PROPERTY OF
AMERICAN AIRMOTIVE
POWER PLANT
ENGINEERING

HYDROMATIC *REVERSING* PROPELLERS

OVERHAUL MANUAL
MODEL 43E60

HAMILTON STANDARD

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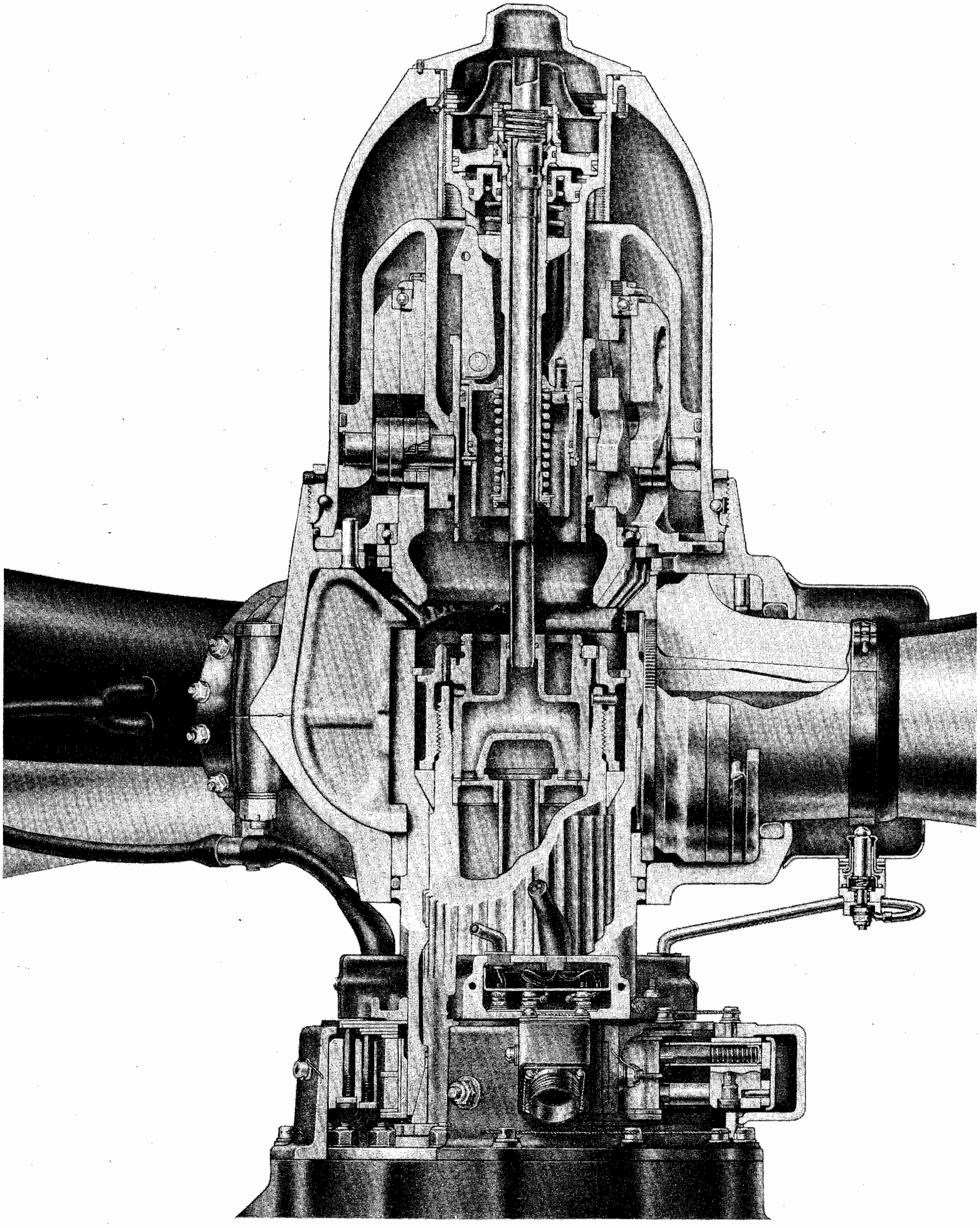


Figure 1—1. Cutaway View 43E60 Engine Oil Propeller

Introduction

1—1. This manual provides the overhaul instructions for the Reversing Hydromatic propeller used on the Douglas DC-6B airplane. These propellers in conjunction with their accessories provide constant speed operation, fast feathering, and reversing. In addition to the propeller, the basic equipment includes a double-acting constant speed control, electric de-icing and control assembly, synchronizer assembly, de-icer timer, RPM control box assembly, RPM control relay box, and various switches, indicator lights, circuit breakers, etc. The overhaul time should be in compliance with the latest revised applicable operating agency directions.

1—2. The Reversing Hydromatic propeller is composed of a 43E60-9 hub assembly, and 6895A-8 blades, with heater and connector assembly 78932.

1—3. This equipment is supplied by the Hamilton Standard Division of the United Aircraft Corporation, East Hartford, Connecticut.

1—4. GENERAL DESCRIPTION.

1—5. HUB MODEL DESIGNATION.

1—6. The model designation for the propeller hub consists of a basic model number plus a parts list number for a specific unit; i.e., 43E60-9, PL 43E60-9P2. In this case, the basic model number indicates the following:

a. The first number, 4, indicates a major change in the hub design.

b. The second number, 3, indicates the number of blades in the hub.

c. The letter, E, identifies the blade shank size.

d. The last two numbers, 60, preceding the dash indicates the SAE propeller shaft size.

e. The number following the dash, 9, indicates the functional and installational characteristics of the hub.

f. The hub assembly parts list number, PL 43E60-9P2, indicates the various physical differences between certain parts or between assemblies, but as long as these differences do not affect the operational characteristics of the propeller, the propeller dash number will remain the same.

1—7. BLADE MODEL DESIGNATION.

1—8. The blade assembly is identified by design numbers stamped on the circumference of the butt end of each blade. As an example, on a blade designated as a 6895A-8, (shown in figure 5,) the numbers and letter indicates the following:

a. The first number group, 6895, specifies the basic blade design.

b. The letter, A, following the basic blade design number group shows that the blade is a blade assembly; an assembly generally includes the bearing assembly, the bushing, the bushing drive pins, the shim plate drive pins, the bushing screws, and the balancing plug assembly.

c. The dash number, 8, following the basic blade design number indicates the number of inches the propeller diameter is reduced by straight cut-off from that provided by the basic blade design.

1—9. DETAILED DESCRIPTION.

1—10. The hub assembly is composed of three major sub-assemblies; barrel assembly, dome assembly, and low pitch stop lever assembly as shown in Figure 2—51 plus certain related parts which may vary with installational requirements.

1—11. The barrel assembly consists of the spider, barrel, barrel supports, blade gear segments and various other parts as shown in Figure 2—52. The barrel is manufactured in two halves which are machined and balanced in pairs and kept together throughout the service life of the propeller. These barrel halves are held together by means of twelve bolts located between each blade bore in groups of four. The bolt centers are drilled out to provide for lead wool used in final balance, and are closed by use of welch plugs. The barrel carries the high centrifugal blade loads by means of shoulders at each blade bore, and lips are incorporated outside the shoulders to hold the blade packing. The blades are mounted on the spider arms and retained by the two barrel halves. Each blade is free to rotate about its longitudinal axis under control of the dome assembly.

1—12. The dome assembly consists of a dome shell, stationary cam, rotating cam, piston, and various other parts as shown in Figure 2—58. This assembly is the pitch changing mechanism for the blades and is attached to the outboard end of the barrel. Its rotating cam meshes with the blade gear segments to change the blade angle as the piston is moved by oil pressure from the control. The cams are constructed so that the tracks offer additional range outside the constant speed portion in the high pitch direction for feathering, and in the low pitch direction for reversing. The piston incorporates a sleeve with slotted openings on its inboard end to permit dumping of the high pressure oil on the barrel side to the outboard piston side when the propeller is being held in the reverse position.

1—13. The low pitch stop lever assembly is a combination shaft extension and hydraulic operated low pitch stop, shown in Figure 2—59. Low pitch stop settings are provided by mechanical stops attached to the lever sleeve. These stops come in contact with the outboard end of the piston sleeve and are held in place by a spring loaded wedge. To permit movement beyond the low pitch setting toward reverse pitch, the low pitch stops are released by application of high pressure oil to the servo piston.

1—14. The oil transfer housing is an adapter threaded into the propeller shaft. It provides oil passages from the propeller shaft to both sides of the piston in the dome.

1—15. DE-ICING AND CONTROL ASSEMBLY.

1—16. The de-icing and control assembly is a means of power transmission to the blade heaters for de-icing purposes and signal transmission for propeller control purposes. This assembly comprises a brush pad and bracket assembly which includes a control brush bracket assembly and is attached to the engine nose, a slip ring assembly, signal and control cam assembly, control switch, and blade cam guard assembly which are attached to the revolving propeller. In conjunction with the de-icing system is a timer assembly which controls the specified cycling time of the particular installation.

1—17. PRINCIPLES OF OPERATION.

1—18. The propeller control forces are centrifugal and aerodynamic twisting moment on the blades and oil under pressure delivered by the pump in the constant speed control assembly or governing mechanism. The centrifugal twisting moment is a component of centrifugal force which acts on the blades of the rotating propeller in a direction tending to move the blades toward zero angle. The areodynamic moment results from the air loads on the blades and usually acts in a direction tending to move the blades toward high blade angle and is usually small in comparison to the centrifugal twisting moment. The pump oil pressure is directed by the constant speed control to either side of the propeller piston.

1—19. CONSTANT SPEED.

1—20. During constant speed operation the centrifugal force on the fly-weights in the governor opposed by the force of the speeder spring, determines the side of the piston in the propeller dome to which the pump oil will be directed for changes in blade angle. If engine rpm is lower than the constant speed control setting, pump oil is directed from the control decrease pitch line to the inboard side of the propeller piston. The piston moves outboard changing the blades to a lower angle. If engine rpm is higher than the constant speed setting, pump oil is directed from the increase pitch passages through the oil transfer housing, and the oil supply tube to the outboard side of the propeller system. The piston is forced inboard causing the blades to assume a higher angle.

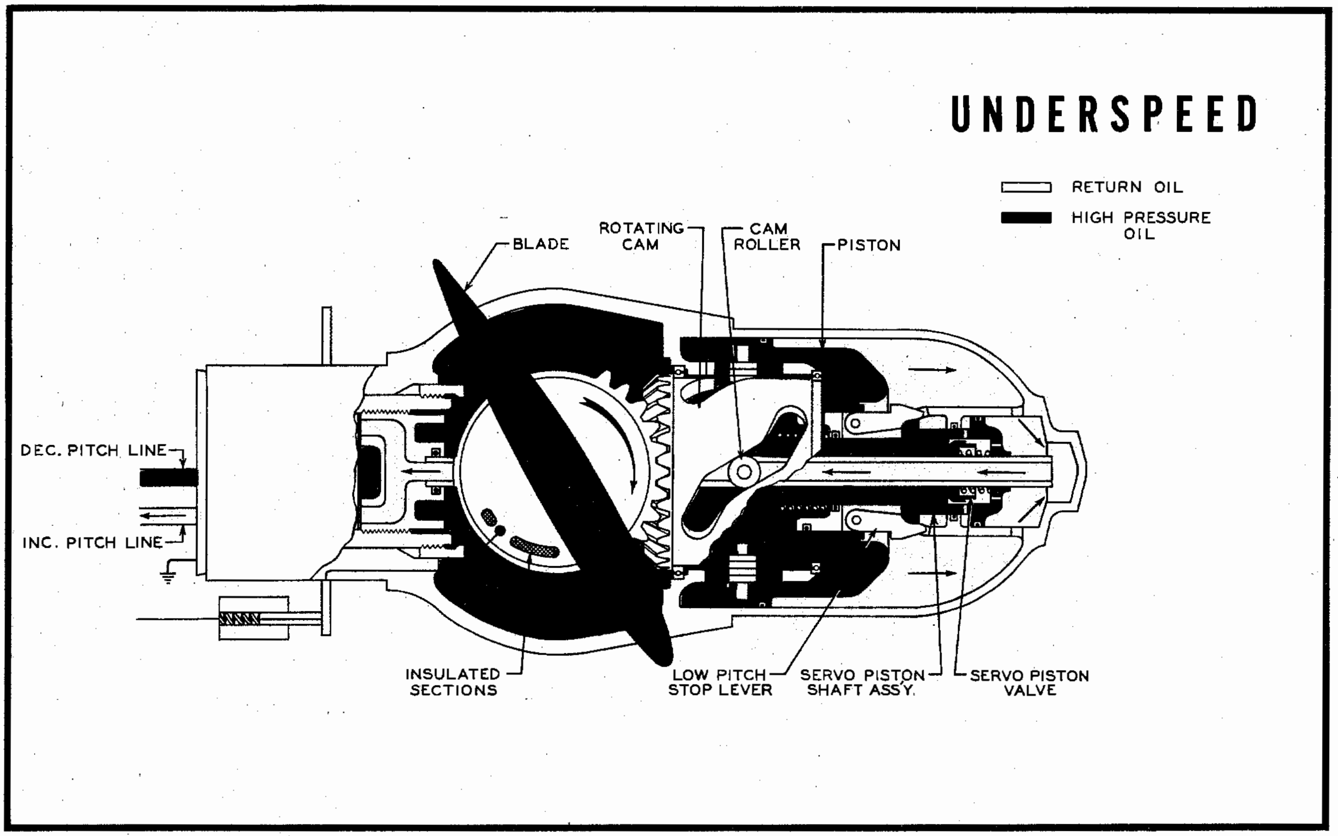


Figure 1—2. Engine Oil Operating Diagram

During the onspeed condition the forces in the control are in balance. The pilot valve is positioned so that only enough oil flow to the outboard side of the propeller piston is allowed to replace normal internal leakage oil at the pressure required to balance the centrifugal twisting moment on the blades which tends to force them towards zero blade angle.

1—21. REVERSING AND UNREVERSING.

1—22. Reversing is begun by moving the throttle into the reverse portion of the quadrant. This action energizes the solenoid, opening its valve to direct pump oil to the reverse positioning chamber in the pilot valve sleeve, and also starts the auxiliary pump. The pilot valve is moved to the underspeed position where it directs control pump and auxiliary pump oil to the inboard side of the piston forcing the piston outboard. At the same time pressure is exerted against the servo piston, moving the piston and the servo piston shaft outboard. As soon as the stop lever wedge is pulled beyond the stop levers, they close in rapidly out of the way of the piston sleeve. The piston continues outboard turning the rotating cam which moves the blades toward the reverse blade angle. The auxiliary pump is shut off by a #2 control switch at a point slightly above the stop. When the propeller reaches reverse, the piston sleeve has moved far enough to allow the inboard high pressure oil to meter through the slots in the inboard end of the piston sleeve to the outboard side of the piston thereby reducing the barrel pressure.

