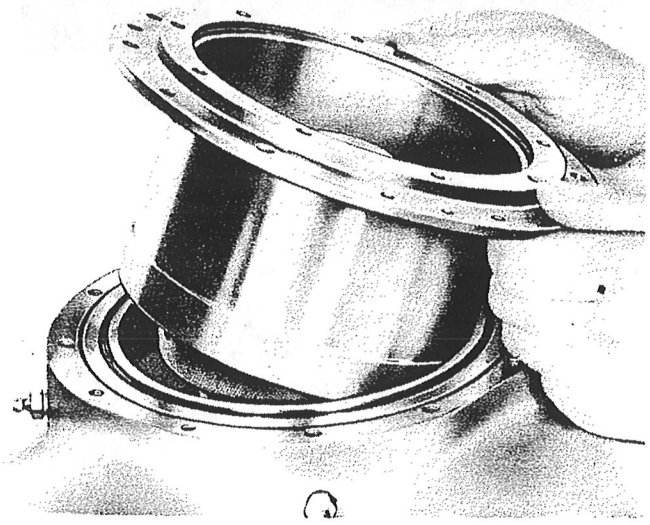


Figure 132—Installing Master Gear Retaining Plate

(e) Install a new seal on the master gear retaining plate. *(See figure 131.)*

(f) Install the master gear retaining plate. *(See figure 132.)*

(g) Install the bolts and washers holding the master gear retaining plate in place and safety.

(7) Recheck the blade angles. Angles for the blades in any one hub should not vary more than plus or minus .2 degree from the designed basic angle, and the allowable angle variation between any two blades in a given hub is .2 degree. For proper procedure to arrive at specified minimum blade angle, refer to table I.

Note

It is impossible to further correct any error in blade angle because the blade gear becomes an integral part of the blade when the blade dowels are inserted in the dowel holes in the blade gear and cylinder. All blades must be turned to the minimum blade angle before installing the master gear, and each blade will assume an angle determined by the meshing of the teeth of the master gear with the teeth of the blade gear. Manufacturing tolerances bring this to within .2 degree angle among all blades on a propeller. If the blade gear of any blade should be turned one tooth away from the minimum angle before installing the master gear, the angle of that blade will deviate approximately 9 degrees from the established minimum angle. It is obvious, therefore, that no corrections can be made for any one blade in relation to the other blades by reindexing that blade when the master gear is installed. If an error of 9 degrees is encountered in a blade, remove the master gear and make certain that all blades are turned to minimum angle.

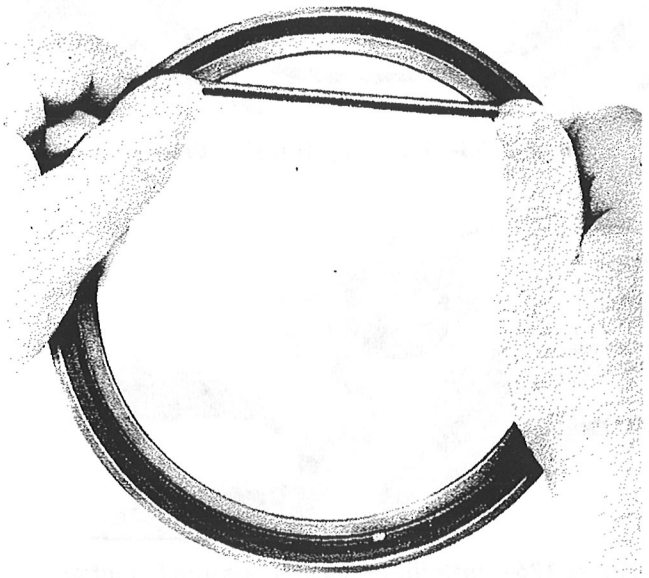


Figure 133—Installing Ball-loaded Spring in Seal

b. ASSEMBLY OF THE REGULATOR.

(1) Install the housing bearing as follows:

(a) Install the ball-loaded housing seal spring in the housing seal. *(See figure 133.)*

(b) Install the housing seal and washer in the housing with the spring side of the seal up. *(See figure 134.)*

(c) Install the housing bearing. *(See figure 135.)*

(d) Install the bearing retention plates and safety the screws with .032-inch safety wire. *(See figure 136.)*

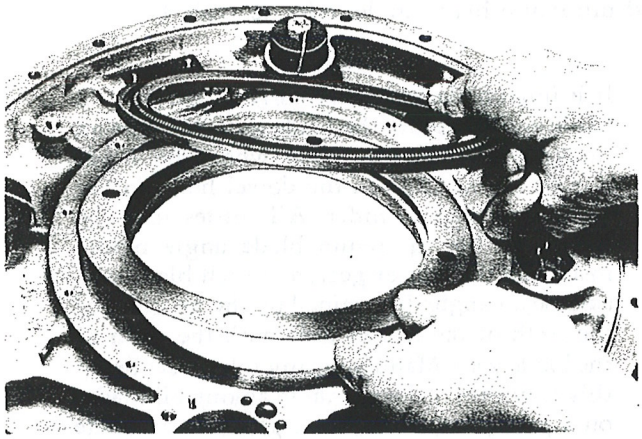


Figure 134—Installing Housing Seal and Washer

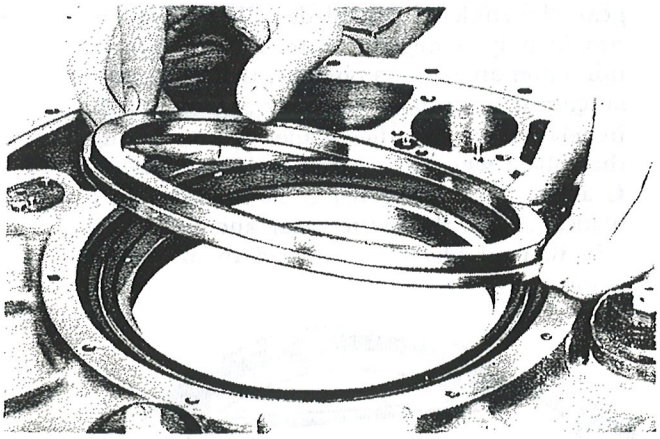


Figure 135—Installing Housing Bearing

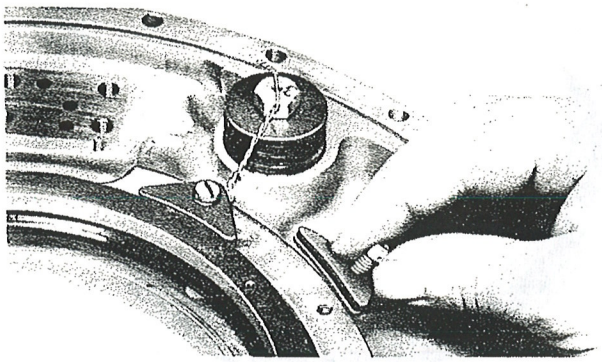


Figure 136—Installing Housing Bearing Retention Plate

(2) Install the governor as follows: *(See figure 137.)*

(a) Install the governor filter gasket. The convex side must go toward the governor body. Note that the oil ports are slightly offset from the bolt holes. Care must be taken to install these parts so that the oil passages mate properly.

(b) Install the governor so that the shoe extends toward the center of the regulator housing. Align the hole in the governor with the dowel in the housing. Install the governor mounting bolts and washers. Tighten the bolts evenly, using 90 to 100 inch-pounds torque. Safety the bolts with .032-inch safety wire. Check the governor piston for freedom of movement, by compressing and releasing the governor lever using the fingers only.

(3) Install the pressure control valve as follows:

(a) Install new "O" ring packings in the pressure control valve body.

(b) Install the pressure control valve, aligning the hole in the valve body with the dowel in the housing. *(See figure 138.)* Tighten and safety the pressure control valve mounting bolts using .032-inch safety wire.

(4) Install the pump as follows:

(a) Install a new pump seal in the recess in the regulator housing.

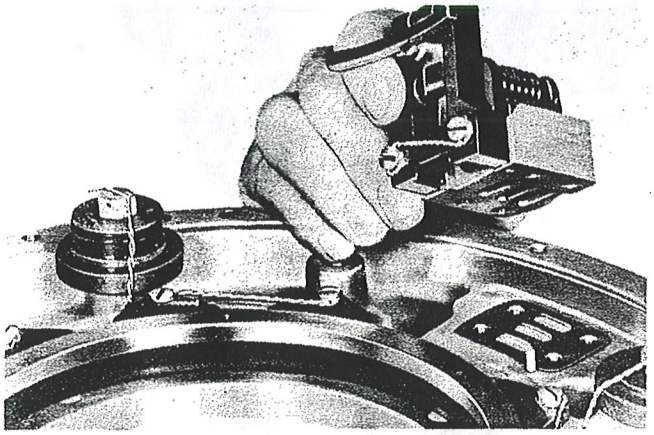


Figure 137—Installing the Governor

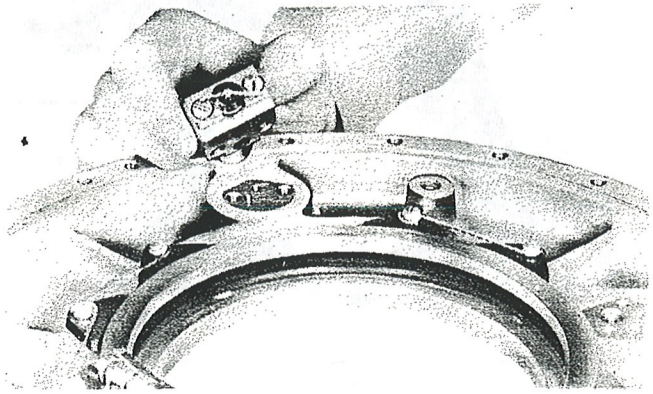


Figure 138—Installing the Pressure Control Valve

(b) Install the pump into the housing so that the dowel hole in the flange of the pump mates with the locating dowel pin in the housing. *(See figure 139.) Do not hammer on pump or gear.*

(c) Tighten the pump bolts evenly and safety with .032-inch brass safety wire.

(5) Reassemble and install the external filter as follows:

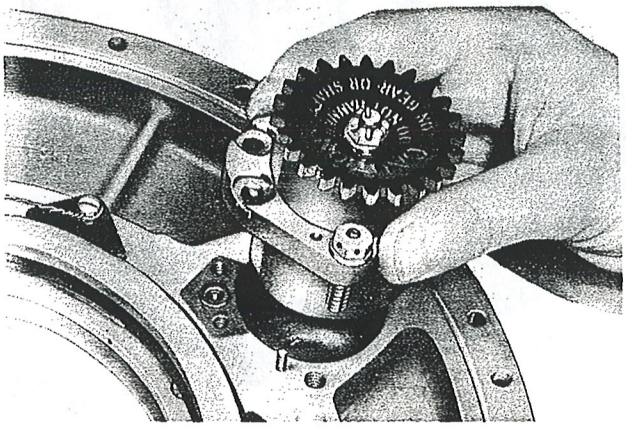


Figure 139—Installing the Pump

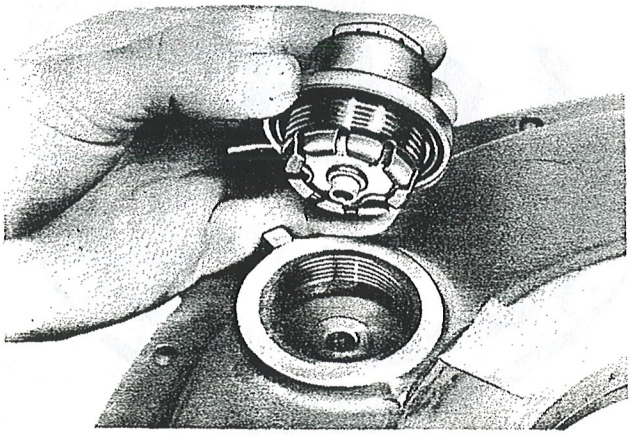


Figure 140—Installing the Filter

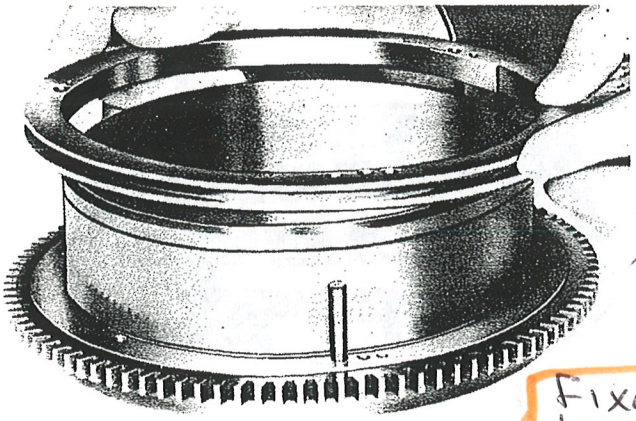


Figure 141—Installing Control Ring

(a) Install a new "O" ring gasket in the groove of the filter cap.