1—23. During the unreversing operation, auxiliary pump oil is directed to position the pilot valve for overspeed operation. Also, auxiliary oil is delivered to the outboard side of the propeller piston to move the blades toward positive pitch in the constant speed range. As soon as the blades reach an angle 5—7 degrees above the low pitch setting, the control switch on blade #1 closes to energize the unreversing termination circuit. The governing mechanism now assumes control of the propeller in the constant speed range.

1—24. FEATHERING AND UNFEATHERING.

1—25. The feathering operation is begun by depressing the feathering push-button switch momentarily. This closes the circuit which energizes the holding coil of the push-button switch and the relay which directs the high amperage current to operate the auxiliary motor and pump. The pressure rise at full feathered position actuates the pressure cut-out switch on the control assembly to terminate auxiliary pump action and de-energizes the push-button holding coil.

1—26. To unfeather, the push-button is pulled out and held manually. This action completes the circuits to energize the auxiliary pump motor and the decrease pitch solenoid valve. Auxiliary pump pressure is exerted against the inboard side of the propeller piston to change the blades to a lower angle. At the first indication of propeller wind-milling, the push-button is released, unfeathering stops, and the normal constant speed operation is resumed. In case the push-button is inadvertently held out too long, the blade control switch will break the circuit to terminate unfeathering at an angle well above the low pitch angle.

Overhaul

2—1. OVERHAUL TOOLS REQUIRED.

TOOL NUMBER	NOMENCLATURE	APPLICATION	FIGURE NUMBER
HSP-33	Bench — Assembly	To assemble propellers. Does not include HSP-167.	2—1
HSP-46	Stand — Balance	For balancing propellers.	2—2
HSP-105	Protractor — Blade Angle	For measuring blade angles.	2—3
HSP-167	Support — Assembly Post	To support post on bench.	2—1
HSP-232	Ways — Knife Edge Balancing	Used with HSP-46 for balancing propellers.	2—4
HSP-272	Puller — Barrel Half	For separating the barrel.	2—5
HSP-381	Inserter — Blade Bushing	For installing blade bushing into bore.	2—6
HSP-465	Strap — Dome	For holding dome.	2—7
HSP-470	Fixture — Rear Cone Lapping	For lapping rear cone into spider.	2—8
HSP-535	Puller — Bushing	For removing blade bushing.	2—9
HSP-687	Bushing — Assembly and Balance	For supporting propeller at assembly or balance.	2—10
HSP-706	Gage — Spider Spline No-Go	For checking hub splines.	2—11
HSP-916	Puller — Plug	For removing balancing plugs.	2—12
HSP-1083	Extensiometer — Barrel Bolt	To measure elongation of barrel bolts.	2—13
HSP-1093	Gage — Blade Fillet Radius	For checking blade fillet.	2—14
HSP-1258	Handle — Dome Lifting	For lifting dome.	2—15
HSP-1260	Wrench — Stop Lever Adjusting	For adjusting low pinch stop lever.	2—16
HSP-1276	Wrench — Servo Piston & Dome Cap	For assembling servo piston to stop lever.	2—17
HSP-1278	Post — Test	Used with HSP-2100 for testing propellers.	2—18
HSP-1320	Gage — Preload	To determine shims required between dome and hub.	2—19
HSP-1328	Puller — Cam Roller Shaft	To install and remove cam roller shafts.	2—20
HSP-1397	Reamer — Taper Bore	For machining taper bore in blades.	2—21
HSP-1400	Hub — Blade Balancing	For balancing blades in sets.	2—22
HSP-1401	Gage — Taper Plug	For checking taper in blade butt.	2—23
HSP-1410	Fixture — Concentricity Checking	For checking squareness and concentricity of 2 piece barrel.	2—24
HSP-1460	Socket — Oil Transfer Housing	To install and remove oil transfer housing.	2—25

2—1. OVERHAUL TOOLS REQUIRED (cont.)

TOOL NUMBER	NOMENCLATURE	APPLICATION	FIGURE NUMBER
HSP-1477	Adapter — Cone Seat Grinding	For machining cone seats.	2—27
HSP-1597	Block — Valve Test	For testing solenoid valves.	2—28
HSP-1661	Tool requirement deleted		2—29
HSP-1682	Sling — Propeller Hoisting	For lifting propeller.	2—30
HSP-1685	Sleeve — Stop Lever Test	For testing stop lever assembly.	2—31
HSP-1731	Gage — Cone Seat	For checking cone seat diameters.	2—32
HSP-1733	Tester — Portable Hydraulic Propeller	For testing Hydromatic propellers.	2—33
HSP-1753	Post — Assembly	To support propeller at assembly or disassembly.	2—34
HSP-1754	Post — Concentricity	Adapts to all assembly posts.	2—35
HSP-1827	Indicator — Blade Checking	For checking nicks and scratches in blades.	2—36
HSP-1833	Wrench — Dome Retaining Nut	For propellers with or without muff.	2—37
HSP-1891	Socket — Propeller Retaining Nut	To install and remove propeller retaining nut.	2—26
HSP-1896	Fixture — Bench Holding	For holding cam during dome assembly.	2—38
HSP-1936	Wrench — Reverse Stop Adjusting Sleeve	For adjusting dump valve during test.	2—39
HSP-2063	Wrench — Servo Nut	For installing and removing servo nut.	2—40
HSP-2127	Torque Fixture — Cam Bearing Nut	Used to apply 300-350 lb.-ft. torque.	2—41
HSP-2128	Wrench — Servo Piston Shaft	Used to assemble or disassemble dump type stop lever assemblies.	2—42
HSP-2268	Separator — Bearing Cam Roller	Used to assemble or disassemble needle bearings.	2—43
HSP-2382	Tool — Peening	Used to shot peen damaged areas on shotblasted blades.	2—44
HSP-2430	Template — Blade	For checking blade angles.	2—45
HSP-2469	Inserter and Remover — Piston Sleeve	To remove and install piston sleeves.	2—46
HSP-2480	Grinding Fixture — Piston Sleeve	Used for grinding piston sleeve.	2—47
HSP-2533	Pressure Test Fixture — Control Switch	To test switch after reassembly.	2—48
HSP-2564	Wheatstone Bridge — Low Ohm	Used for checking de-icing blade heaters.	2—49
HSP-2626	Bar — Blade Turning	For turning blades.	2—50
HSP-ST-5100	Assembly — Hydraulic Torque Wrench	Consists of HSP-5001, 5002, 5003, 5004, and 5006. To Torque propeller retaining nut.	2—51

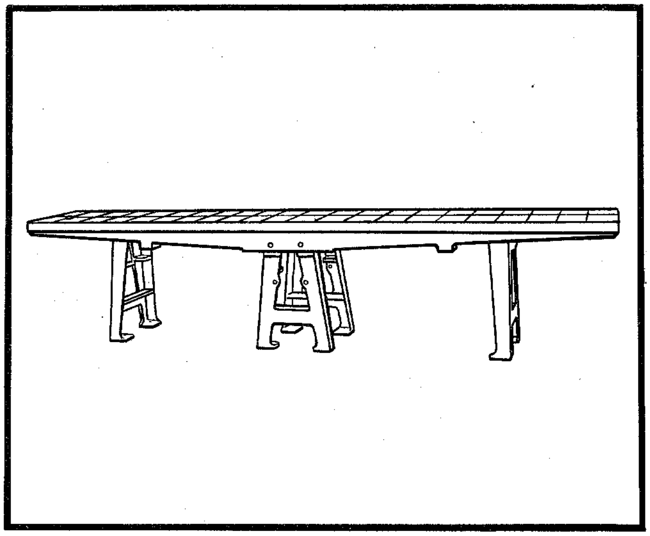


Figure 2—1. Bench Assembly

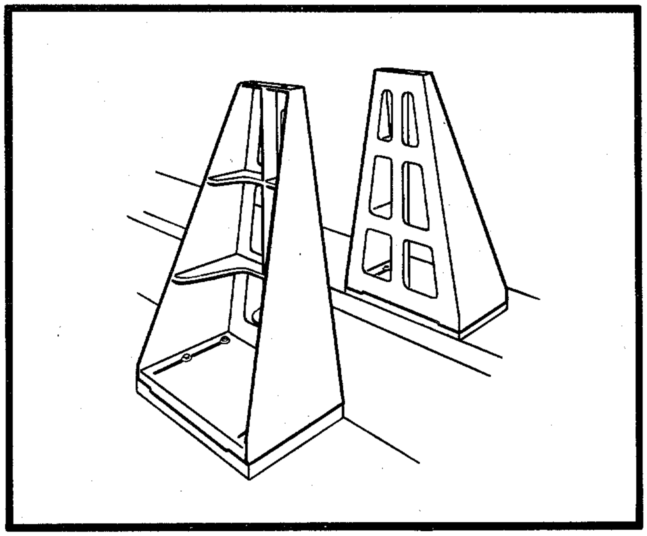


Figure 2—2. Balance Stand

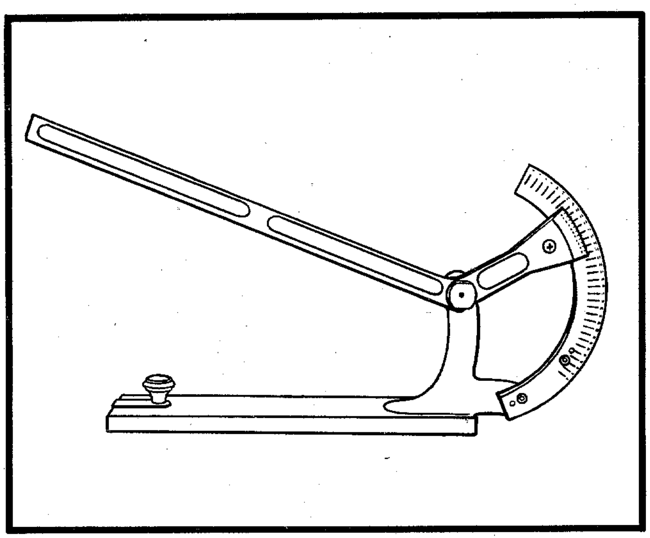


Figure 2—3. Blade Angle Protractor

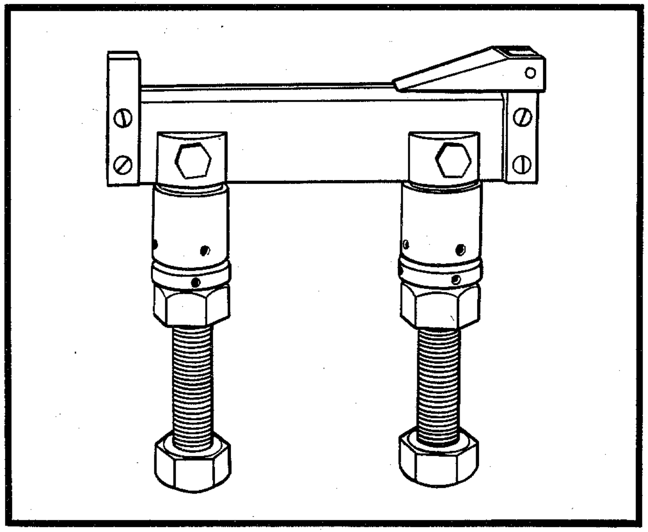


Figure 2—4. Knife Edge Balancing Ways

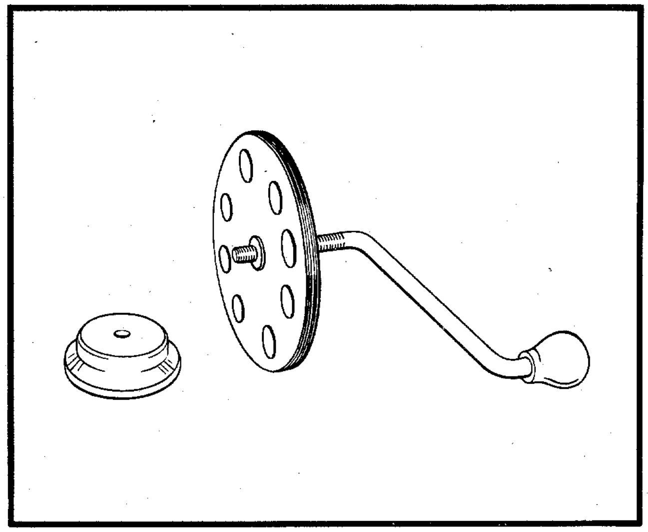


Figure 2—5. Barrel Half Puller

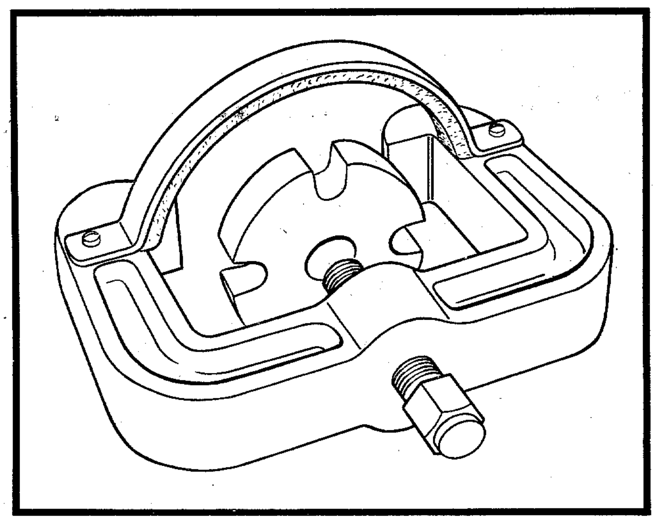


Figure 2—6. Blade Bushing Inserter

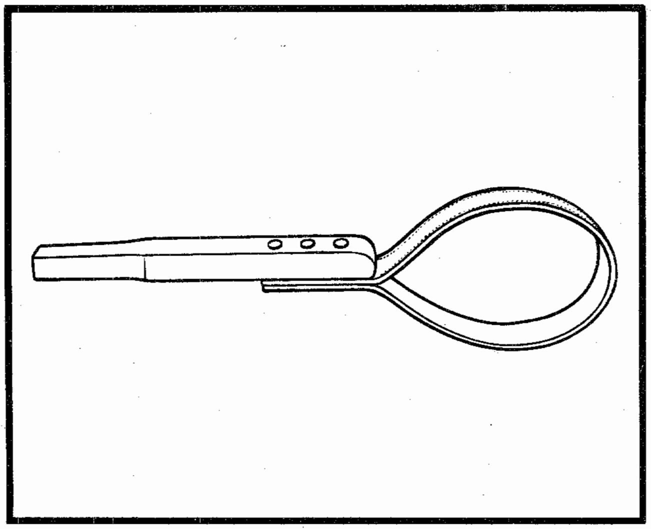


Figure 2—7. Dome Strap

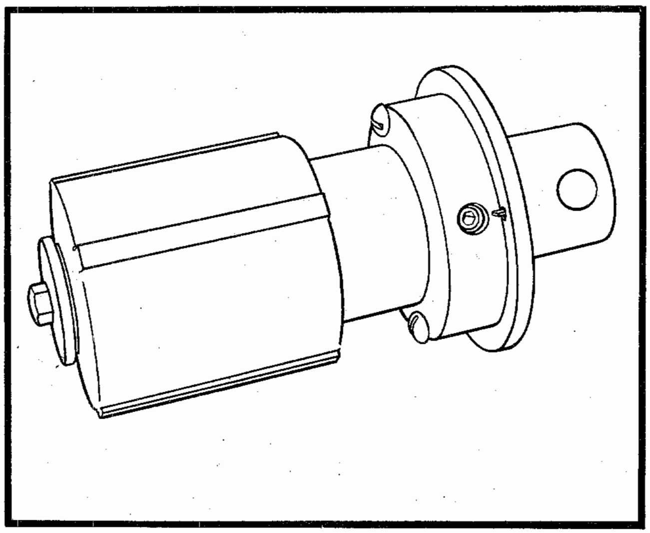


Figure 2—8. Rear Cone Lapping Fixture

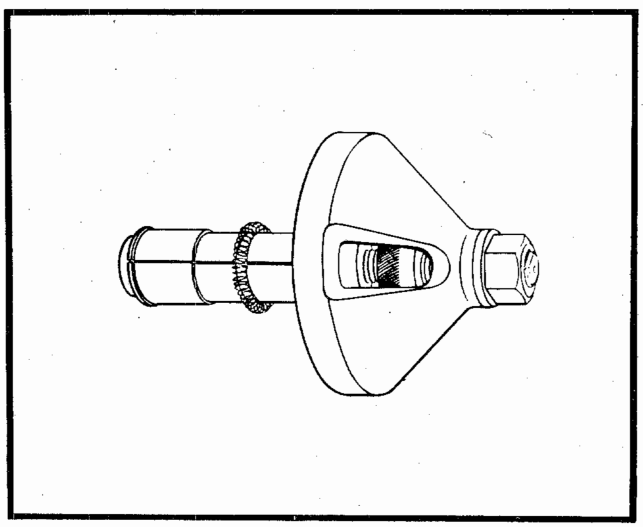


Figure 2—9. Bushing Puller

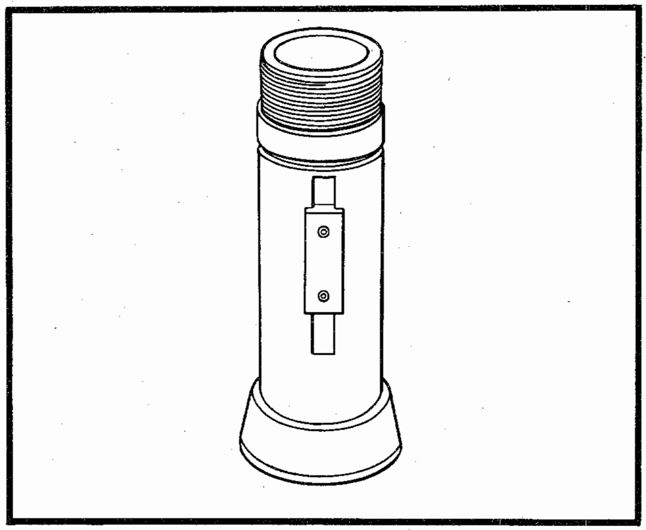


Figure 2—10. Assembly and Balance Bushing

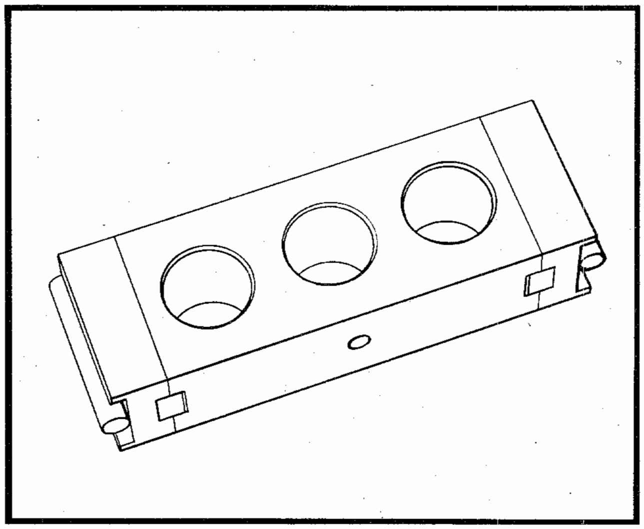


Figure 2—11. Spider Spline No-Go Gage

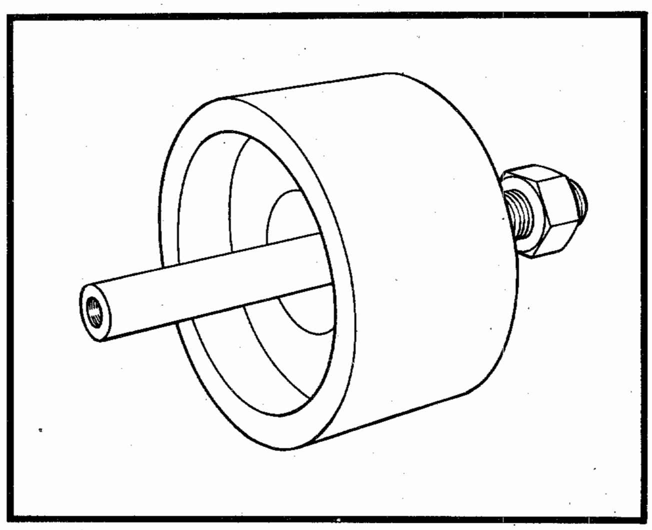


Figure 2—12. Blade Plug Puller

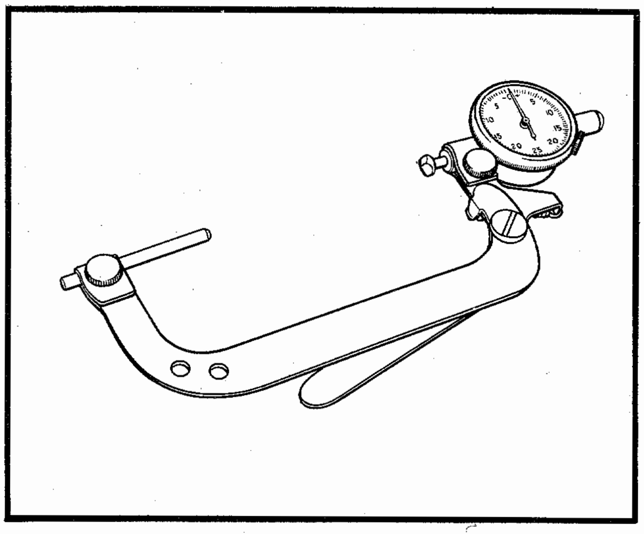


Figure 2—13. Barrel Bolt Extensionmeter

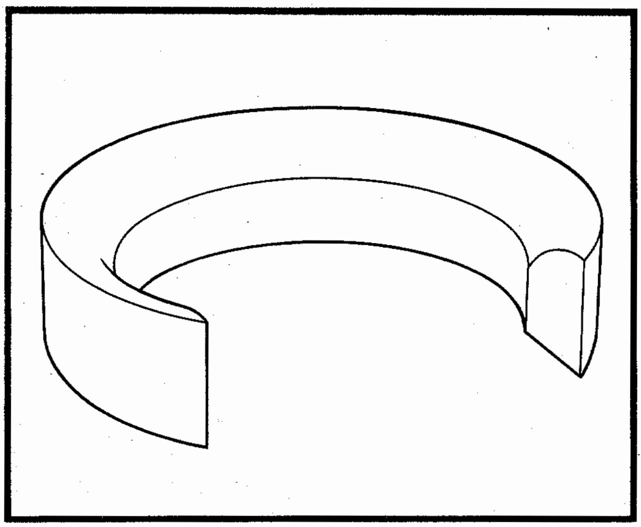


Figure 2—14. Blade Fillet Radius Gage

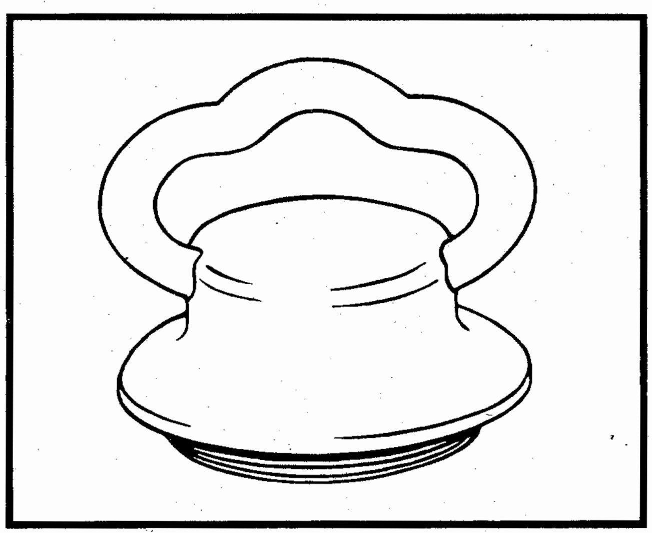


Figure 2—15. Dome Lifting Handle

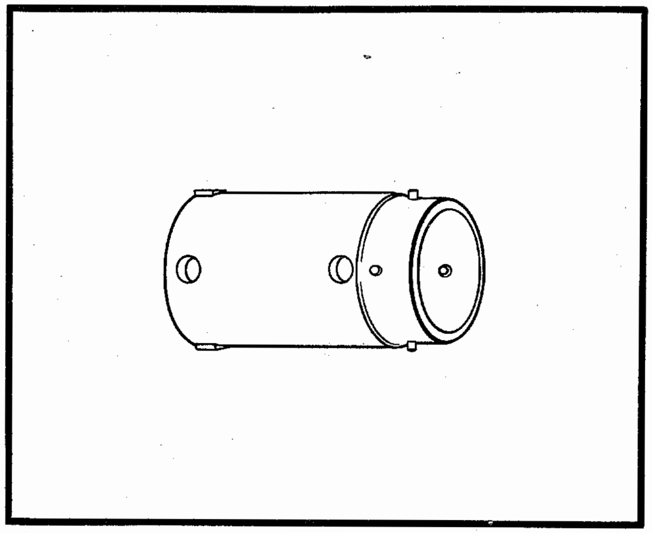


Figure 2—16. Stop Lever Adjusting Wrench

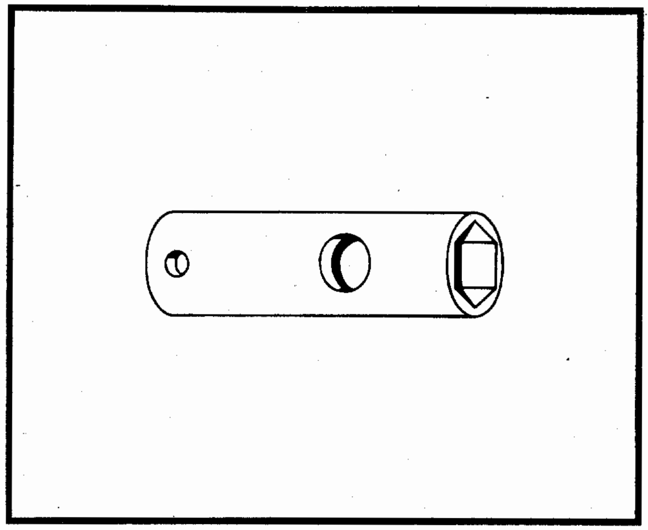


Figure 2—17. Servo Piston & Dome Cap Wrench

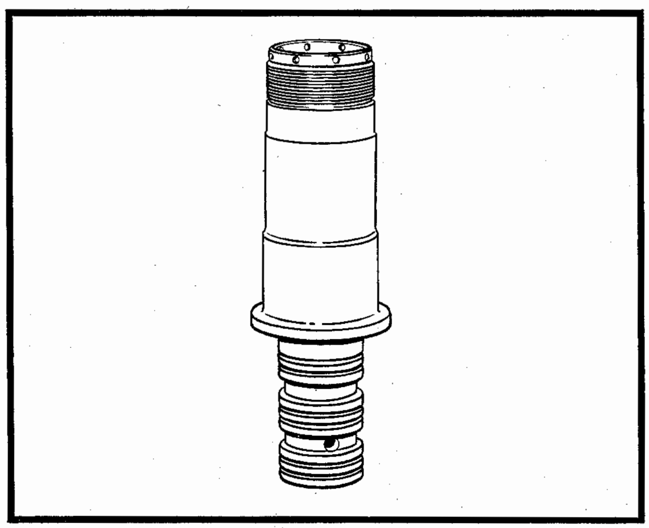