(b) Install a new seal on the filter cartridge, and enter the large end of the spring in the recess of the cartridge.

(c) Install the filter cartridge in the cap with the spring facing inward.

(d) Install the filter snap ring.

(e) Install the filter assembly in the housing. *(See figure 140.)* Safety with .032-inch safety wire.

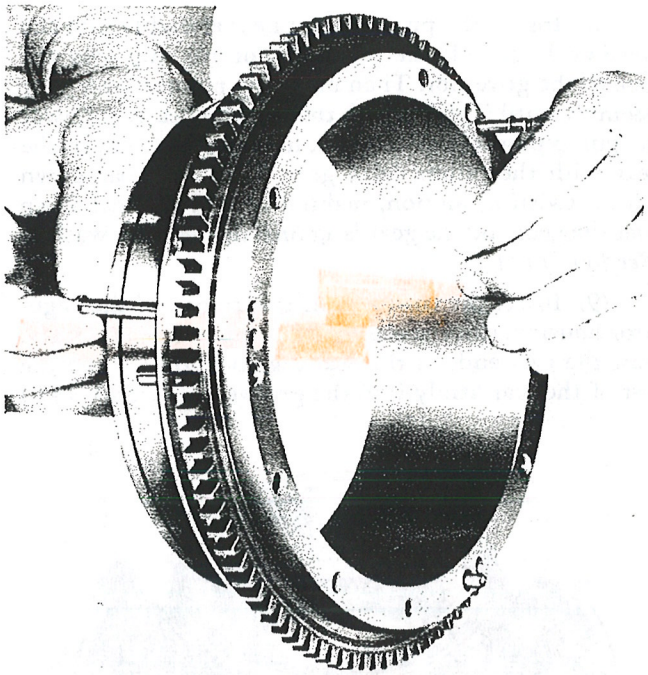


Figure 142—Installing Stop Pins

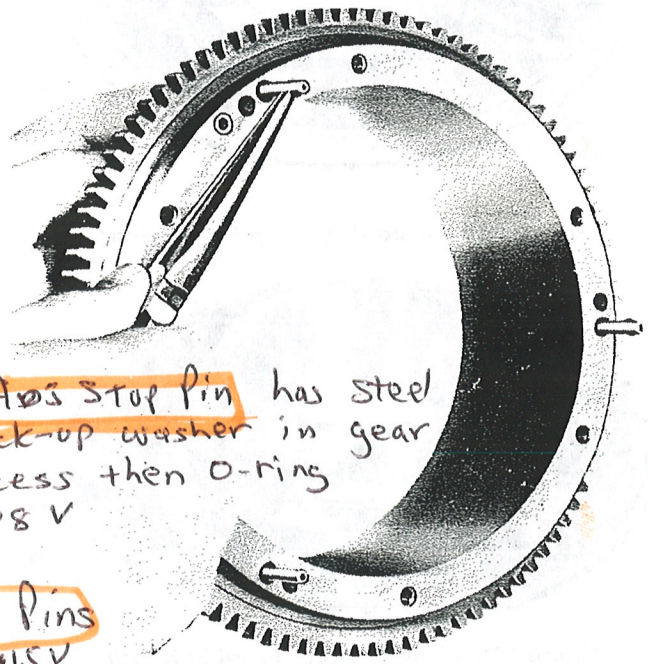


Figure 143—Installing "C" Washers

(6) Assemble the control ring to the pump power gear assembly as follows:

(a) Install the control ring on the pump power gear with the notation "GEAR SIDE" toward the gear. *(See figure 141.)*

(b) Insert the stop pins in the control ring and through the pump power gear. *(See figure 142.)*

(c) Install new "C" washers in the grooves at the ends of the stop pins. *(See figure 143.)*

(7) Lubricate the housing seal and housing bearing with regulator fluid.

(8) Install the pump power gear assembly into the housing. First slide the regulator control ring over the shoe of the governor. Then move the pump power gear assembly until it aligns with the housing bearing. Lower the pump power gear in place, meshing the teeth of the gear with the pump drive gear. Press the gear down with a twisting motion, making certain the seal is up over the gear and the gear is against the housing washer. *(See figure 144.)*

(9) Insert the cord seal in the groove of the regulator housing. Cut the seal 1/8 inch longer than necessary. Butt the two ends of the seal together, then work the rest of the seal firmly into the groove. *(See figure 145.)*

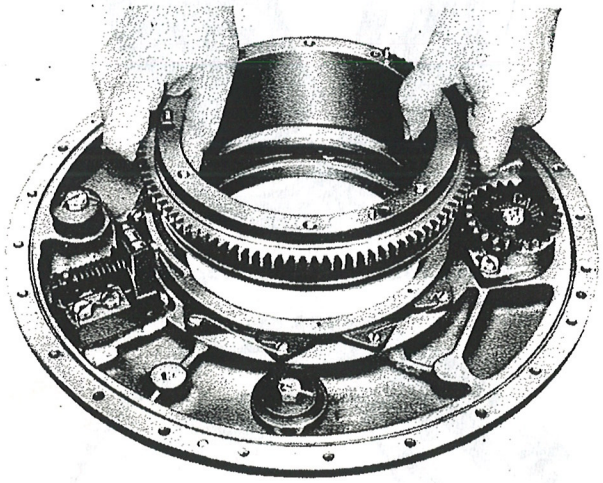


Figure 144—Installing Pump Power Gear

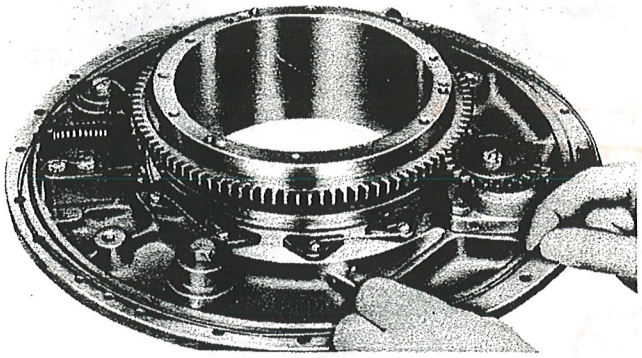


Figure 145—Installing Cord Seal in Housing

(10) Install the cover seal spring in the regulator cover seal, then install the cover seal in the regulator cover with the metal side facing the cover. *(See figure 146.)*

(11) Install the regulator cover bearing. *(See figure 147.)* Tighten the cover bearing mounting screws and safety.

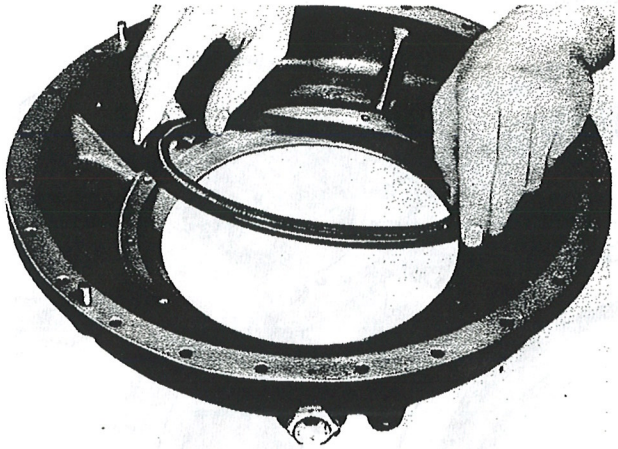


Figure 146—Installing Cover Seal

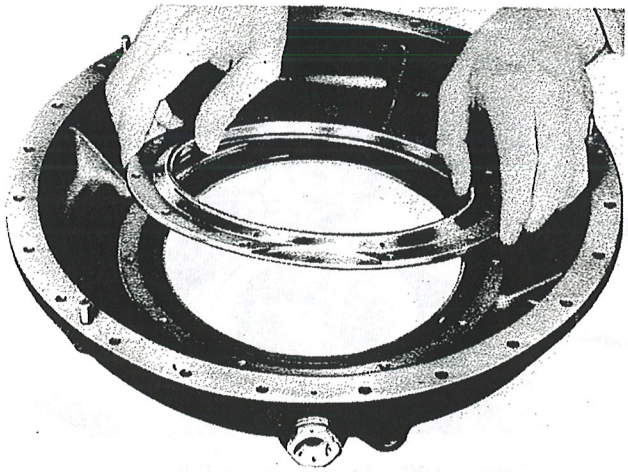


Figure 147—Installing Cover Bearing

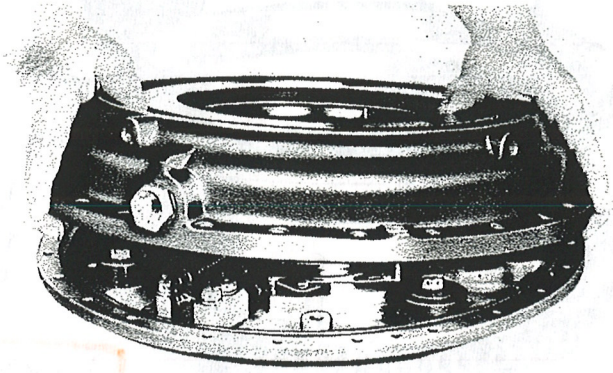


Figure 148—Installing Regulator Cover

(12) Lubricate the cover bearing and seal with regulator fluid, then place the regulator cover over the housing. *(See figure 148.)* Align the dowels of the cover with the dowel holes in the housing.

(13) Using new nuts and washers, install the cover mounting bolts, which hold the regulator cover and housing together, but which do not retain the spinner bulkhead to the regulator. *(See figure 149.)* The nuts have fiber inserts and do not require the use of safety wire.

(14) Install the adapter gasket on the pump power gear assembly. *(See figure 150.)*

(15) Assemble and install the adapter ring as follows:

(a) Place a seal, flat washer and a spring in each of the control screw holes in the order named. Tap a new cupwasher into place over the spring with the lip of the washer facing inward. Make certain the washer is installed evenly so that the edge of the washer is flush with the face of the adapter ring. *(See figure 151.)*

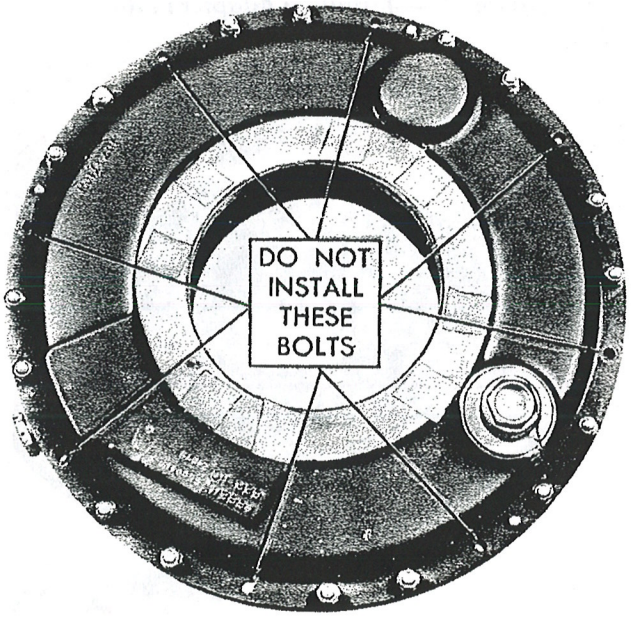


Figure 149—Install Regulator Cover Bolts, Which Do Not Retain Bulkhead

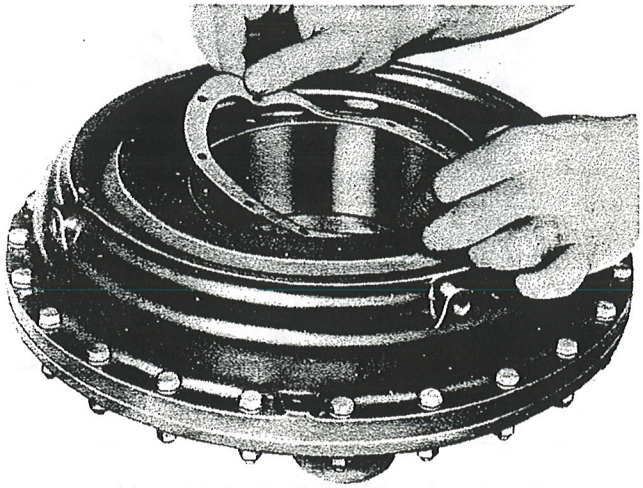


Figure 150—Installing Adapter Gasket

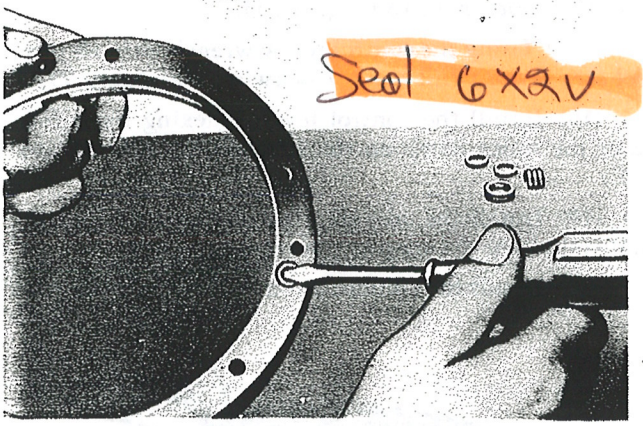


Figure 151—Assembly of Adapter Ring

1. Seal
2. Washer
3. Spring
4. Cup Washer

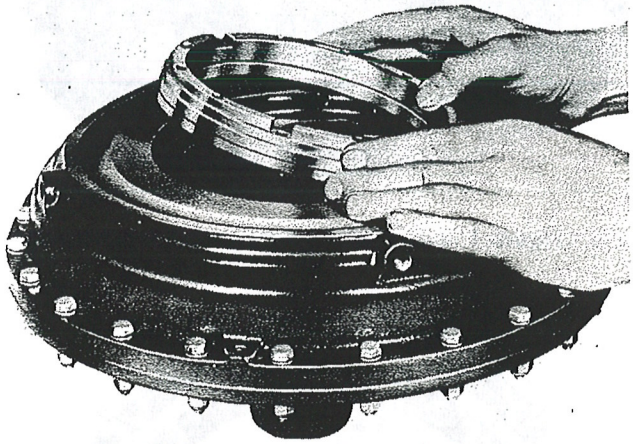


Figure 152—Installing Adapter Ring

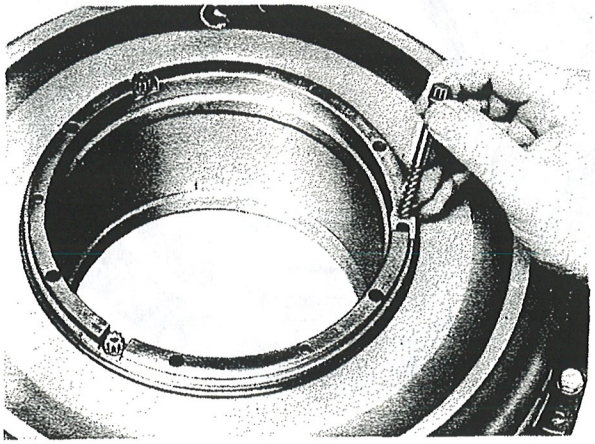


Figure 153—Installing Control Screws

(16) Install the adapter ring assembly over the adapter gasket. *(See figure 152.)*

(17) Install the control screws as follows:

(a) Place one control screw washer on each control screw.

(b) Insert the three control screws and washers into the adapter ring. *(See figure 153.)*

(c) Using the control screw wrench, turn all control screws their full travel clockwise. *(See figure 154.)*

(18) Install the control lever, indexing tooth No. 32 at the index mark on the adapter ring. *(See figure 155.)*

(19) Install the adapter plate (figure 156), and install and safety the adapter plate bolts.

(20) Install the spinner bulkhead aligning the regulator dowels with the dowel holes in the bulkhead. *(See figure 157.)* Install the cover mounting bolts, washers and nuts. The nuts have fiber inserts and do not require the use of safety wire.

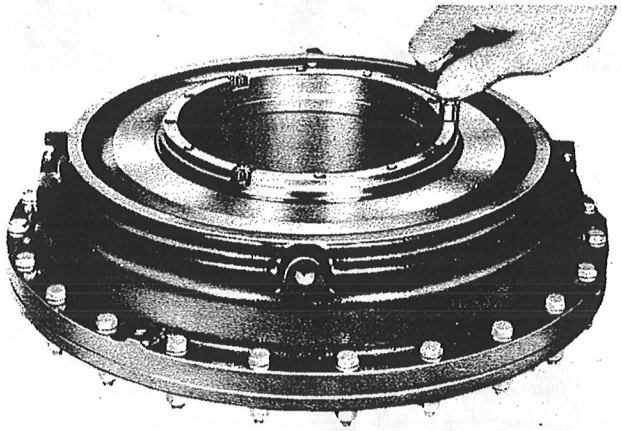


Figure 154—Tightening Control Screws

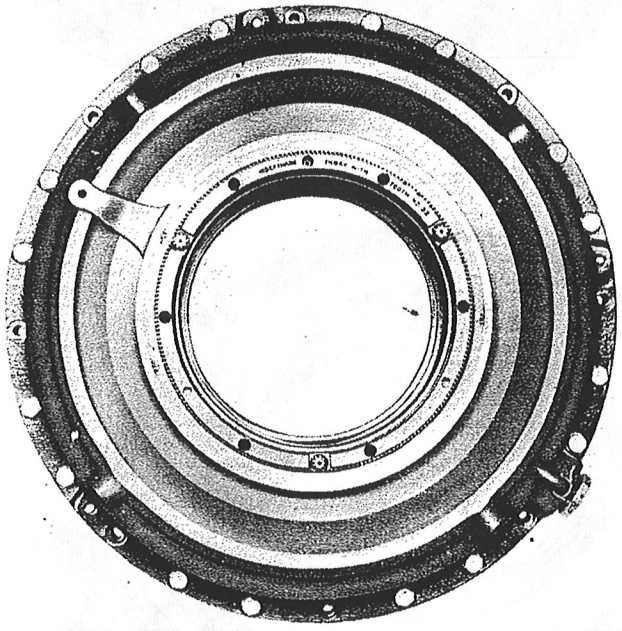


Figure 155—Indexing Control Lever

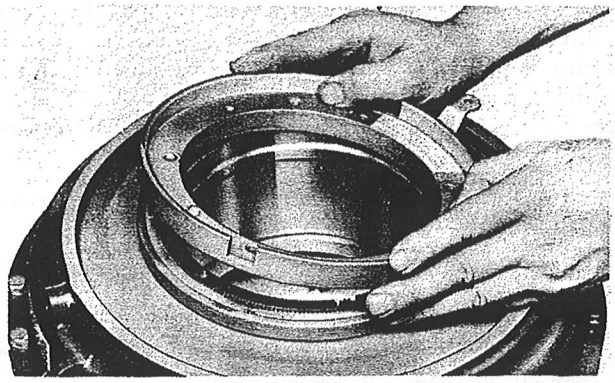


Figure 156—Installing Adapter Plate

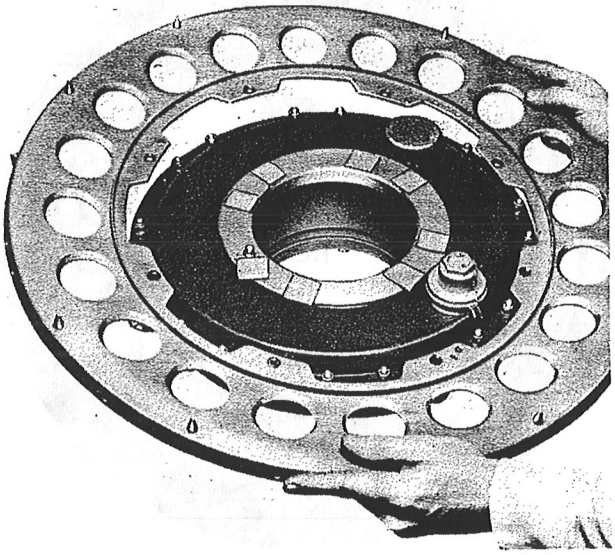


Figure 157—Installing Spinner Bulkhead

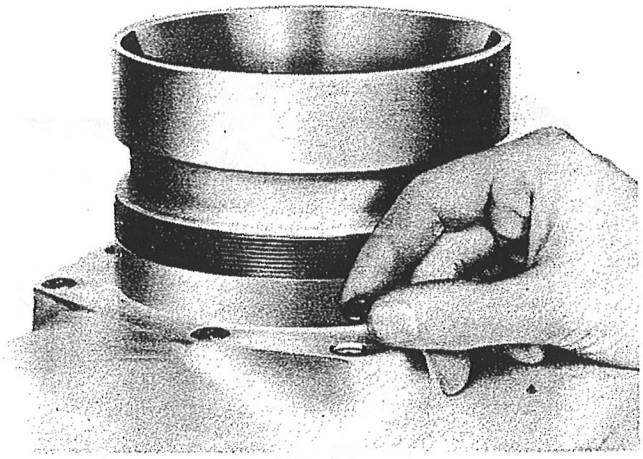


Figure 158—Installing Transfer Seal

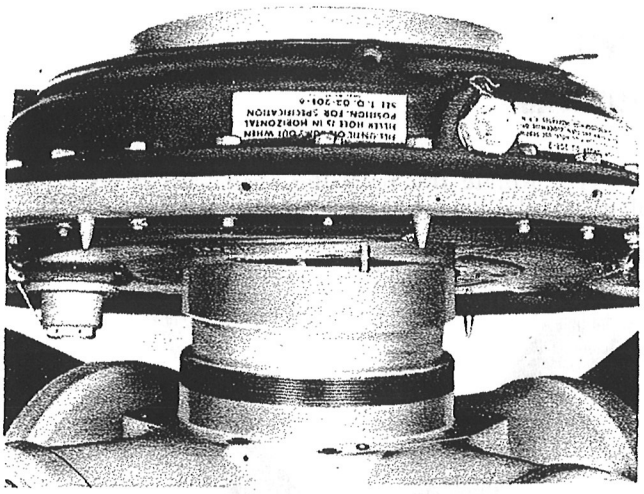


Figure 159—Installing the Regulator

c. INSTALLATION OF THE REGULATOR.

(1) Remove the masking tape from the hub transfer ports and install new transfer seals in the hub. *(See figure 158.)*

(2) Remove the masking tape from the regulator transfer ports. Assemble the regulator on the propeller hub. *(See figure 159.)* The dowel in the regulator housing must align with the dowel hole in the hub.

(3) Apply anti-seize compound, Specification No. AN-C-53, on the nut and start the nut by hand, turning counterclockwise. *The regulator nut has a left-hand thread.* Tighten the nut with the regulator nut wrench and a 4-foot bar. Tighten to 500-600 foot-pounds torque, using hands only on the bar. Do not strike bar with hammer or mallet.

(4) Check the clearance between the regulator housing and the hub. It should not be possible to insert a .002-inch feeler at any point.

SECTION VII
TEST PROCEDURES

1. PROPELLER BALANCING.

a. STATIC BALANCING PROCEDURE.

(1) Remove the regulator as directed in section VI, paragraph 3. *a.*

(2) Disassemble and thoroughly clean the hub as directed in section VI, paragraph 3. *c.*

(3) Replace the torque units.

(4) Replace the blades.

(5) Install the balancing adapter.

(6) Install the master gear and master gear retaining plate.

(7) Check the blades for their minimum angle. Allowable variation between any two blades with master gear installed is .2 degree.

(8) Set the blades at approximately the intermediate angle between minimum and maximum blade angles.

(9) Insert the arbor and carefully lower the propeller on the brass stops of the balancing ways. *(See figure 160.)*

(10) Rotate the arbor until it is squarely against the stops at the opposite end of the ways. *(See figure 161.)*

(11) Rotate the arbor back until it reaches the center of the knife edges.