Figure 2—18. Test Post

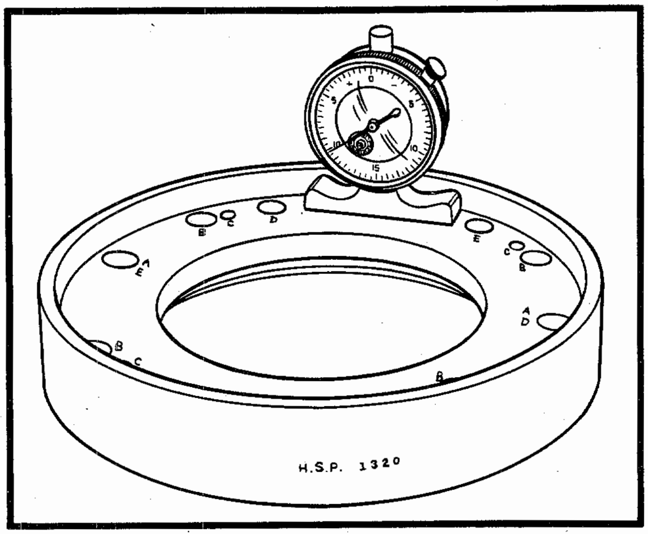


Figure 2–19. Preload Gage

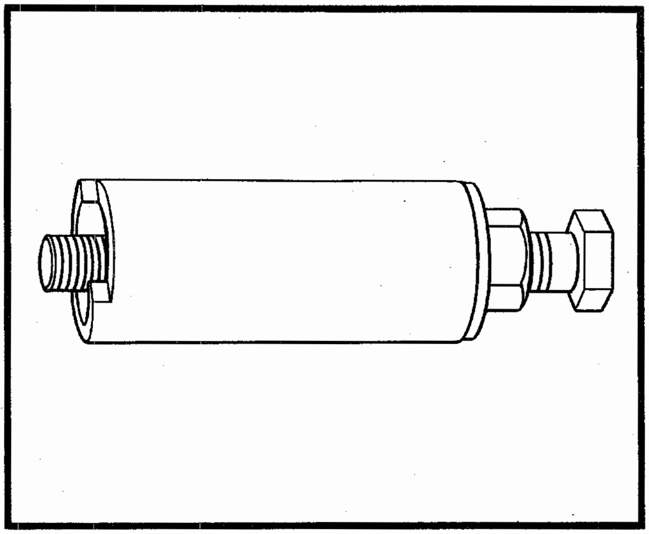


Figure 2–20. Cam Roller Shaft Puller

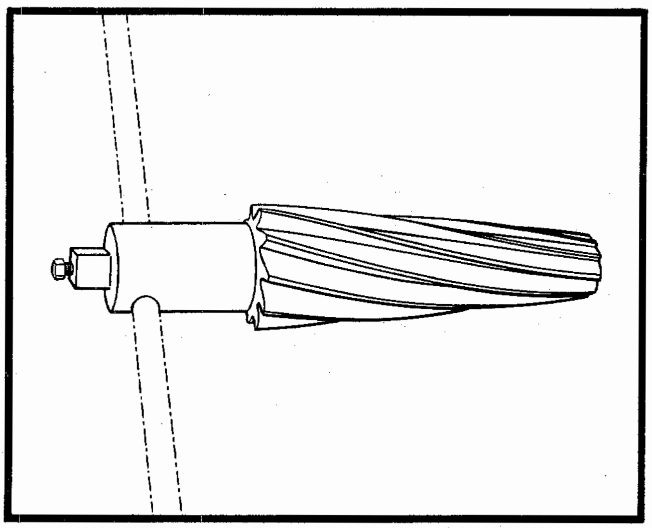


Figure 2–21. Taper Bore Reamer

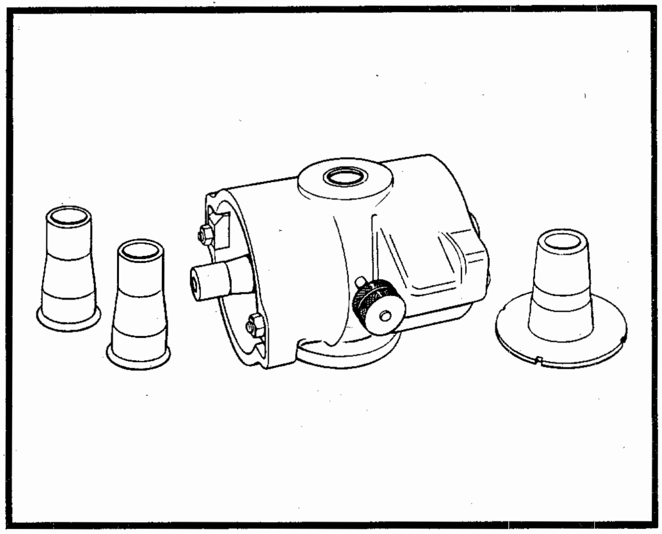


Figure 2–22. Blade Balancing Hub

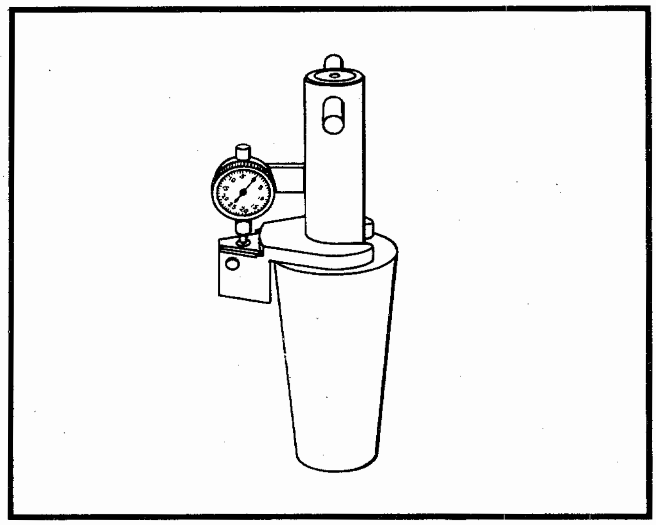


Figure 2–23. Taper Plug Gage

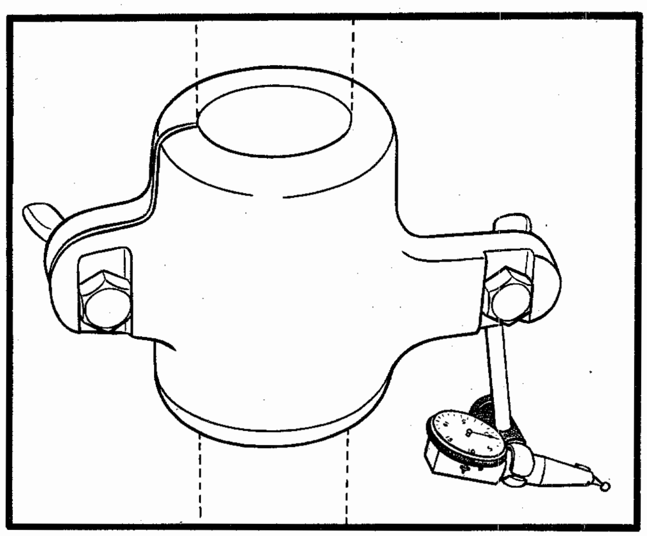


Figure 2–24. Concentricity Checking Fixture

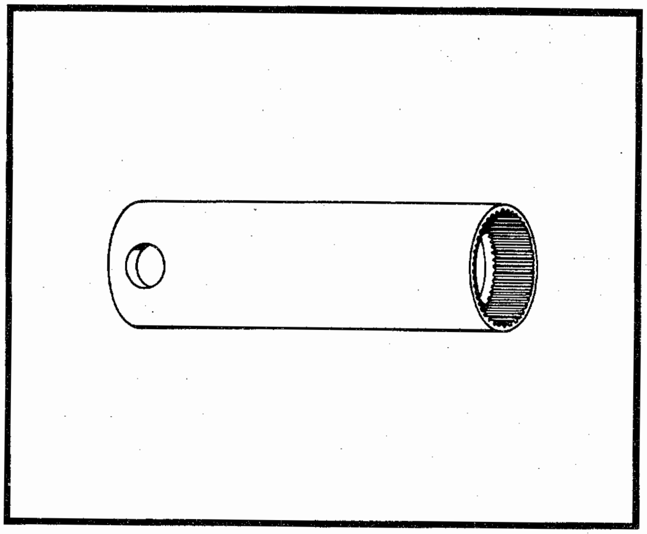


Figure 2—25. Oil Transfer Housing Socket

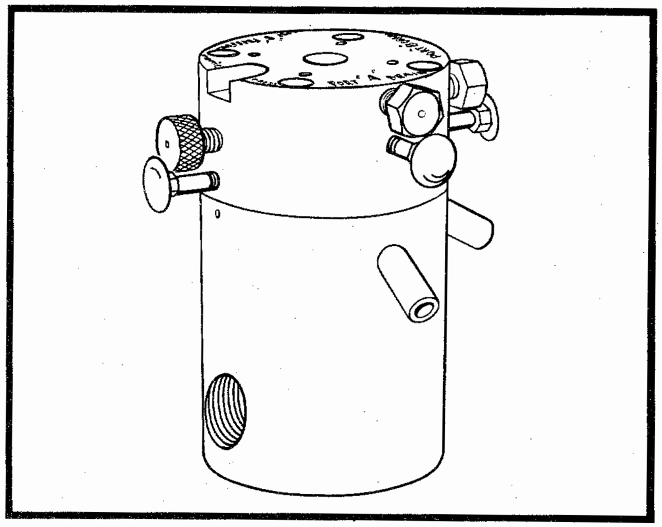


Figure 2—28. Valve Test Block

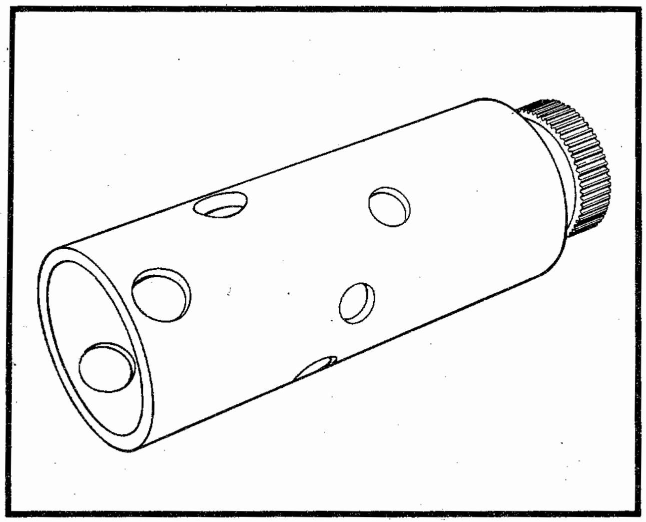


Figure 2—26. Propeller Retaining Nut Socket

DELETED

Figure 2—29. Rotor Puller

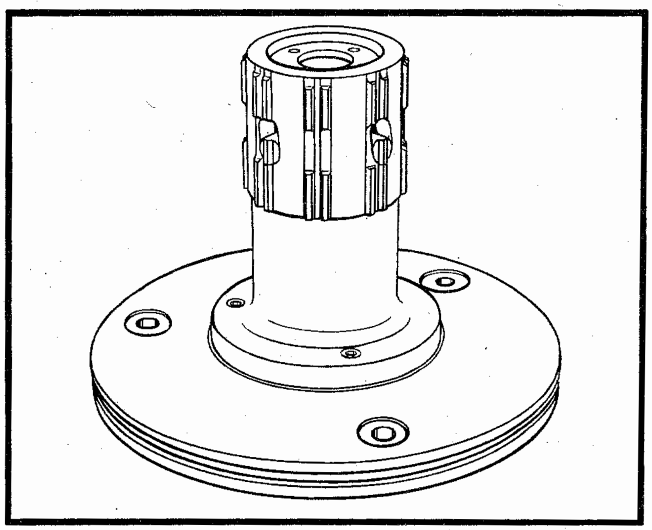


Figure 2—27. Cone Seat Grinding Adapter

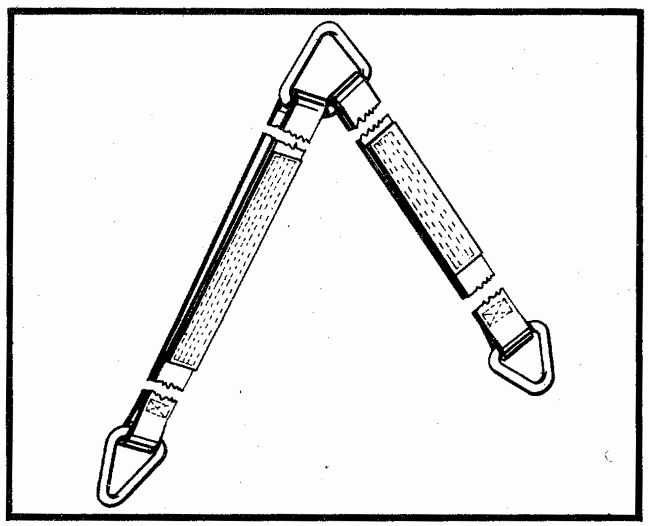


Figure 2—30. Propeller Hoisting Sling

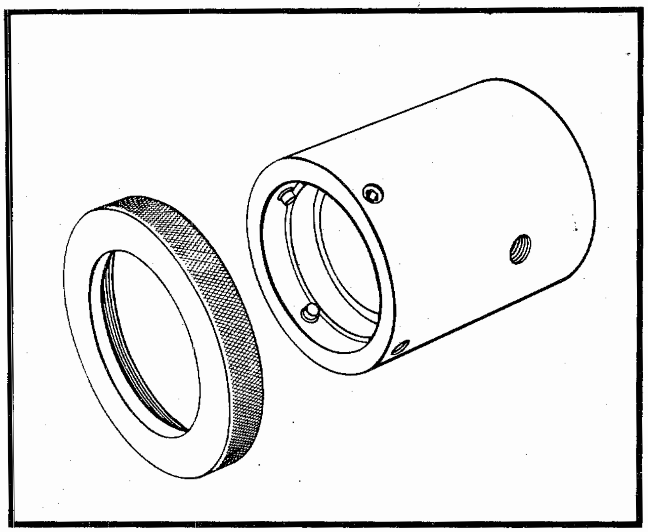


Figure 2—31. Stop Lever Test Sleeve

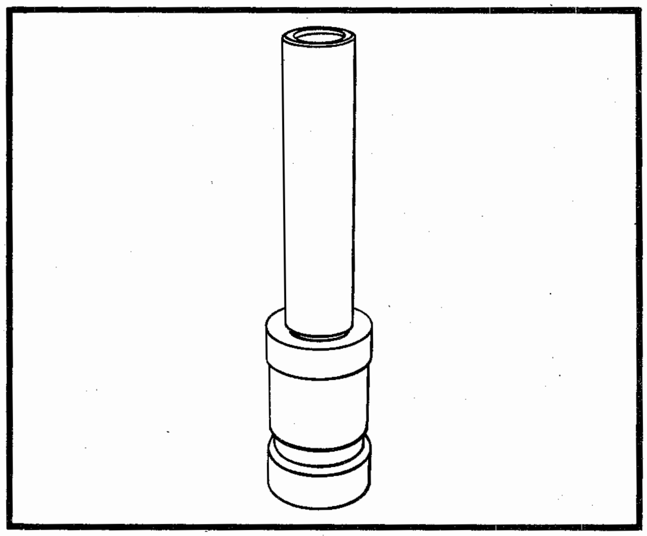


Figure 2—34. Assembly Post

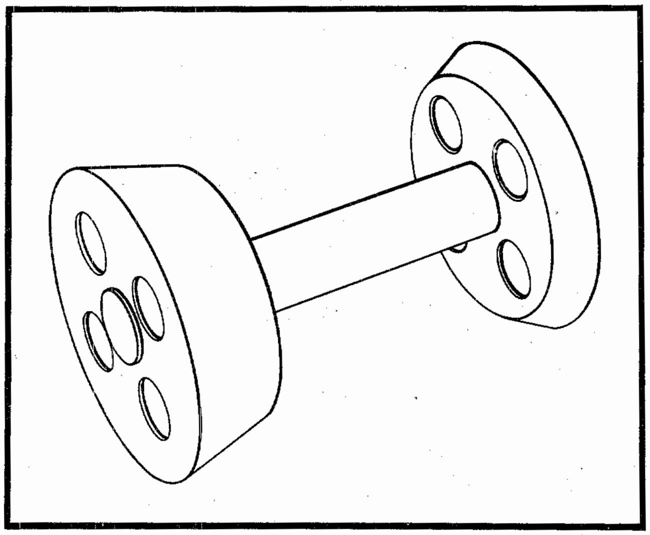


Figure 2—32. Cone Seat Gage

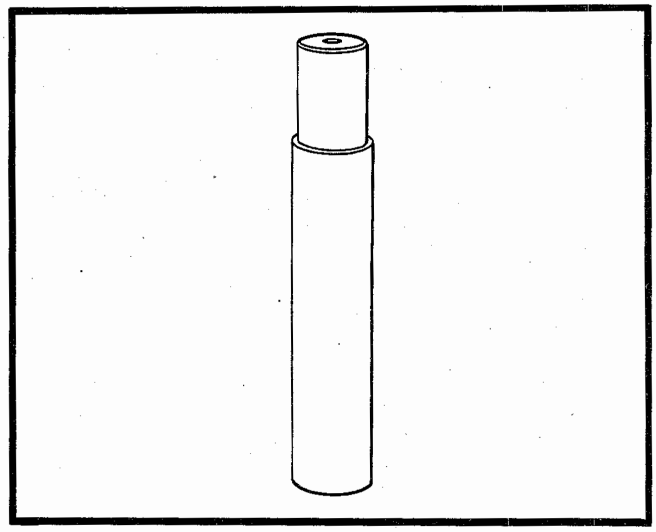


Figure 2—35. Concentricity Post

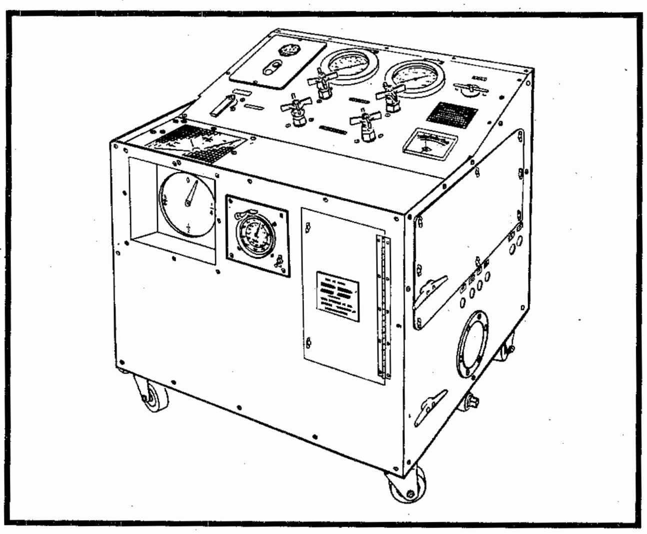


Figure 2—33. Portable Hydraulic Propeller Tester

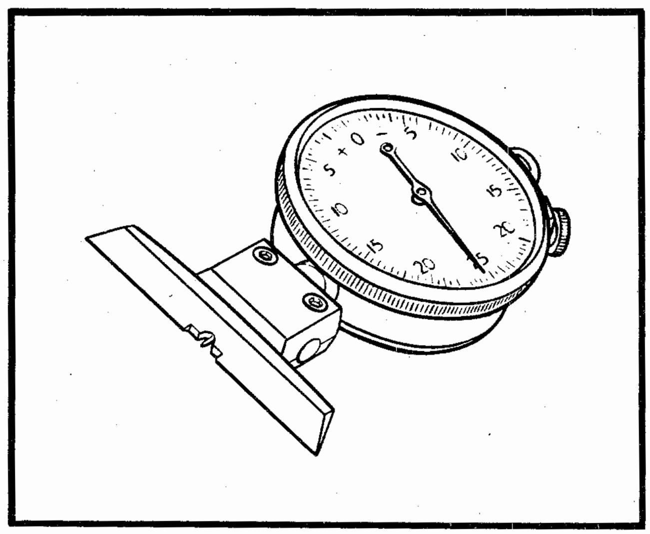


Figure 2—36. Blade Checking Indicator

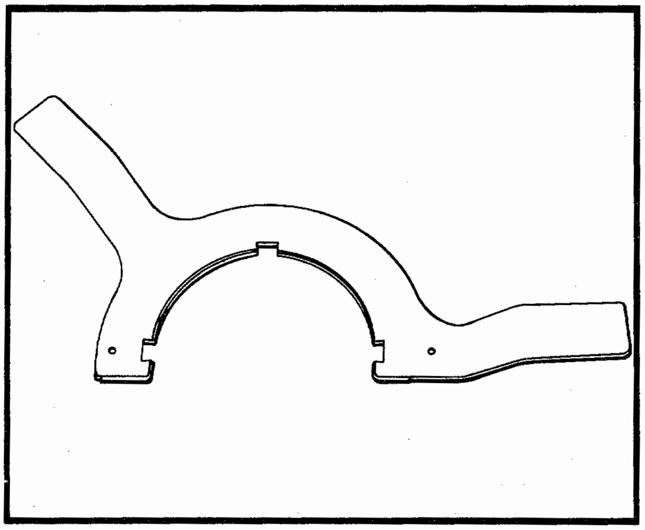


Figure 2—37. Dome Retaining Nut Wrench

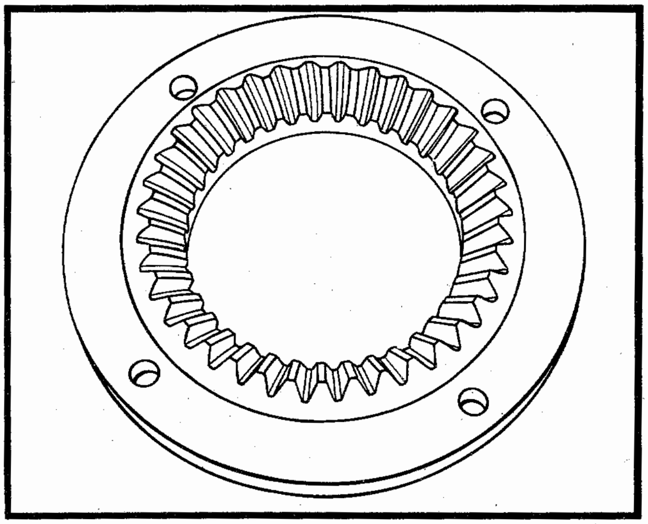


Figure 2—38. Bench Holding Fixture

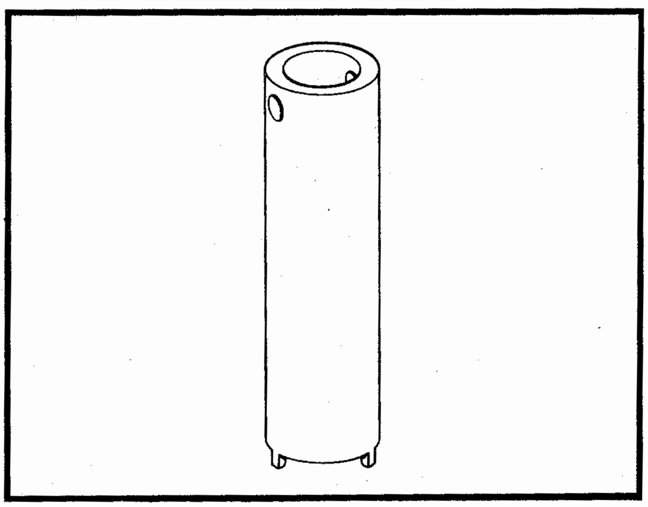


Figure 2—39. Reverse Stop Adjusting Sleeve Wrench

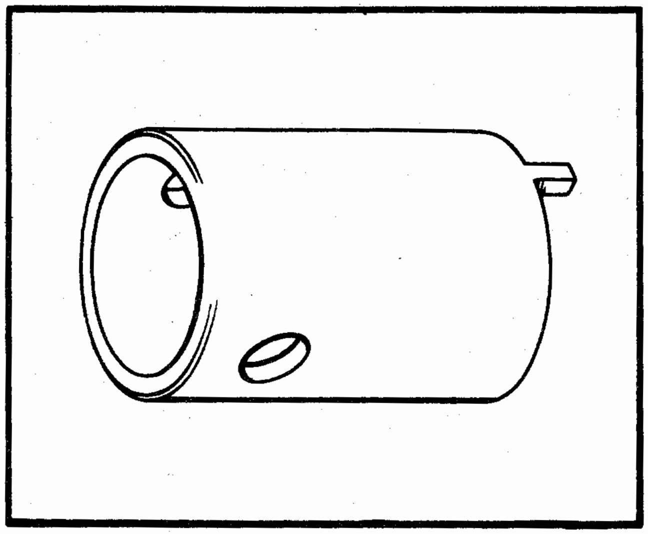


Figure 2—40. Servo Nut Wrench

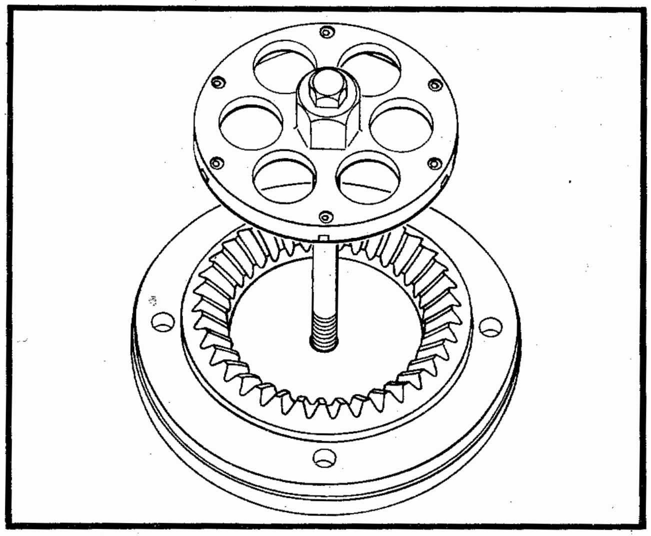


Figure 2—41. Cam Bearing Nut Torque Fixture

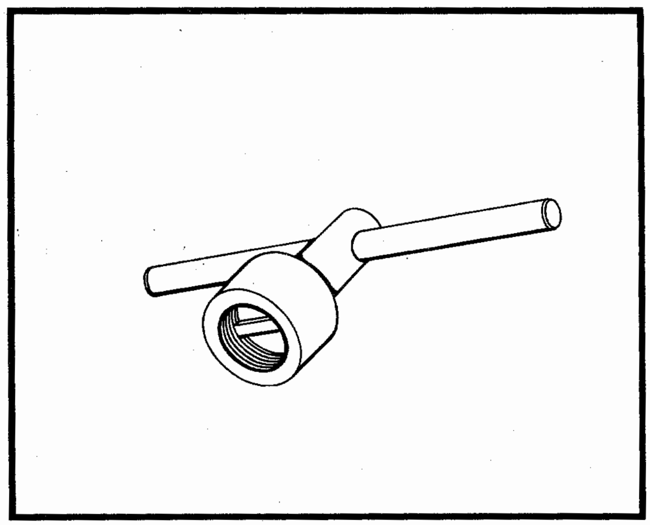


Figure 2—42. Servo Piston Shaft Wrench

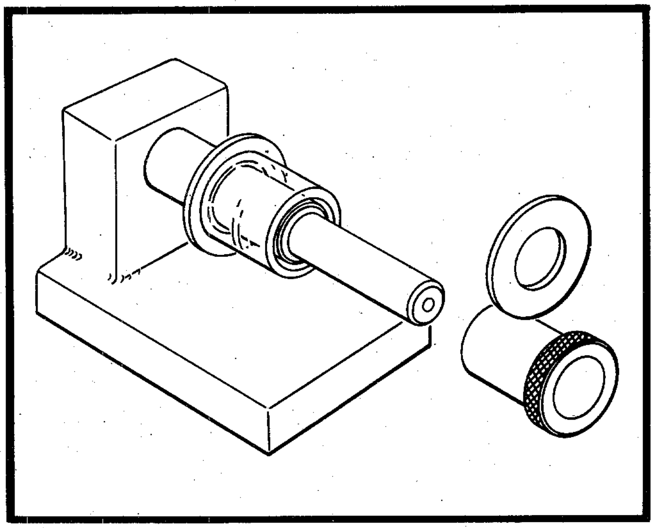


Figure 2—43. Bearing Cam Roller Separator

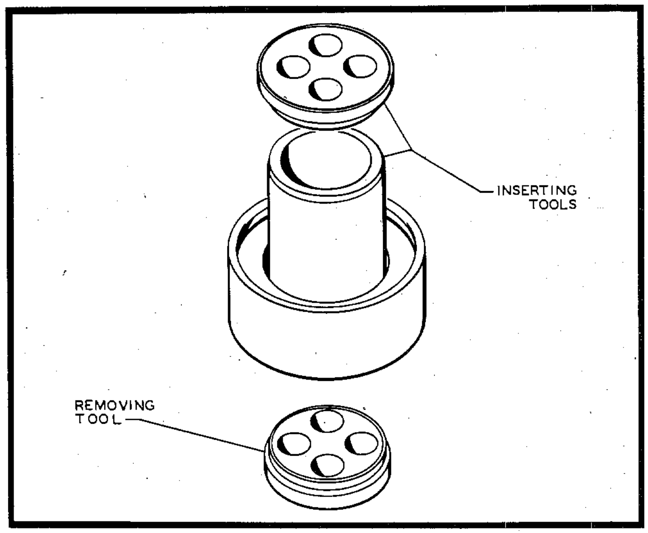


Figure 2—46. Piston Sleeve Inserter and Remover

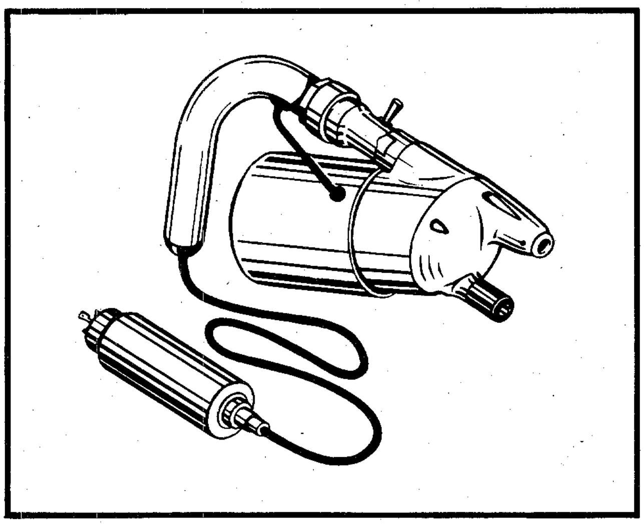


Figure 2—44. Peening Tool

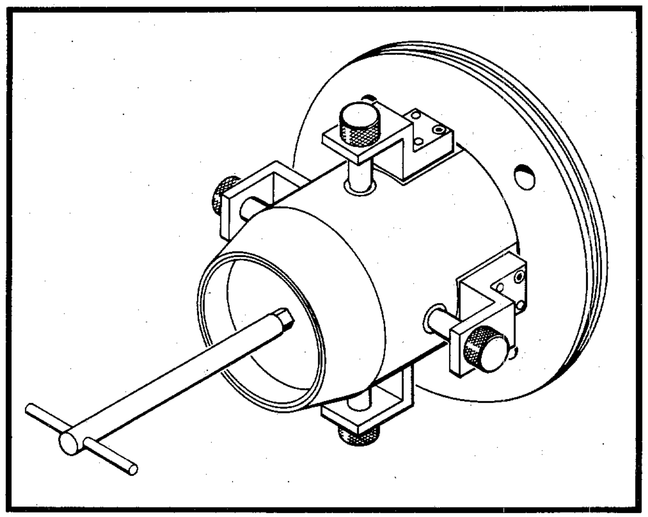


Figure 2—47. Piston Sleeve Grinding Fixture

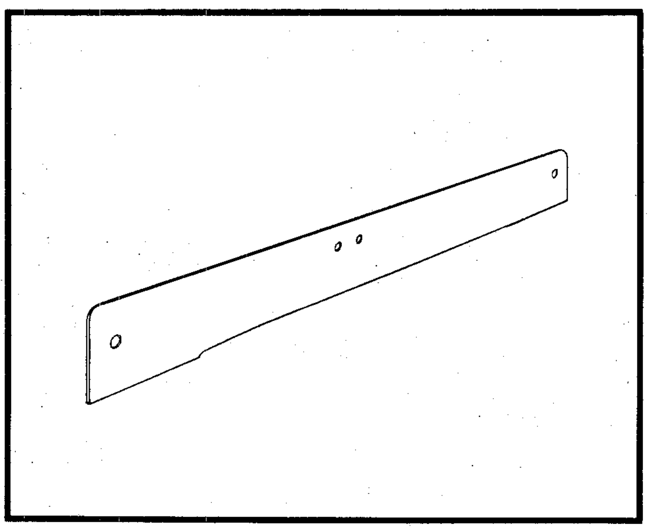


Figure 2—45. Blade Template

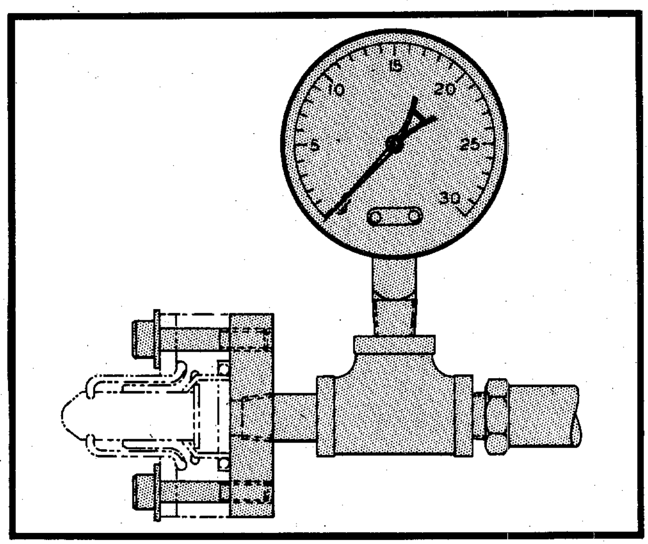


Figure 2—48. Control Switch Pressure Test Fixture

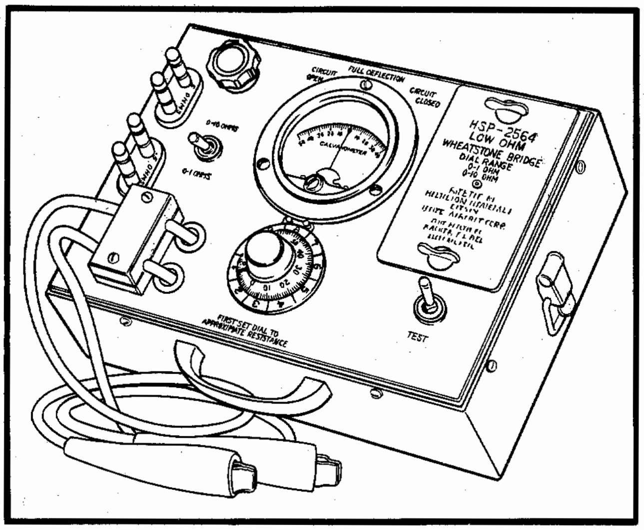


Figure 2—49. Wheatstone Bridge — Low Ohm

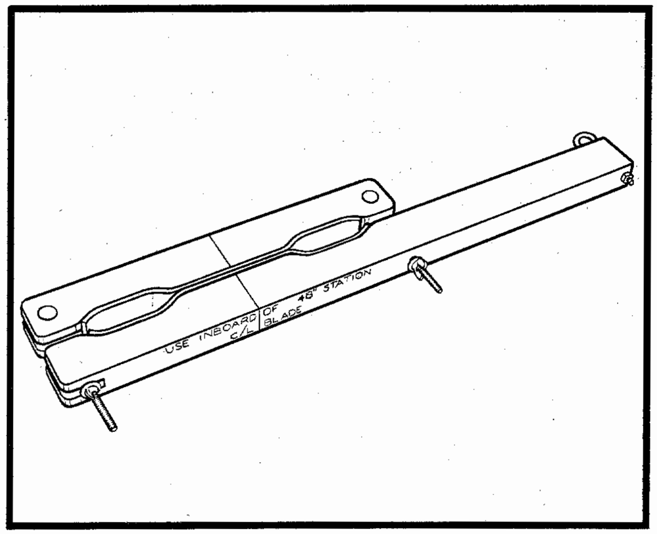


Figure 2—50. Blade Turning Bar

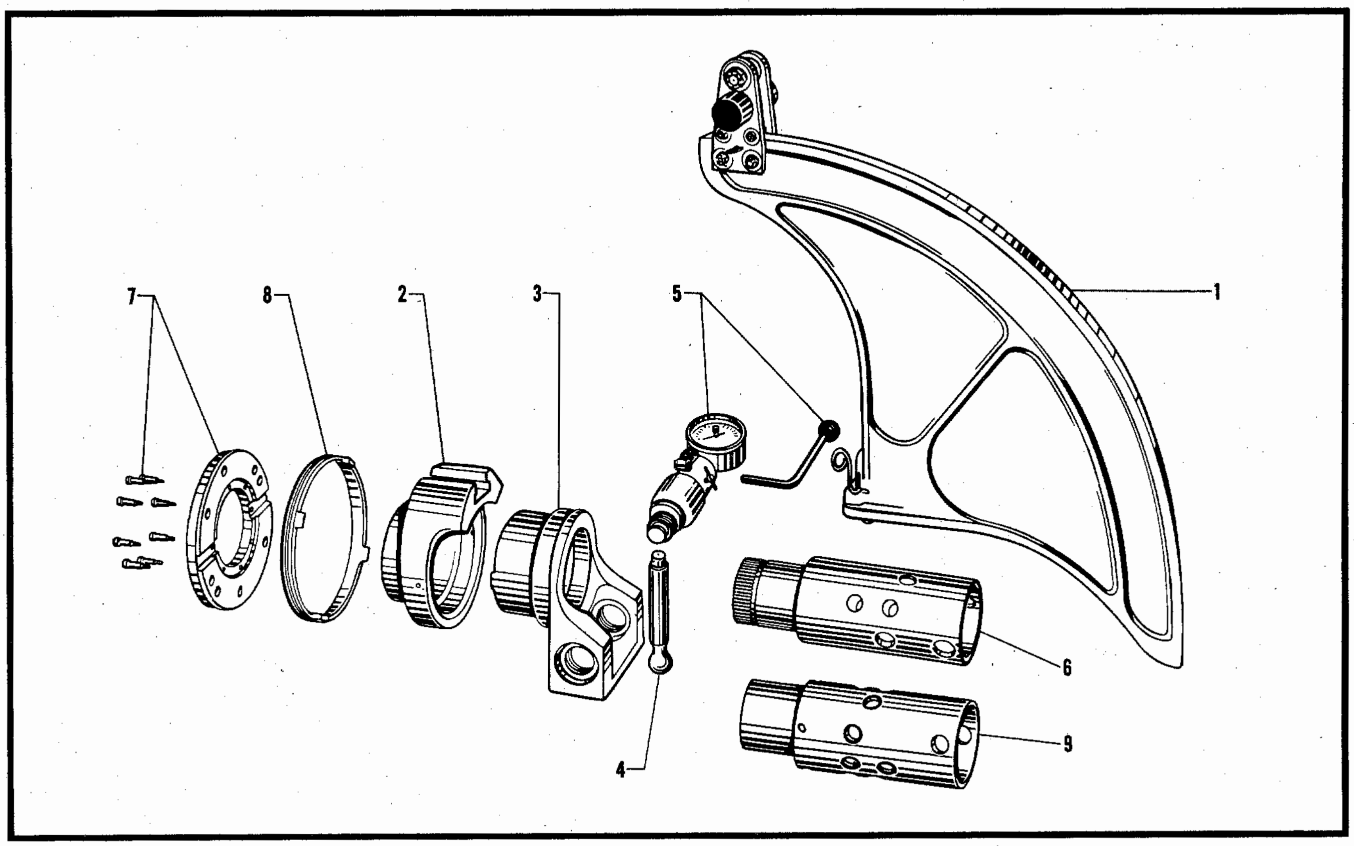


Figure 2—50A. Hydraulic Torque Wrench Assembly

2–2. DISASSEMBLY.

Note