(12) Rotate the propeller then stop it with two blades in the horizontal position. Note the movement of the propeller, as the lightest blade will seek the highest point. *(See figure 162.)*

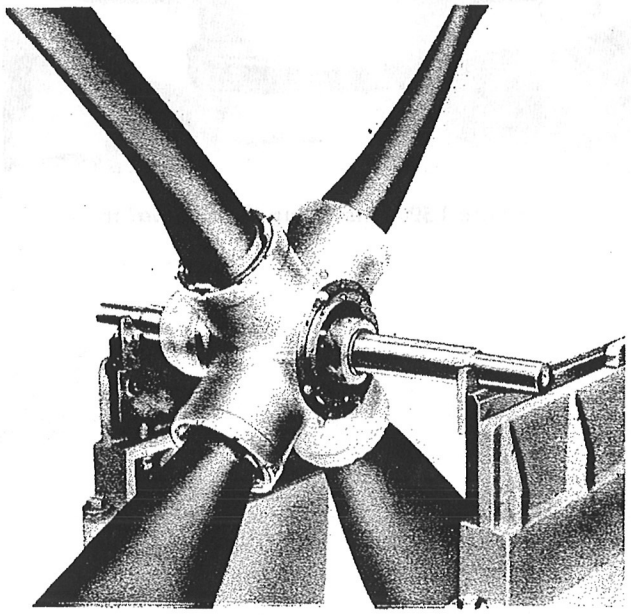


Figure 161—Aligning Propeller with Balancing Ways

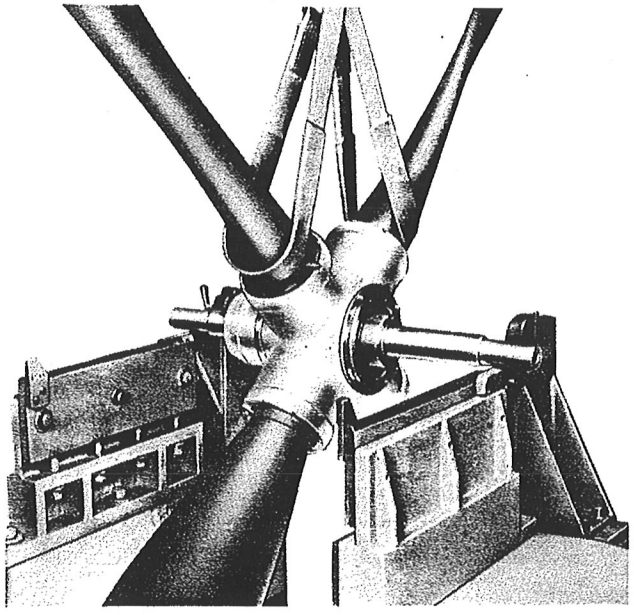


Figure 160—Lowering Propeller on Balancing Ways

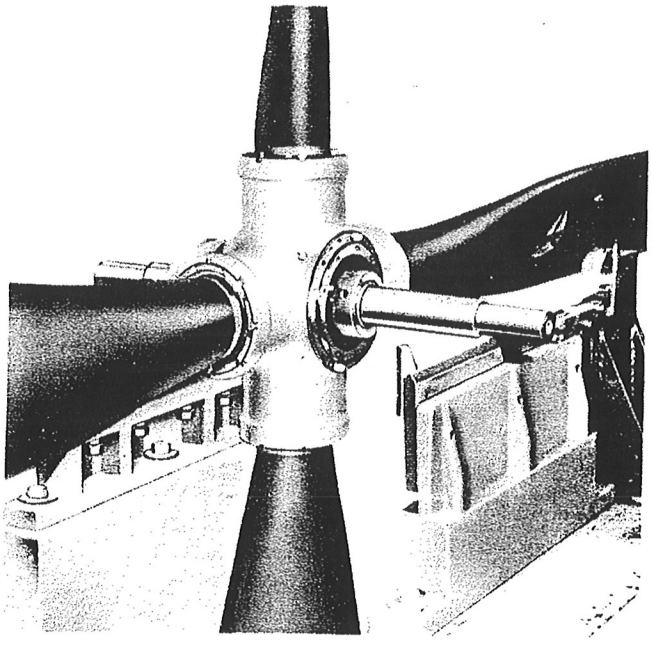


Figure 162—Balancing Propeller Horizontally

(13) Place the remaining blades in a horizontal position, noting the movement of the propeller to determine the light or heavy blade.

(14) Add balance weights with the screws to the castellations in the blade retaining nut of the light blade (or blades) until the propeller shows little tendency to rotate.

(15) If sufficient weight cannot be added by means of balance weights, proceed as follows:

(a) Using masking or other light tape, attach sufficient blade balance washers to the light blade or blades at a point which corresponds to the position of the balance cup until the propeller shows little tendency to rotate. *(See figure 163.)* Position these weights as follows: model A642S-E1, 3½ inches from the end of the hub socket; model A642S-E2, 2¾ inches from the end of the hub socket.

(b) When this portion of the operation is complete, use slings and hoist to lift the propeller from the balancing ways.

(c) Return the propeller to the surface table and, removing the necessary blades, install the balance washers in the balancing cup as required to equal the weight added externally during the balance check.

(d) Replace the blades in the hub and install the blade locks in the same position.

(e) Set the blades approximately at the midpoint between the minimum and the maximum blade angles.

(g) Replace the adapter and arbor and set the propeller again on the ways of the balancing stand, squaring the arbor with the knife edge stops.

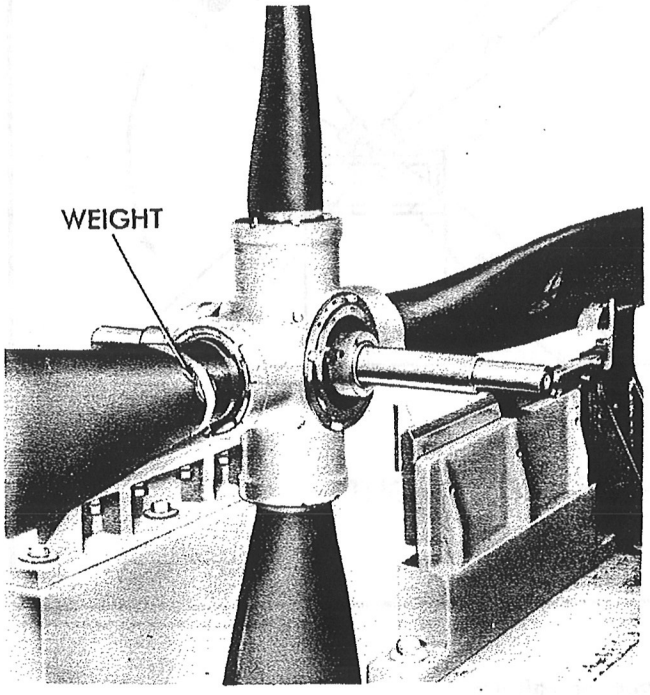


Figure 163—Balancing Propeller Horizontally

(16) Test for propeller balance as directed in paragraph b of this section.

b. TESTING FOR STATIC PROPELLER BALANCE.

Note

A simple test which can be used to determine whether or not propellers are in satisfactory static balance requires a piece of metal weighing 1/10 of one ounce. A United States copper penny is suggested since it is approximately 1/10 of an ounce in weight. This test eliminates the necessity of balancing the propeller to a standstill.

(1) Attach the weight to the propeller blade by a small strip of adhesive or masking tape. The radius at which the weight should be attached is 35 inches.

(2) Each blade should be tested, one after another, and in each test they should move in the direction indicated in figure 164. If the propeller does not move in the directions indicated for the various positions illustrated in figure 164, add or remove balance weights from the blade retaining nut until application of the test weight to any one blade will cause it to move in the direction indicated in the figure.

c. SUSPENSION METHOD OF PROPELLER BALANCING.

(1) GENERAL.

(a) Where knife edge equipment is not available, the propeller suspension method of balancing makes possible accurate correction of propeller unbalance. All the equipment required to conduct this type of balancing is supplied in a kit. The kit contains front and rear cone adapters, a suspension shaft and cable assembly, top and bottom nuts, spacers and a wrench. *(See figure 165.)* This kit is designated as AAF 8042-3A100.

(2) PROCEDURE.

(a) Remove the regulator. (Refer to section VI, paragraph 3, *a.)*

(b) Disassemble and thoroughly clean the hub as directed in section VI, paragraph 3. *c.*

(c) Replace the torque units and blades.

(d) Check the blades for proper indexing at low angle. Allowable variation between any two blades is .2 degree.

(e) Remove the balancer shaft from the kit and wipe excess oil from the balancer parts. Add a spacer and the No. 60 front cone adapter to the suspension balancer shaft. The letter "F" is stamped on the face of the front cone adapter.

(f) Adjust the top nut of the balancer until the distance from the face of the front cone adapter to the base of the balancer shaft is 9¾ inches. *(See figure 166.)* This is done to properly locate the pivot point just above the center of gravity.