Procedures herein may be altered to suit the prevailing conditions in that disassembly is required only to the extent necessary to allow complete inspection, repair, or replacement of any worn parts.

Note

Care should be taken when handling the dome assembly so that the oil transfer tube will not become damaged.

2–3. REMOVAL OF ATTACHING PARTS FROM HUB.

2–4. As partial disassembly of the electric de-icing assembly is effected at the time of removal of the propeller from the aircraft, the remaining parts may be removed from the hub as follows:

a. Remove the dome-barrel seal from the barrel shelf, insert the assembly bushing and lower the propeller over the assembly post.

b. Remove the screws and cover plates from the three terminal boxes of the slip ring assembly. Then remove the self-locking nuts and washers from the terminals and remove the leads from the boxes.

c. Remove the slip ring locating screw and remove the slip ring assembly from the spider rear extension.

Note

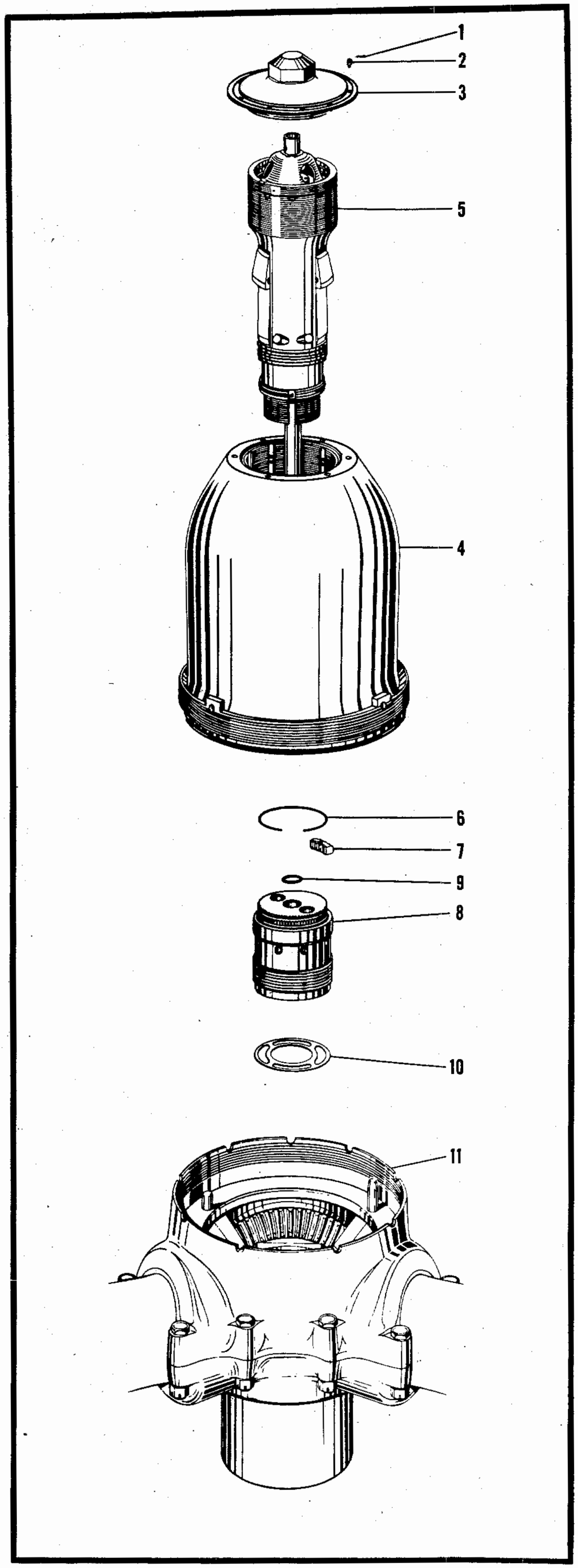
If the slip ring assembly does not slide off readily, the use of a non-metallic hammer is permissible to lightly tap the assembly.

d. Unsafety and remove the self-locking nuts and washers from the barrel bolt extensions and remove the heater connector clamps. Then remove the extensions and the barrel bolts attaching each guard assembly to the barrel. Separate the guard halves and remove from the propeller.