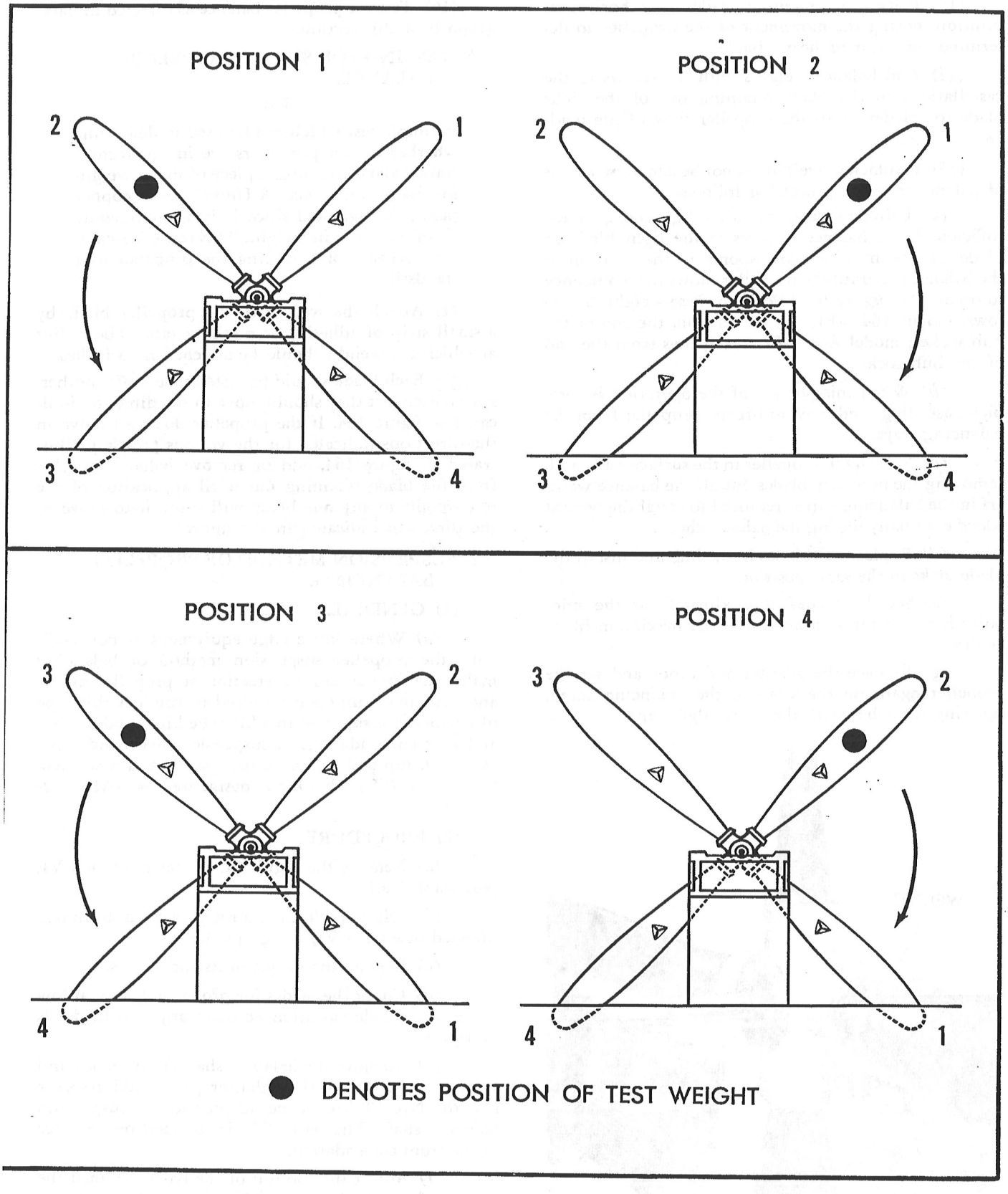


Figure 164—Checking Propeller Balance

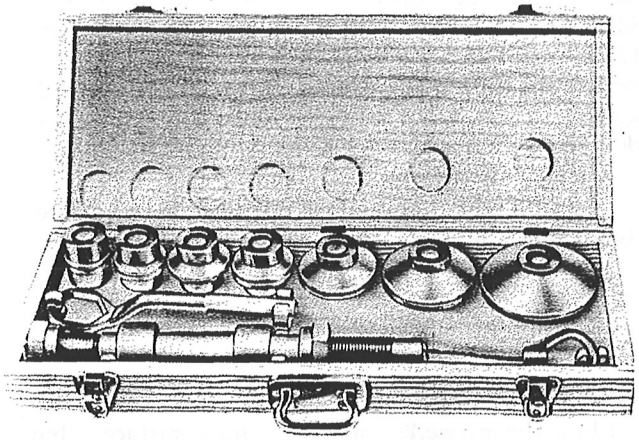


Figure 165—Suspension Balancing Equipment

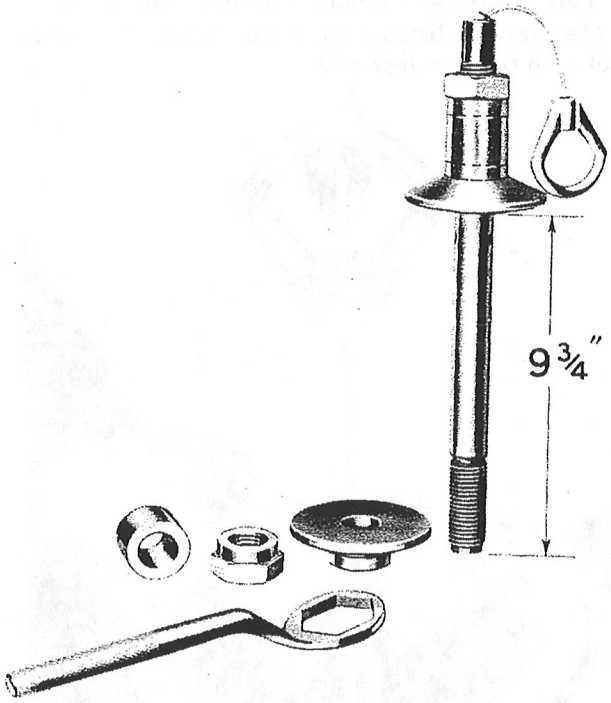


Figure 166—Adjusting Suspension Balancer

(g) Insert the balancer (with the top nut, spacer, and front cone adapter installed), through the propeller hub. *(See figure 167.)*

(h) Install the No. 60 rear cone adapter, a spacer and the bottom nut on the balancer shaft from the inboard side of the propeller. The letter "R" is stamped on the face of the rear cone adapter.

(i) Tighten the bottom nut with the special wrench supplied with the balancing kit. *(See figure 168.)*

CAUTION

When tightening the bottom nut, it is not necessary to exert a pressure of more than 15 pounds. Pressures greater than this may damage the cone adapter edges.

(j) Make certain all blades are at a low angle.

(k) Install the master gear, shim, and the master gear retaining plate.

(l) Set the blades at approximately the intermediate angle between minimum and maximum blade angle.

(m) Using a hoist, suspend the propeller horizontally from the ring at the end of the balancer cable.

(n) Observe the position of the disc at the top of the balancer shaft in relation to the ring. If any part of the ring is visible, the propeller is heavy on the side where the ring shows. *(See figure 169.)*

CAUTION

Keep propeller from circulating air.

(o) Attach balance weights to the castellations in the blade retaining nut on the light blade. Observe the position of the disc over the ring. Continue adding or removing balance weights on the light blade (or blades) until balance is obtained. *(See figure 170.)*

(p) If the propeller cannot be balanced by the addition of balance weights, add balance washers on the blade root at the position provided for the balance

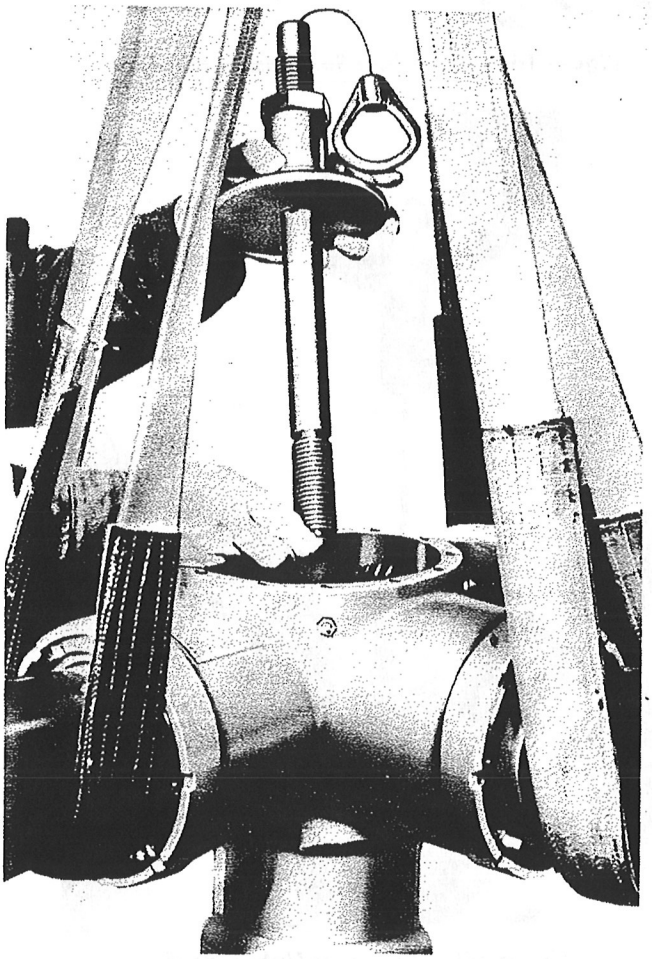


Figure 167—Installing Suspension Balancer

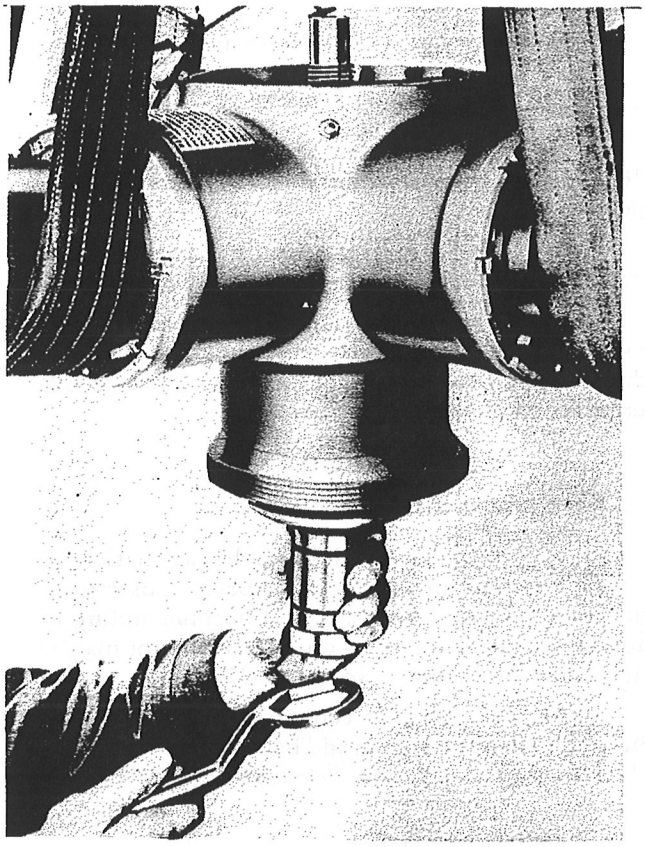


Figure 168—Installing Suspension Balancer

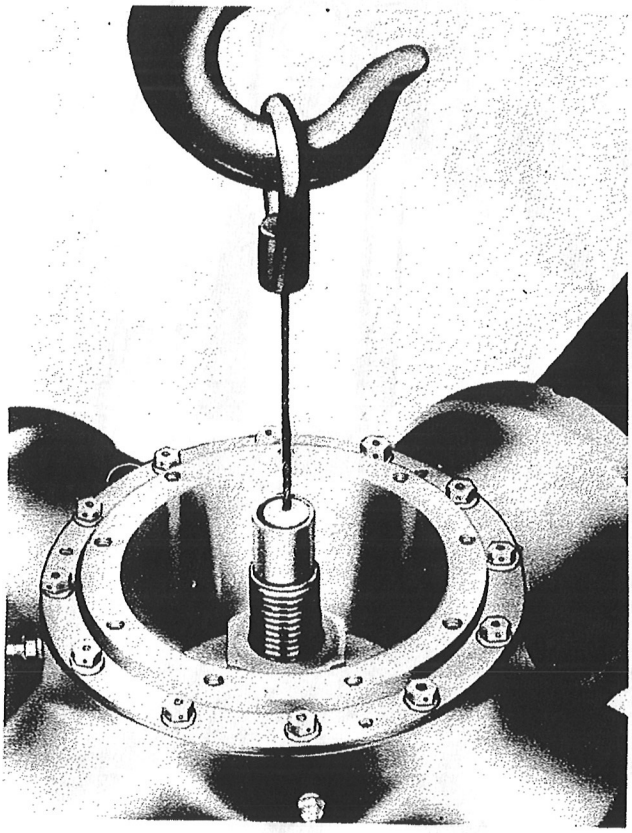


Figure 169—Propeller Unbalanced

washers inside the blade. This distance on model A642S-E1 is 3½ inches from the hub socket; on model A642S-E2 this distance is 2¾ inches from the hub socket. Remove the light blade. Install the necessary number of washers in the balance cup as required. Replace the blade in the hub and recheck the propeller balance, following the above steps.

(q) Tighten and safety the balance weights and the blade retaining nut locks with .032 inch safety wire.

CAUTION

Provide a .003 inch minimum between the balance weights and the blade shank.

2. CHECKING THE BLADE TRACK.

a. Place the propeller on an accurate surface table with the center line of the blade over the center line of the table.

b. Turn the blades to their minimum blade angle.

c. Measure the distance from the table to the center line of each tip. *(See figure 171.)*

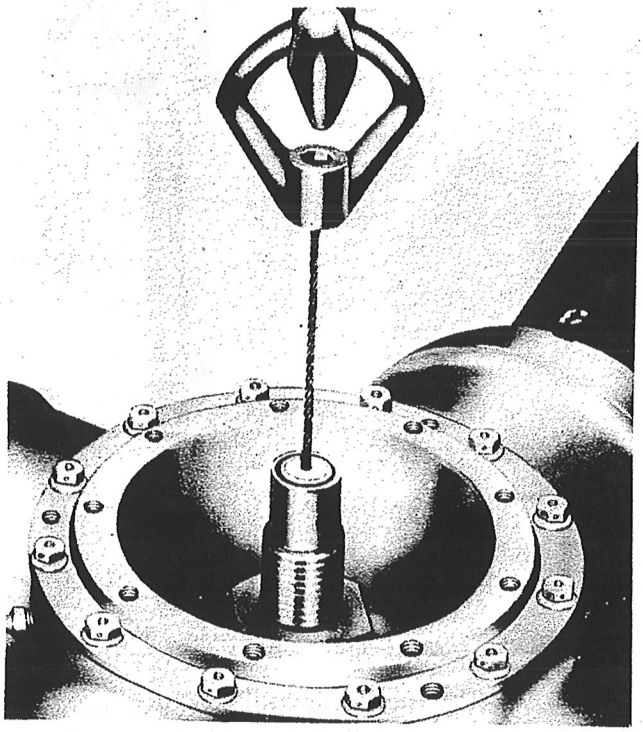


Figure 170—Propeller Balanced

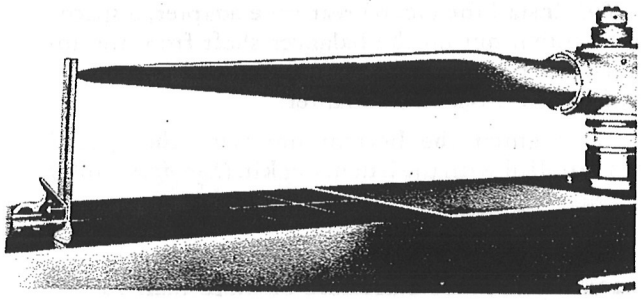


Figure 171—Checking Blade Track

Note

Allowable variation of the blades is plus or minus 1/16 inch from perfect track.

3. CHECKING THE BLADE ANGLE.

a. Place the propeller on a surface table with the thrust face of the propeller blade toward the table and the center line of the blade over the center line of the table.

b. Turn the blades to their minimum angle, and using a blade angle protractor and blade template, measure the angle between the thrust face of the blades and the surface at the 42-inch station. *(See figure 172.)*

Note

Locate the 42-inch station as directed in section VI, paragraph 5. *a.* (4).

c. Compare the angles of all blades. Angles for the blades in any one hub should not vary more than plus or minus .2 degree from the desired basic angle and the allowable angle variation between any two blades in a given hub is .2 degree. For proper indexing procedure to arrive at specified minimum blade angles, refer to section VI, paragraph 5. *a.* (1) *(p)*.

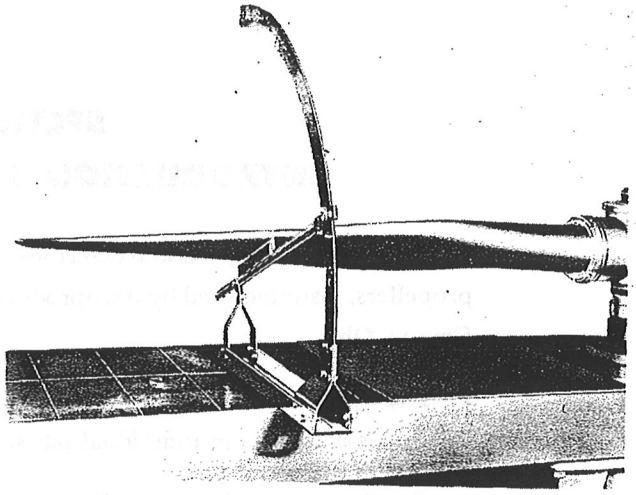


Figure 172—Checking Blade Angle

SECTION VIII
INTRODUCTION TO PARTS CATALOG

1. This parts catalog lists and describes the parts for models A642S-E1 and A642S-E2 propellers, manufactured by Aeroproducts Division of General Motors Corporation, Dayton, Ohio.

2. These propellers have been arranged in major assemblies which are broken down into subassemblies and individual parts.

3. The illustrations in Section IX assist in the identification of service parts. These various illustrations show the typical construction of important assemblies, and indicate the Index Number under which these parts may be located in the Group Assembly Parts List. Part numbers and descriptions may be secured by referring to the Figure and Index Number columns in the parts lists. *The index number is to be used for identification only. The part number and description must always be used for inquiries and orders.*

4. The Group Assembly Parts List, Section IX, consists of a breakdown of the complete assembly in serviceable subassemblies and detailed parts. Each assembly listed is directly followed by its component parts, properly indented to show its relationship to the assembly. The quantities specified are those used at the location shown, and are not necessarily the total number used per accessory. Refer to the Numerical Parts List, Section X, for the total quantity.

5. The Numerical Parts List, Section X, lists part numbers numerically, including standard parts. The column "Total Quantity" indicates the total number used per propeller.

6. The Standard Parts List, Section XI, lists the standard parts used per propeller.

7. Service Tools, Section XII, is a complete list of special tools necessary to install, disassemble, and reassemble the propeller unit. Illustrations of the service tools precede the tool list and will aid in the identification of these tools.

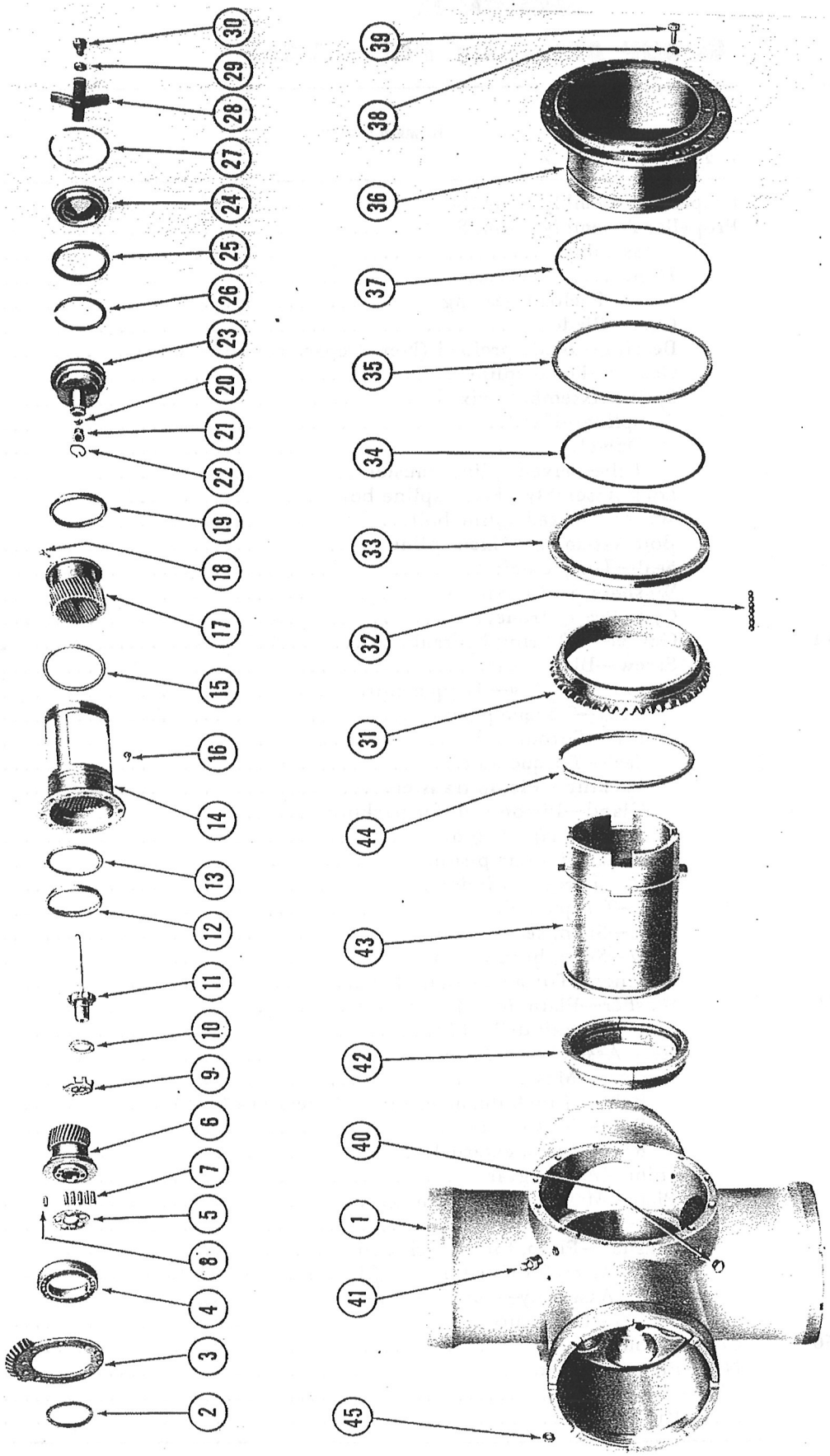


Figure 173—Hub Assembly

SECTION IX

GROUP ASSEMBLY PARTS LIST

FIGURE AND INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY.
176	6500487	Propeller Assembly (A642S-E1)	1
176	6500632	Propeller Assembly (A642S-E2)	1
173	6500486	Hub Assembly	1
173—1	6510935	Hub	1
173—2	6510003	Shim—Preload bearing	4
173—3	6511044	Gear—Blade	4
173—4	F-OL10-A	Bearing—Blade preload (New Departure) (6510004)	4
173—5	6510781	Gasket—Fixed spline	4
173	6500382	Spline Assembly—Fixed	4
173—6	6510769	Spline—Fixed	1
173—7	6510770	Dowel	5
173—8	6510821	Tube—Fixed spline transfer	1
173—9	6500383	Lock Assembly—Fixed spline bolt	4
173—10	6510772	Washer—Fixed spline bolt	4
173—11	6500384	Bolt Assembly—Fixed spline	4
173—12	6500449	Seal—Torque unit	4
173—13	6510774	Washer—Seal retaining	4
173—14	6510779	Cylinder—Torque	4
173—15	AN6230-11	Gasket—"O" ring hydraulic	4
173—16	6510064	Screw—Blade gear	16
173	6500385	Piston Assembly—Torque unit	4
173—17	6510776	Skirt—Torque piston	1
173—18	6510778	Pin—Torque unit	1
173—19	6500449	Seal—Torque unit	1
173—20	6510826	Packing—Piston transfer	1
173—21	6511045	Gland—Piston transfer packing	1
173—22	6510767	Ring—Snap, piston	1
173—23	6510777	Head—Torque piston	1
173—24	6510782	Head—Torque cylinder	4
173—25	6500449	Seal—Torque unit	4
173—26	6510775	Ring—Snap, seal retaining	4
173—27	6510780	Ring—Snap, head retaining	4
173—28	6511298	Retainer—Torque cylinder head	4
173—29	AN960-416	Washer—Plain, for ¼ inch bolt	4
173—30	6511356	Bolt—Aircraft drilled head	4
173	6500011	Gear Assembly—Master	1
173—31	6510025	Gear—Master	1
173—32	Com'l	Ball—¼ inch diameter grade A steel (147485)	78
173—33	6510026	Race—Master gear	1
173—34	6510028	Ring—Snap, external	1
173—35	6510029	Shim—Master gear	1
173—36	6511283	Plate—Master gear retaining	1
173—37	6511284	Seal—Master gear retaining	1
173—38	AN960-416	Washer—Plain, for ¼ inch bolt	12
173—39	AN74-5	Bolt—Aircraft drilled head, ¼ inch x 28, 5 inch long	12
173—40	6500727	Valve Assembly—Lubricator relief	1
173—41	AN286-1	Fitting—Lubricator	3
173—42	AN5007-60	Cone—Front	1
173—43	6510339	Nut—Propeller shaft	1
173—44	AN5009-60	Ring—Snap	1
173—45	6510399	Seal—Ring type	8

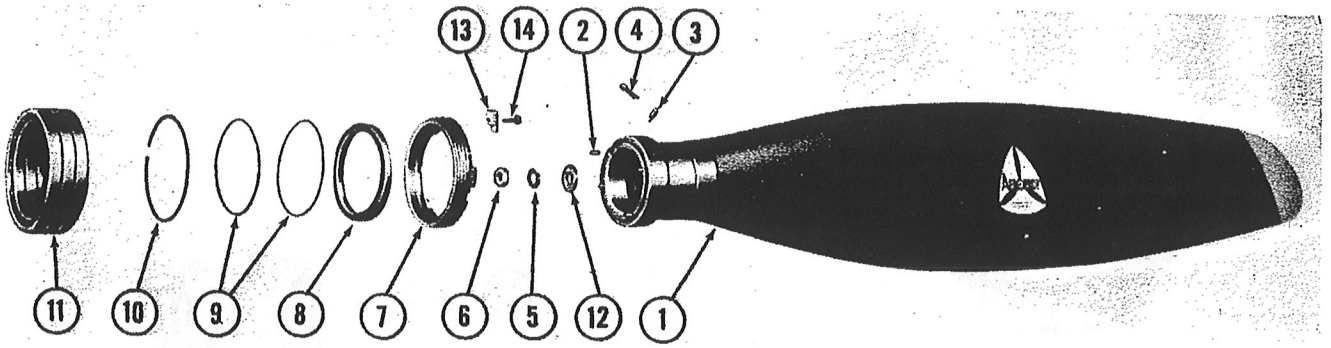


Figure 174—Blade Retention Assembly

FIGURE AND INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY.
174	6500448	Blade Retention Assembly (A642S-E1)	4
174	6500633	Blade Retention Assembly (A642S-E2)	4
174—1	A20-156-24M	Blade Assembly (A642S-E1)	1
174—1	A2891106	Blade Assembly (A642S-E2)	1
174—2	6510096	Dowel	6
174—3	6510095	Lock—Blade nut	1
174—4	AN380-2-2	Pin—Cotter, 1/16 inch x 1/2 inch long	1
174—5	AN935-516	Washer—Lock for 5/16 inch bolt	1
174—6	AN315-5R	Nut—Aircraft, plain 5/16—24 right hand thread	1
174	6500029	Nut Assembly—Blade retaining	1
174—7	6510089	Nut—Blade retaining	1
174—8	6510090	Seal—Blade retaining nut	1
174—9	6510091	Spring—Blade retaining nut seal	2
174—10	6510092	Ring—Snap, internal	1
174—11	3-OP-23	Bearing—Blade (New Departure) (6510093)	1
174—12	6510120	Washer—Balance plug	2
174—13	6510174	Lock—Blade retaining nut	10
174—14	AN502-8-8	Screw—Fillister head 8—36 x 1/2 inch long	10
175—	6500480	Regulator Assembly (A642S-E1)	1
175—	6500765	Regulator Assembly (A642S-E2)	1
175—1	6500492	Housing Assembly	1
175—2	AN6227—4	Packing—"O" ring hydraulic	2
175—3	6500595	Valve Assembly—Pressure control	1
175—4	AN960-416	Washer—Plain for 1/4 inch bolt	2
175—5	AN74-11	Bolt—Aircraft drilled head 1/4 inch x 1—18 inch long	2
175—6	6500726	Gasket—Filter screen	1
175—7	6500665	Governor Assembly (A642S-E1)	1
175—7	6500688	Governor Assembly (A642S-E2)	1
175—8	AN74-12	Bolt—Aircraft drilled head, 1/4 x 1 5/16 inch long	4
175—9	AN960-416	Washer—Plain, for 1/4 inch bolt	4
175	6500304	Pump Assembly—Gear	1
175—10	IP-519G-72	Pump—Gear (6500395)	1
175	6500221	Gear—Pump	1
175—11	212	Key—Woodruff (6511153)	1
175—12	6510464	Gear—Pump drive	1
175—13	AN960-416L	Washer—Plain, for 1/4 inch bolt	1
175—14	AN320-4	Nut—Aircraft 1/4 inch x 28, 7/16 inch head	1
175—15	AN380-2-3	Pin—Cotter, 1/16 x 3/4 inch long	1
175—16	6510451	Seal	1
175—17	AN960-416	Washer—Plain, for 1/4 inch bolt	2
175—18	6510226	Bolt—Aircraft drilled head	2
175—19	AN960-10	Washer—Plain for No. 10 bolt	2