2–5. DISASSEMBLY OF HUB.

a. Remove the remaining barrel bolt cotter pins, nuts, and bolts.

b. Using the barrel half puller, lift off the outboard barrel half. Take out the barrel half seals. Lower the



1 Cotter Pin
2 Dome Cap Lock Screw
3 Dome Cap
4 Dome Assembly
5 Low Pitch Stop Lever Assembly
6 Segment Lock Wire
7 Lock Segment
8 Oil Transfer Housing
9 "O" Ring Seal
10 Shaft Gasket
11 Barrel Assembly

Figure 2–51. Propeller Assembly

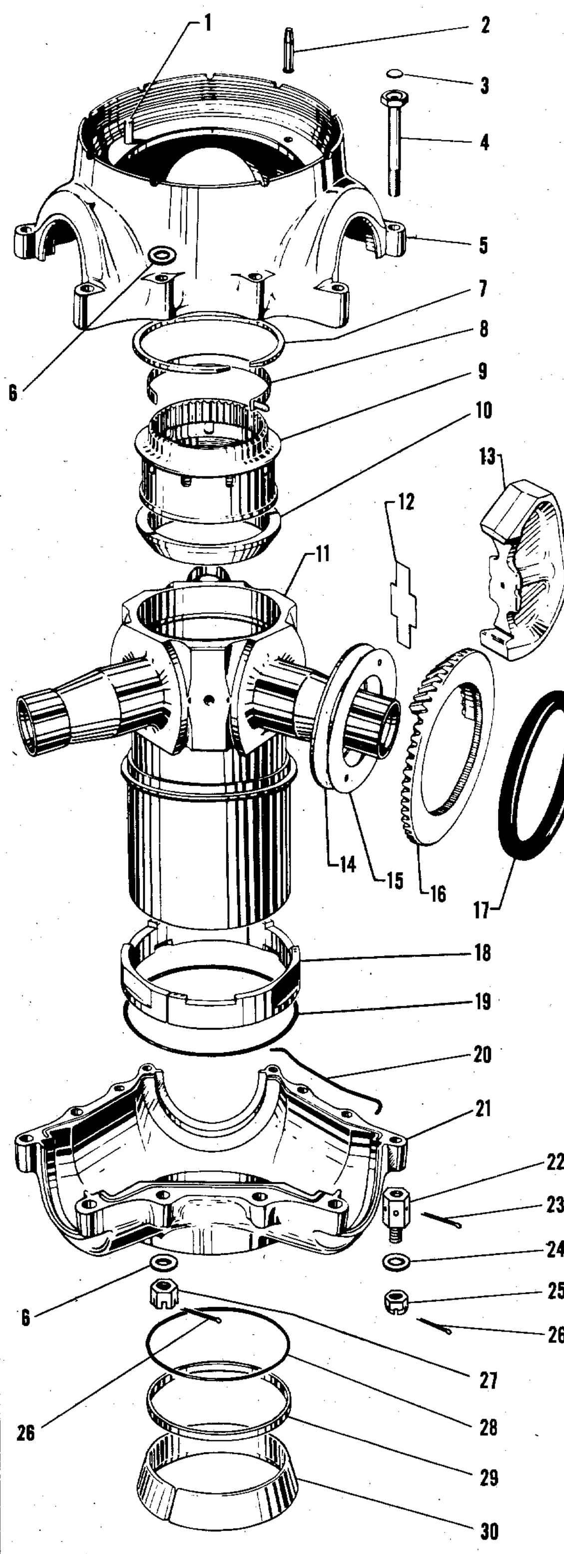


Figure 2—52. Barrel Assembly

1 Locating Dowel
2 Locating Dowel
3 Welch Plug
4 Barrel Bolt
5 Barrel (Front Half)
6 Washer
7 Hub Snap Ring
8 Retaining Nut Lock Assembly
9 Propeller Retaining Nut
10 Front Cone
11 Spider
12 Barrel Support Shim
13 Barrel Support
14 Spider Shim Plate
15 Spider Shim
16 Blade Gear Segment
17 Blade Packing
18 Spider Ring
19 "O" Ring Seal (Spider And Barrel)
20 Barrel Half Seal
21 Barrel (Rear Half)
22 Barrel Bolt Extension
23 Cotter Pin
24 Washer
25 Castellated Nut
26 Cotter Pin
27 Castellated Nut
28 "O" Ring Seal (Spider And Shaft)
29 Spider And Shaft Seal Spacer
30 Rear Cone

inboard barrel half by driving evenly on the parting edge with a rawhide mallet. Take out the blade thrust bearings.

CAUTION

Do not let the inboard barrel half or the blade thrust bearings drop onto the assembly table. A thick pad of cloth, felt, rubber, or some shock-absorbing material should be placed around the base of the assembly post to prevent damage to the inboard barrel half.

c. Remove the blades from the spider.

d. Take off the barrel supports and the included barrel support shims.

e. Remove the spider ring with its "O" ring seal.

f. With the aid of a loop of wire, extract the hub snap ring. Unscrew and remove the retaining nut and the front cone from the assembly and balance bushing. Lift off the spider and remove the bushing. Take the inboard barrel half off the assembly post.

2–6. DISASSEMBLY OF BLADE.

a. Remove the spider shim plate and the spider shim from each blade butt.

b. Using a brass drift, if necessary, tap the gear segment off the blade butt.

c. Take off the blade packing by stretching it over the blade butt.

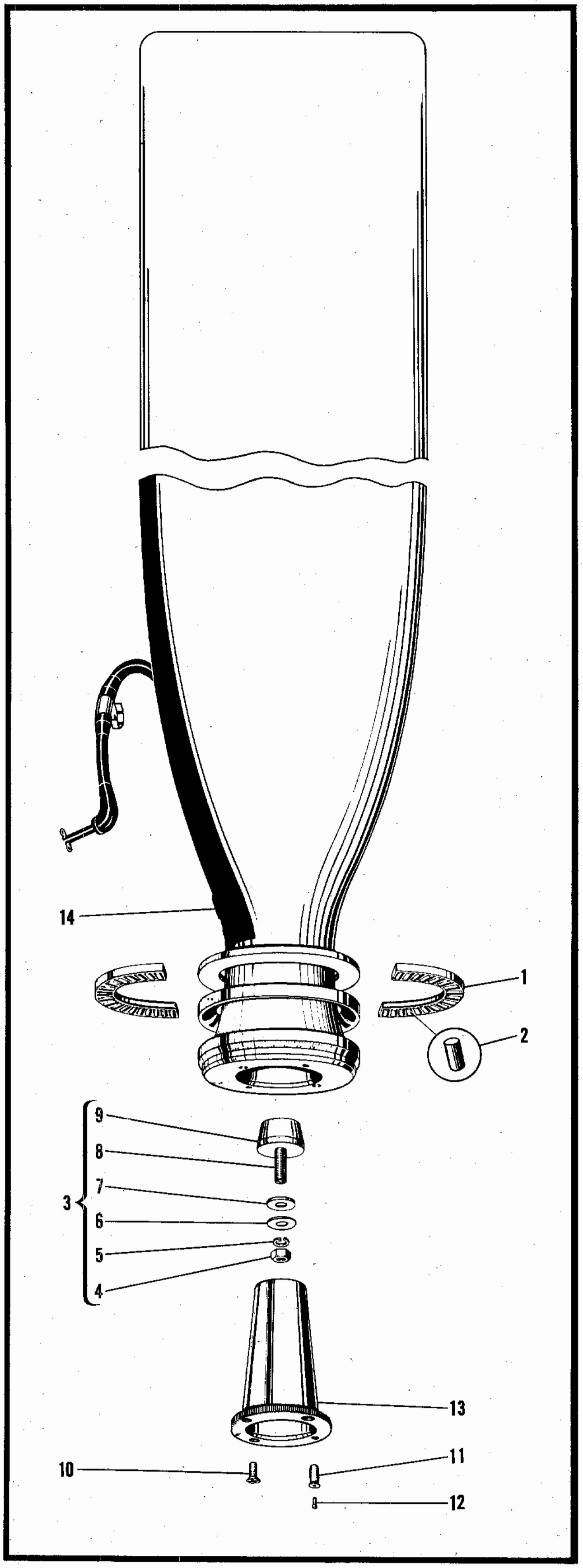
d. Remove the blade slip ring and cam assembly by unsafetying and removing the screw, then opening up the ring.

e. Should it be necessary to remove the bushing, balancing plug, and the cork and lead from the butt, this may be accomplished as follows:

f. Remove the bushing screws and attach the HSP-535 bushing puller to the blade shank in the following manner. The expander portion is inserted inside the blade bushing and the flange at the base is locked behind the end of the bushing. The "hat" portion is placed over the blade butt with the expander stud protruding through the middle. The stud nut is then attached and tightened as shown to remove the bushing.

g. Using the blade plug puller HSP-916, install it into the blade shank as shown and remove the balancing plug.

h. A corkscrew brazed onto the end of a steel rod is used for removing the cork from the taper bore. The lead wool at the end of the taper bore may be removed by the use of a steel drill approximately 5/16 inch in diameter welded onto a steel rod. Hammer the drill into the lead wool and then pull out.



1 Thrust Bearing Retainer
2 Crown Roller
3 Blade Plug Assembly
4 Nut
5 Lock Washer
6 Balancing Washer (Light)
7 Balancing Washer (Heavy)
8 Blade Plug Stud
9 Blade Plug
10 Flat Head Screw
11 Blade Bushing Drive Pin
12 Shim Plate Drive Pin
13 Blade Bushing
14 Heater And Connector Assembly

Figure 2—53. Blade Assembly

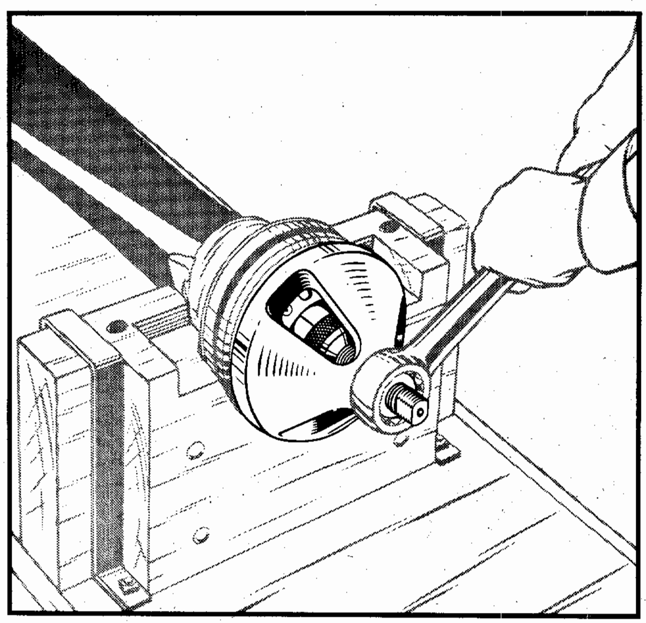


Figure 2—54. Removing Bushing

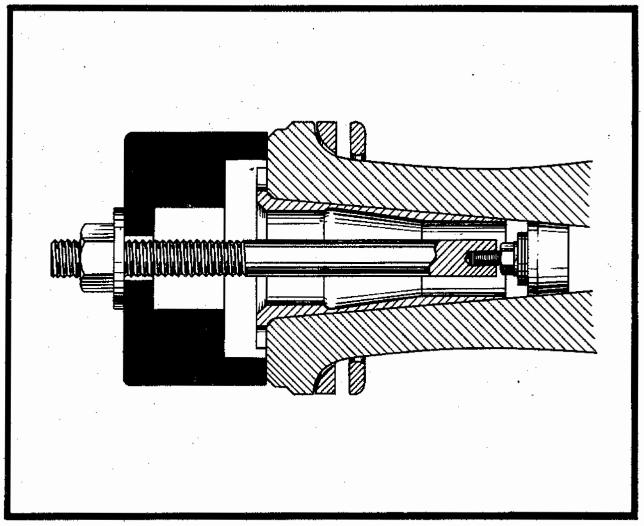


Figure 2—55. Removing Balancing Plug

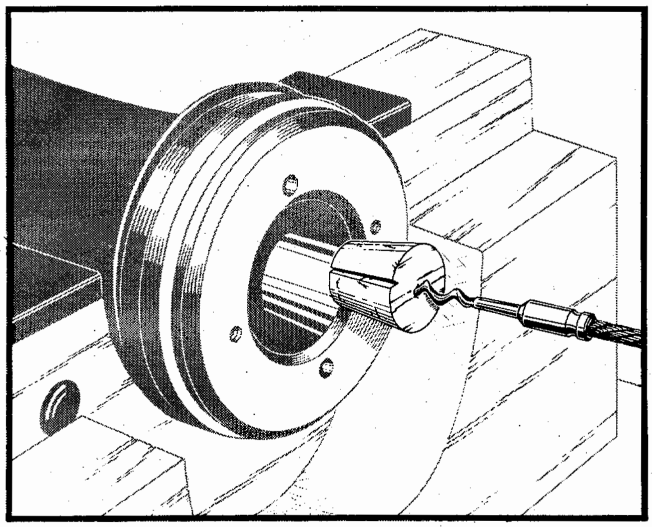


Figure 2—56. Removing Cork from Blade Butt

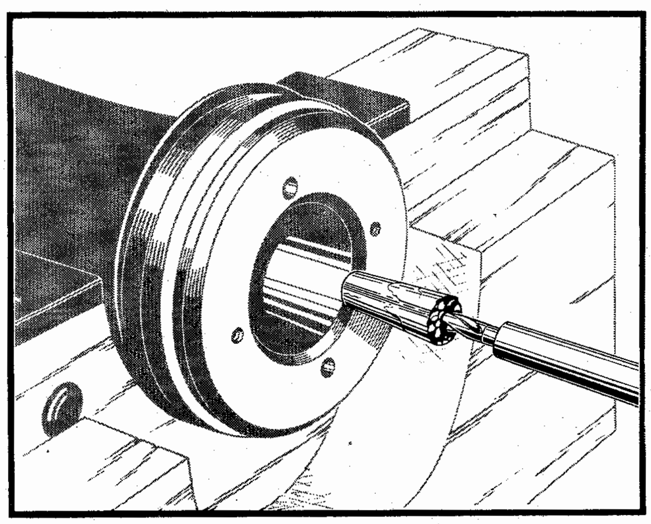


Figure 2—57. Removing Lead from Blade Butt

2—7. REMOVAL OF DE-ICING HEATER PAD.

2—8. The following information pertains to the removal of rubber de-icing equipment adhered to aluminum blades when it is necessary to replace the heater pad.

2—9. Any technique used for parts removal which will not damage the blade surface or otherwise impair the structural strength of the blade is permissible. If heat is used for removal purposes, intense local heating must be avoided so that the shot blasted surfaces are not subjected to temperatures exceeding 295 degrees F; further, the shot blasted surfaces must not be held at any temperature above 150 degrees F for longer than 2.5 hours.

2—10. Among the various techniques used by operators, the use of a small hand riveting gun fitted with a plexiglass scraper has been found a favorable method of boot or pad removal. For removal of adhesives, the use of methyl ethyl ketone is recommended.

2—11. DISASSEMBLY OF DOME.