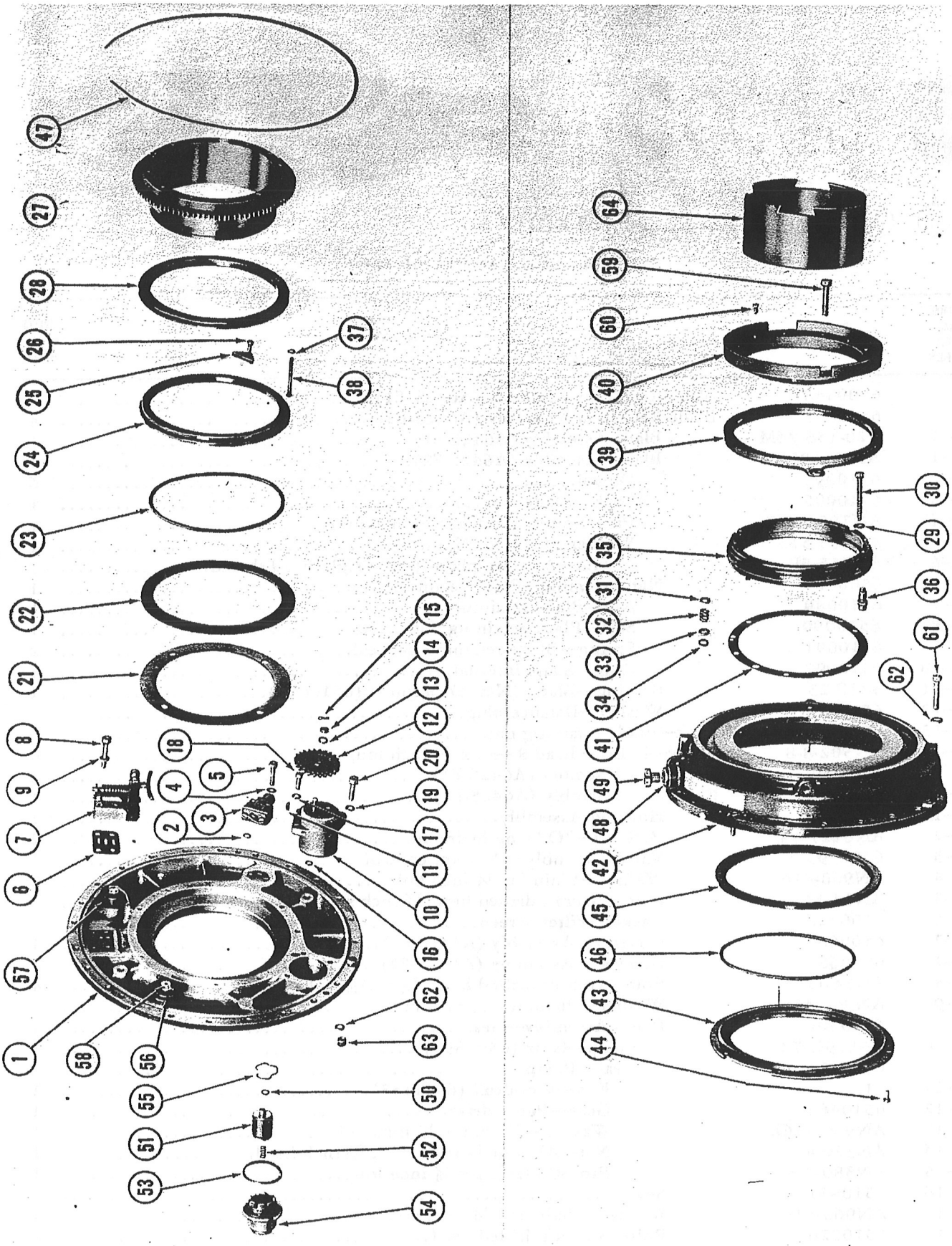


Figure 175—Regulator Assembly

FIGURE AND INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY.
175—20	AN73-5	Bolt—Aircraft drilled head, 10—32 x 5/8 inch long	2
175—21	6510452	Washer—Regulator	1
175—22	6510447	Seal—Housing	1
175—23	6500110	Spring Assembly—Housing seal	1
175—24	6511026	Bearing—Housing	1
175—25	6511046	Plate—Bearing retention	9
175—26	AN503-10-8	Screw—Drilled fillister head, 10—24 x ½ inch long	9
175—27	6511028	Gear—Pump power	1
175—28	6510283	Ring—Regulator control	1
175—29	6510453	Washer—Pinion thrust	3
175—30	6510428	Screw and Pinion—Control	3
175	6500543	Ring Assembly—Adapter	1
175—31	6510453	Washer—Pinion thrust	3
175—32	6510481	Spring—Seal	3
175—33	6510324	Washer—Spring retaining cup	3
175—34	6510451	Seal	3
175—35	6511104	Ring—Adapter	1
175—36	6500553	Valve Assembly—Pressure relief	1
175—37	6510227	Washer—"C"	3
175—38	6510167	Pin—Stop	3
175—39	6510449	Control—Gear and Lever	1
175—40	6510285	Plate—Regulator adapter	1
175—41	6511317	Gasket—Regulator adapter	1
175—42	6500149	Cover Assembly—regulator	1
175—43	6510398	Bearing—Cover	1
175—44	AN503-10-8	Screw—Drilled fillister head, 10—24 x ½ inch long	10
175—45	6510448	Seal—High speed cover	1
175—46	6500109	Spring Assembly—Cover seal	1
175—47	6510385	Seal—Cord	1
175—48	6510035	Washer—Filler cap	1
175—49	6510034	Plug—Filler	1
175	6500139	Filter Assembly—Oil	1
175	6500203	Screen Assembly	1
175—50	6510451	Seal	1
175—51	6500145	Cartridge	1
175—52	6510337	Spring—Oil filter	1
175	6500204	Cap Assembly	1
175—53	AN6230-1	Gasket—"O" ring hydraulic	1
175—54	6510342	Cap—Oil filter	1
175—55	6510379	Ring—Snap, pil filter	1
175—56	6510300	Weight—Regulator balance	AR
175—57	6510347	Weight—Regulator balance	AR
175—58	6510477	Bolt—Balance	AR
175—58	6510478	Bolt—Balance	AR
175—58	6510479	Bolt—Balance	AR
175—58	6510480	Bolt—Balance	AR
175—59	AN74-14	Bolt—Aircraft drilled head, ¼ x 1½ inch long	6
175—60	AN503-8-4	Screw—Drilled fillister head 8—32 x ¼ inch long	3
175—61	AN74-13	Bolt—Aircraft drilled head, ¼ inch x 28, 1¼ inch long	24
175—62	AN960-416	Washer—Plain, for ¼ inch bolt	48
175—63	AN365-428	Nut—Self-locking for ¼ inch x 28 bolt, 7/16 inch head	24
175—64	6510031	Nut—Regulator	1
176—1	AN5008-60	Cone—Rear	1
176—2	6510247	Insert—Rear cone	1
176—3	6510352	Spacer—Engine nose stud	2

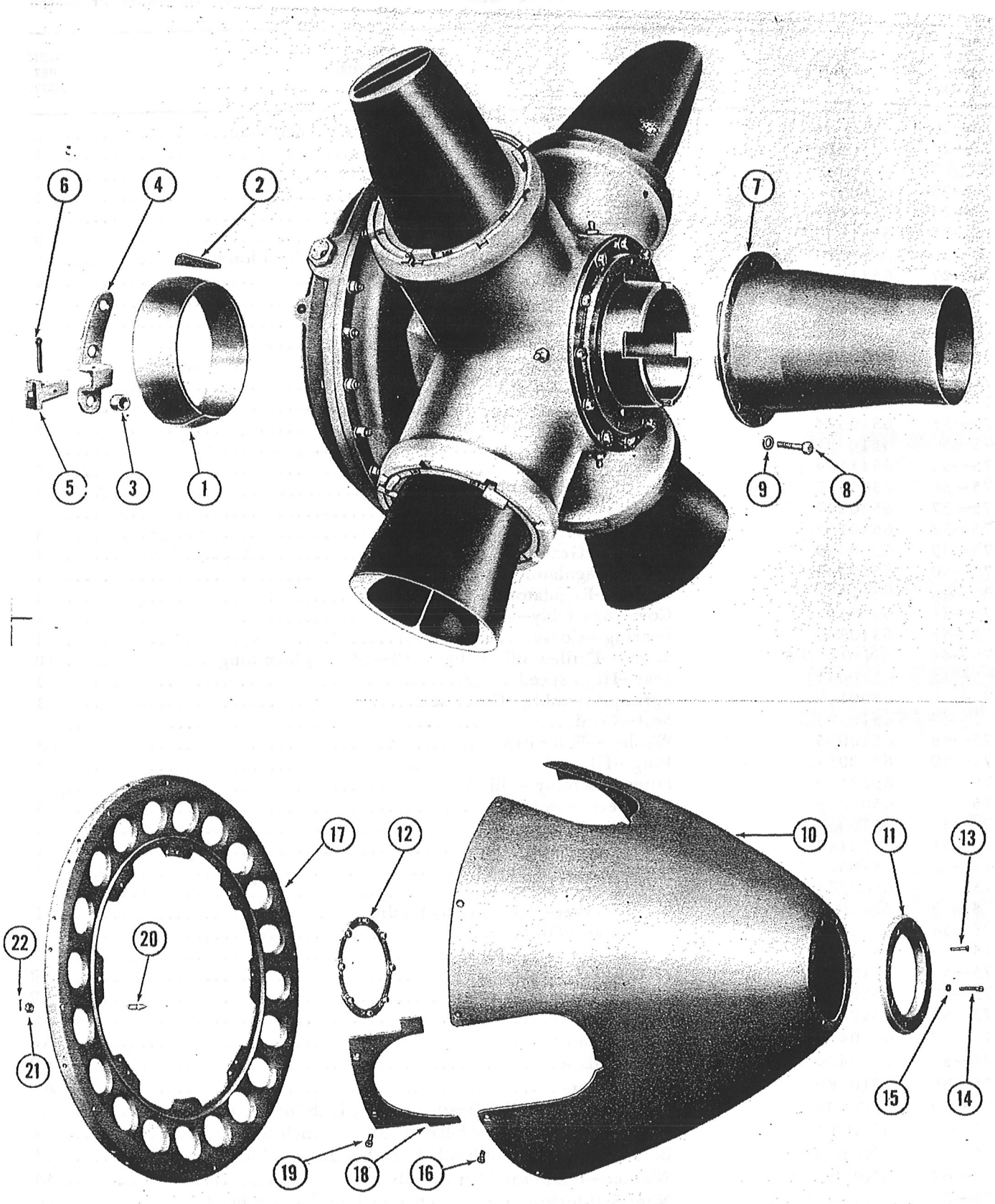


Figure 176—Propeller Installation

FIGURE AND INDEX NUMBER	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	UNITS PER ASSY.
176	6500106	Stop Assembly—Adapter	1
176—4	6510316	Bracket—Adapter stop	1
176—5	6500064	Block Assembly—Adapter	1
176—6	AN380-2-5	Pin—Cotter, 1/16 inch x 1 1/4 inch long	1
176—7	6510404	Adapter—Spinner	1
176—8	6511403	Bolt—Aircraft drilled head	9
176—9	AN960-416	Washer—Plain, for 1/4 inch bolt	9
176	6500609	Spinner Installation Assembly	1
176	6500199	Shell Installation—Spinner	1
176—10	6500182	Shell Assembly—Spinner	1
176—11	6510524	Nose—Spinner	1
176—12	6500194	Ring Assembly—Spinner	1
176—13	AN502-10-16	Screw—Drilled fillister head 10—32 x 1 inch long	4
176—14	AN510-10-14	Screw—Drilled fillister head 10 x 7/8 inch long	4
176—15	AN960-10	Washer—Plain, for No. 10 bolt	4
176—16	6510326	Screw	12
176	6500676	Bulkhead Assembly	1
176—17	6500181	Bulkhead	1
176—18	6500677	Plate Assembly—Spinner	4
176—19	6510326	Screw	8
176—20	6510411	Stud—Spinner pilot	8
176—21	AN310-4	Nut—Aircraft, 1/4—28 NF 3	8
176—22	AN380-2-2	Pin—Cotter, 1/4 inch x 1/2 inch long	9

SECTION X
NUMERICAL PARTS LIST

ARMY STATUS	PROPERTY CLASSIFICATION U. S. ARMY	U. S. NAVY	BRITISH	PART NUMBER	FIGURE AND INDEX NUMBER	TOTAL QTY.
				A20-156-24M	174-1	1
				A2891106	174-1	1
				AN286-1	173-41	3
				AN310-4	176-12	8
				AN315-5R	174-6	1
				AN320-4	175-14	1
				AN365-428	175-63	24
				AN380-2-2	174-4	9
					176-13	
				AN380-2-3	175-15	1
				AN380-2-5	176-6	1
				AN5007-60	173-42	1
				AN5008-60	176-1	1
				AN5009-60	173-44	1
				AN502-10-16	176-4	4
				AN502-8-8	174-14	10
				AN503-10-8	175-26	19
					175-44	
				AN503-8-4	175-60	3
				AN510-10-14	176-5	4
				AN6227-4	175-2	2
				AN6230-1	175-53	1
				AN6230-11	173-15	4
				AN73-5	175-20	2
				AN74-11	175-5	2
				AN74-12	175-8	4
				AN74-13	175-61	24
				AN74-14	175-59	6
				AN74-5	173-39	12
				AN935-516	174-5	1
				AN960-10	175-19	6
					176-6	
				AN960-416	173-29	79
					173-38	
					175-4	
					175-9	
					175-17	
					175-62	
					176-9	
				AN960-416L	175-13	1
				F-OL10-A	173-4	4
				IP-519G-72	175-10	1
				212	175-11	1
				3-OP-23	174-11	1
				42A7392	177-2	1
				42D7386	177-11	1
				42D7387	177-10	1
				42D7388	177-8	1
				42D7390	177-9	1
				6500011	173	1
				6500029	174	1
				6500064	176-5	1
				6500106	176	1
				6500109	175-46	1
				6500110	175-23	1
				6500139	175	1
				6500145	175-51	1
				6500149	175-42	1
				6500181	176-8	1
				6500182	176-1	1
				6500194	176-3	1
				6500199	176	1
				6500203	175	1
				6500204	175	1
				6500221	175	1
				6500304	175	1
				6500382	173	4
				6500383	173-9	4
				6500384	173-11	4
				6500385	173	4
				6500448	174	1
				6500449	173-12	9
					173-19	
					173-25	
				6500480	175	1
				6500486	173	1
				6500487	174	1
				6500492	175-1	1
				6500523	177-5	1
				6500543	175	1
				6500553	175-36	1
				6500591	177-7	1
				6500595	175-3	1
				6500601	177-3	1
				6500609	176	1
				6500632	173	1
				6500633	174	1
				6500665	175	1
				6500674	177-4	1
				6500676	176	1
				6500677	176-9	1
				6500688	175-7	1
				6500726	175-6	1
				6500727	173-40	1
				6500765	175-7	1
				6510003	173-2	4
				6510025	173-31	1
				6510026	173-33	1
				6510028	173-34	1
				6510029	173-35	1
				6510031	175-64	1
				6510034	175-49	1
				6510035	175-48	1
				6510064	173-16	16
				6510089	174-7	1
				6510090	174-8	1
				6510091	174-9	2
				6510092	174-10	1
				6510095	174-3	1
				6510096	174-2	6
				6510120	174-12	2
				6510167	175-38	3
				6510174	174-13	10
				6510226	175-18	2
				6510227	175-37	3
				6510247	176-2	1

ARMY STATUS	PROPERTY CLASSIFICATION U. S. ARMY	U. S. NAVY	BRIT-ISH	PART NUMBER	FIGURE AND INDEX NUMBER	TOTAL QTY.
				6510283	174-28	1
				6510285	175-40	1
				6510300	175-56	AR
				6510316	176-4	1
				6510324	175-33	3
				6510326	176-7	20
					176-10	
				6510337	175-52	1
				6510339	173-43	1
				6510342	175-54	1
				6510347	175-57	AR
				6510352	176-3	2
				6510379	175-55	1
				6510385	175-47	1
				6510398	175-43	1
				6510399	173-45	8
				6510404	176-7	1
				6510411	176-11	8
				6510428	175-30	3
				6510447	175-22	1
				6510448	175-45	1
				6510449	175-39	1
				6510451	175-16	5
					175-34	
					175-50	
				6510452	172-21	1
				6510453	175-29	6
					175-31	
				6510464	175-12	1
				6510477	175-58	AI
				6510478	175-58	AR
				6510479	175-58	AR
				6510480	175-58	AR
				6510481	175-32	3
				6510524	176-2	1
				6510600	177-6	1
				6510767	173-22	1
				6510769	173-6	1
				6510770	173-7	1
				6510772	173-10	4
				6510774	173-13	4
				6510775	173-26	4
				6510776	173-17	1
				6510777	173-23	1
				6510778	173-18	1
				6510779	173-14	4
				6510780	173-27	4
				6510781	173-5	4
				6510782	173-24	4
				6510821	173-8	1
				6510826	173-20	1
				6510935	173-1	1
				6511021	177-1	2
				6511026	175-24	1
				6511028	175-27	1
				6511044	173-3	4
				6511045	173-21	1
				6511046	175-25	9
				6511104	175-35	1
				6511283	173-36	1
				6511284	173-37	1
				6511298	173-28	4
				6511317	175-41	1
				6511356	173-30	4
				6511403	176-8	9

SECTION XI
STANDARD PARTS LIST

PART NUMBER	NOMENCLATURE	ATTACHING QTY.
AN286-1	Fitting	3
AN310-4	Nut	
AN315-5R	Nut	
AN320-4	Nut	
AN365-428	Nut	24
AN380-2-2	Pin	1
AN380-2-3	Pin	
AN380-2-5	Pin	
AN5007-60	Cone	1
AN5008-60	Cone	1
AN5009-60	Ring	1
AN502-10-16	Screw	
AN502-8-8	Screw	10
AN503-10-8	Screw	
AN503-8-4	Screw	3
AN510-10-14	Screw	
AN6227-4	Packing	
AN6230-1	Gasket	1
AN6230-11	Gasket	4
AN73-5	Bolt	
AN74-11	Bolt	
AN74-12	Bolt	
AN74-13	Bolt	24
AN74-14	Bolt	
AN74-5	Bolt	
AN935-516	Washer	
AN960-10	Washer	
AN960-416	Washer	57
AN960-416L	Washer	

SECTION XII
SERVICE TOOLS

FIGURE AND INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY.
177	6500227	Tool Set—Service Overhaul	2
177—1	6511021	Aligner—Cylinder assembly	1
177—2	42A7392	Bleeder Assembly—Hub socket air 6500075	1
177—3	6500601	Fixture Assembly—Piston head assembly	1
177—4	6500674	Indicator—Piston aligner	1
177—5	6500523	Puller Assembly—Piston	1
177—6	6510600	Template—A20-156—Blade	1
177—7	6500591	Wrench Assembly—Control screw	1
177—8	42D7388	Wrench Assembly—Propeller shaft nut 6500070	1
177—9	42D7390	Wrench Assembly—Fixed spline bolt 6500668	1
177—10	42D7387	Wrench Assembly—Blade retaining nut 6500069	1
177—11	42D7386	Wrench—Regulator nut 6510105	1
177	6500123	Tool Set—Field Maintenance	
177—2	42A7392	Bleeder Assembly—Hub socket air 6500075	1
177—8	42D7388	Wrench Assembly—Propeller shaft nut 6500070	1
177—10	42D7387	Wrench Assembly—Blade retaining nut 6500069	1
177—11	42D7386	Wrench—Regulator nut 6510105	1
177—6	6510600	Template—A20-156 Blade	1

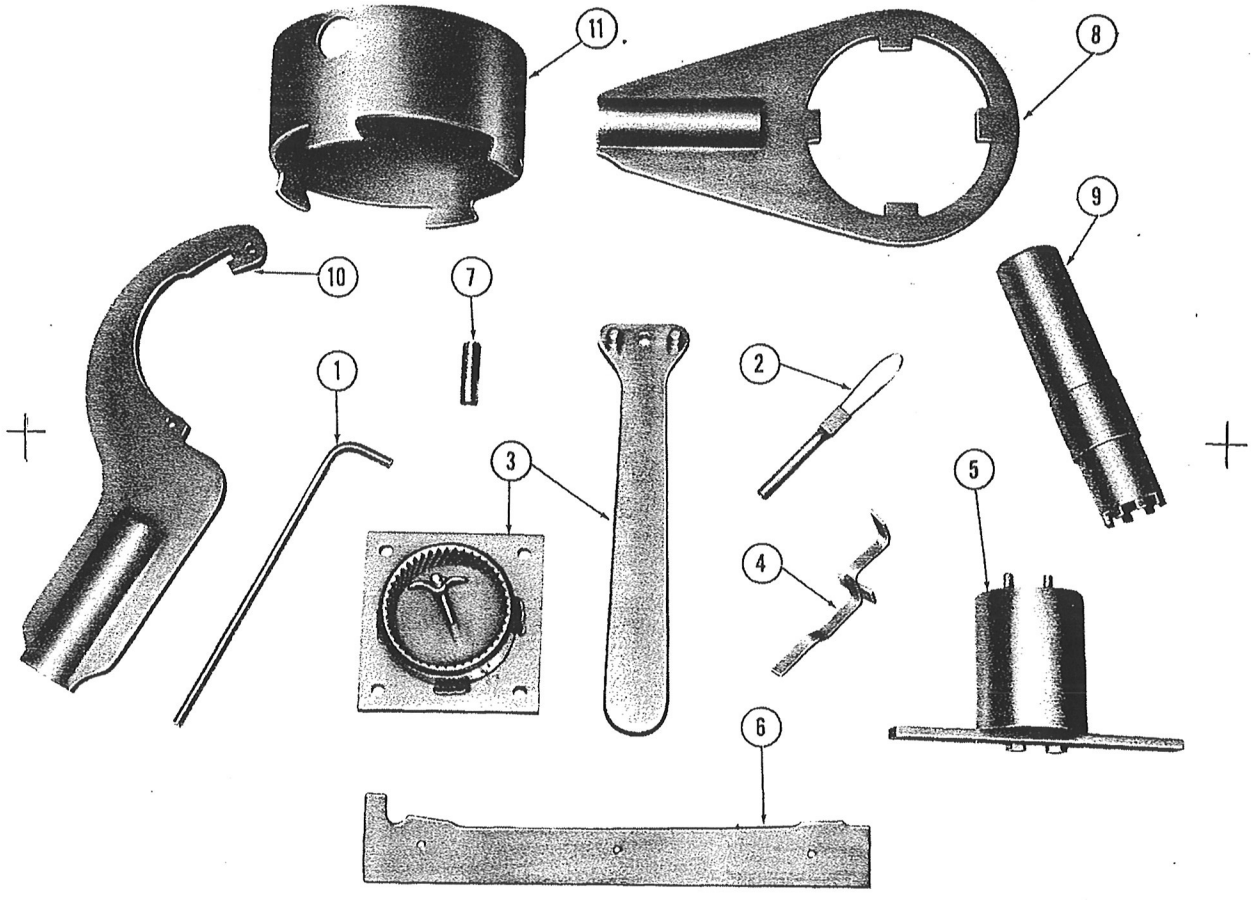


Figure 177—Service Tools