Note

For installations which incorporate the later type reinforced domes, it will be necessary to remove the cotter pin from the head of the dome cap locking screw before the locking screw and dome cap can be removed.

a. Remove the wire lock ring, lock nut, lock ring, and transfer tube, and turn the low pitch stop lever assembly out of the lever sleeve bushing.

b. Take the stop rings off the base of the rotating cam, taking particular notice of the feathering and reverse angle settings.

c. Unscrew the dome shell retaining screws which are inserted through the base of the fixed cam.

d. Thread the dome lifting handle in the dome cap hole. To facilitate removal of the dome shell, a wooden block may be used through the piston sleeve to drive against the lifting handle.

e. Remove the dome lifting handle and, if desired, take out the lever sleeve bushing retaining screws. Then take the bushing out of the dome shell.

f. If necessary, the retaining nut balls may be removed by pulling the retaining welch plug and rotating the dome shell until all of the balls are out.

g. Remove the piston "O" ring seal from the annulus in the piston.

h. Compress and take out the cam roller shaft internal snap rings with Truarc pliers. Pull out the cam roller shafts using the cam roller shaft puller.

i. Lift the piston assembly off the cams, and then remove the cam roller assemblies.

Note

Care should be used in the handling of the cam roller assemblies to avoid loss of needles. Do not dis-assemble further except as specified under Inspection.

j. Take out the cam bearing nut cotter pin, and then unscrew the nut using the cam bearing nut torque fixture. Tap the rotating cam out of the fixed cam, and then take off the inboard and outboard cam bearings.

2–12. DISASSEMBLY OF THE LOW PITCH STOP LEVER ASSEMBLY.

a. The oil transfer tube and retaining cap were removed when the stop lever assembly was removed from the dome. To remove the retaining cap from the oil transfer tube, take off the outer external retaining ring and slide the cap off the tube. Then, the second retaining ring may be removed if necessary.

b. Disengage the outboard lock wire and unscrew the servo valve adjusting nut from the servo piston. Remove the servo valve spring, the servo valve, and the servo valve seal.

c. Remove the snap ring, the tab lock ring, the return spring seat, the washer, and the stop return spring at the inboard end of the stop lever assembly.

d. Take out the servo piston lock wire and unscrew the servo piston from the shaft using the servo piston and dome cap wrench.

e. Remove the spiral lock ring and pull the piston

1 Gear Preload Shim
2 Dome-Barrel Seal
3 Cotter Pin
4 Dome Retaining Nut Lock Screw
5 Stop Ring Spacer
6 High & Low Pitch Stop Rings
7 Dome Cap Seal
8 Screw
9 Dome Shell
10 Screw
11 Lever Sleeve Bushing
12 Welch Plug
13 Ball
14 Dome Retaining Nut
15 Piston Seal
16 Internal Retaining Ring
17 Cam Roller Shaft
18 Piston Assembly
19 Cam Roller Assembly
20 Cam Roller Sleeve
21 Cam Roller Needle Spacer
22 Cam Roller Needle
23 Cam Roller
24 Cam Roller Thrust Washer
25 Cotter Pin
26 Cam Bearing Nut
27 Fixed Cam
28 Rotating Cam
29 Cam Outboard Bearing
30 Cam Inboard Bearing
31 Welch Plug

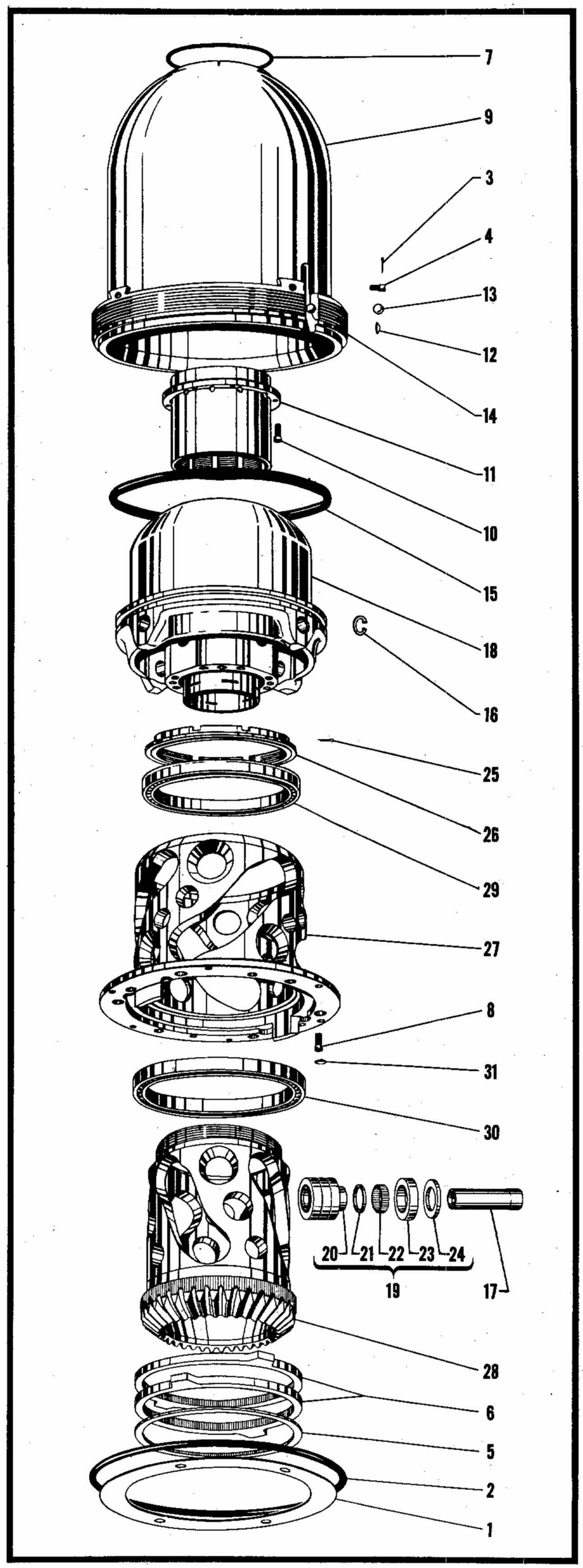


Figure 2–58. Dome Assembly

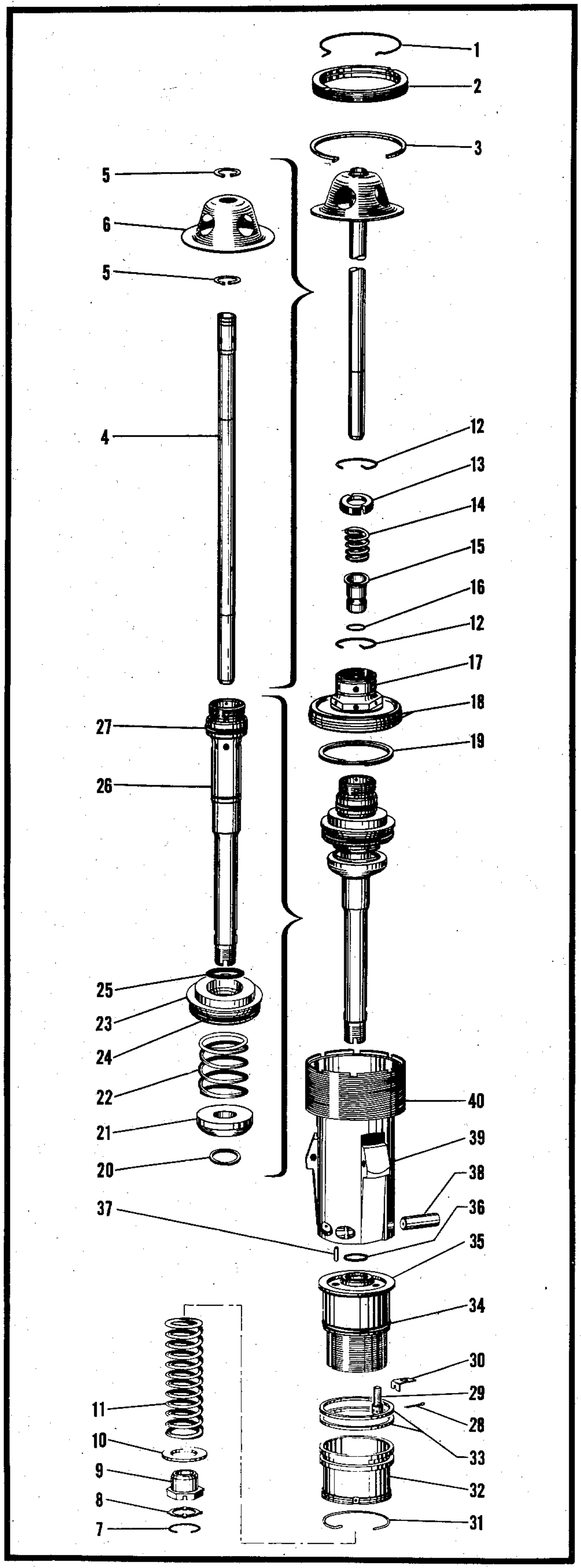


Figure 2—59. Low Pitch Stop Lever Assembly

shaft assembly from the lever sleeve. Should it be necessary to tap the piston shaft assembly from the sleeve, the spring seat nut should first be replaced to protect the threads.

f. Disassemble the servo piston shaft assembly by taking off the lock ring holding the wedge and removing the wedge, the spring, the end plate, and "O" ring seals from the shaft.

g. Disengage the lock ring from the reverse stop adjusting sleeve. Then unscrew the reverse stop adjusting sleeve, and take out the oil seal rings and the "O" ring seal. Unsafety and remove the three end cap retaining screws and the copper locking clips, take off the end cap, and remove the "O" ring seal.

h. Remove the stop lever lock pins and the stop lever pins to permit removal of the levers.

2—13. CLEANING, INSPECTION, AND REPAIR.

2—14. All propeller parts shall be given a close visual inspection, and, in addition, some highly stressed parts shall be given a careful magnetic inspection.

2—15. CLEANING.

2—16. After disassembly of the propeller, all parts shall

1 Lock Wire
2 Cam Retaining Nut
3 Snap Ring
4 Oil Transfer Tube
5 External Retaining Ring
6 Tube Retaining Cap
7 Snap Ring
8 Lock Ring
9 Stop Return Spring Seat
10 Washer
11 Stop Return Spring
12 Lock Ring
13 Valve Spring Adjusting Nut
14 Servo Valve Spring
15 Servo Valve
16 Servo Valve Seal
17 Servo Piston
18 Servo Piston Ring
19 Internal Retaining Ring
20 External Retaining Ring
21 Lever Wedge
22 Spring
23 End Plate
24 End Plate To Lever Sleeve Seal
25 Shaft To End Plate Seal
26 Piston Shaft Assembly
27 Shaft To Piston Seal
28 Cotter Pin
29 Screw
30 Lock Clip
31 Piston Sleeve Lock Ring
32 Reverse Stop Adjusting Sleeve
33 Oil Seal Ring
34 "O" Ring Seal
35 Lever Sleeve End Cap
36 End Cap To Shaft Seal
37 Lock Pin
38 Lever Pin
39 Piston Stop Lever
40 Lever Sleeve

be thoroughly cleaned with an approved cleaning solution. Under no circumstances shall a wire brush, steel wool, or an abrasive compound be applied. Internal passages shall be blown out with compressed air to insure that they are free from foreign particles. The cleaning fluid shall be kept clean by using suitable strainers and by renewing it periodically. All parts shall be completely free of oil and wiped dry of cleaning fluid before inspection. If the parts are to remain idle for some time after inspection and before reassembly, they shall be protected by an approved anti-corrosion compound.

2–17. INSPECTION.

2–18. Carefully give all parts visual inspection for wear, galling, metal pick-up, cracks, nicks, burrs, and other damage. Check all threads for rough edges and irregularities. Thoroughly check all plated and painted parts for damage exposing bare metal. Inspect moving parts for freedom of movement. Visually inspect cam roller needles as follows:

a. Using the cam roller bearing separator HSP-2268, remove any parts from the arbor and install the Lucite tube.

b. Install cam roller bearing assembly on the arbor with the large washer outboard and push against the arbor shoulder, then remove the washer.

c. Install the pusher on the arbor with the knurled end outboard. Butt the Lucite tube against the cam roller then move the pusher inboard pushing the needle bearings into the tube. Remove the rollers from the pusher. The needles may now be clearly seen for visual inspection.

d. Re-assemble needles in cam rollers by moving Lucite tube and needles back on cam roller bushing, then remove the bushing, needles, and tube in a unit from the arbor.

e. Install the pusher on the arbor with the knurled end inboard, then re-install the cam roller bushing, needles, and tube in a unit, on the arbor to butt against the arbor shoulder.

f. Place the cam rollers against the outboard end of the tube and lightly push inboard until roller starts on bushing. Bring the pusher against the inboard end of tube and hold, then push the rollers inboard until the needles are in place. Reinstall the washer and remove assembly from the arbor. With a piece of wire, fasten each cam roller assembly together to keep them from separating until such time as they are re-assembled into the dome.

2–19. BLADES. Inspect the blades for corrosion, erosion, bends, nicks, cracks, raised edges, etc. All blades shall be given a thorough and competent cleaning to remove all signs of grease and corrosion preventive other than paint, lacquer or anodize. Blades evidencing abrasions that have penetrated boots or heater strips should have the boot or heater strip removed for abrasion depth measurement. Also, blades exhibiting evidence of impact with a large and solid mass such as snow banks, maintenance stands, birds in flight, etc., shall be repaired. Measurement, repair and rework instructions are provided in paragraphs 2–71 through 2–102. Disassembly shall be only as needed to make any necessary repair.

2–20. HUB DIMENSIONAL INSPECTION.

2–21. Carefully inspect all fits and clearances listed in the clearance chart and its tabulation. The dimensions to the left of the bracket are the manufacturing tolerances, and the dimension to the right of the bracket is the limiting fit allowable for service use. An interference fit is indicated by the letter T and a loose fit by the letter L. Worn parts which permit clearances in excess of those listed in the clearance chart shall be replaced with new parts.

2–22. MAGNETIC INSPECTION.

2–23. A careful magnetic check should be made on the following parts: barrel, barrel bolts, barrel bolt nuts, spider, fixed cam, rotating cam, stop rings, cam rollers, cam roller shaft, gear segments, piston stop levers, lever sleeve, and blade thrust washers. Three methods of magnetization are used: one, direct magnetization, in which the current flows directly through the part; two, bar type induced magnetization, in which the part (usually circular in shape) is suspended from a bar carrying the current; and three, solenoid type induced magnetization, in which the part is inserted into a coil carrying the current. In each case, direct current should be used. For the first two methods, a calibration procedure is required; this is described in the following paragraph. For solenoid type magnetization, a definite amperage current through the coil is needed. It is suggested that a vertical bar be used where possible so that the piece may be centered around the bar for an even distribution of the current.

2–24. EQUIPMENT.

2–25. The equipment and method employed will be calibrated by means of the calibration piece shown. The equipment is calibrated at one of several levels of current density depending upon the parts to be inspected in a particular inspection unit.

2–26. The calibration pieces shall be contacted one at a time directly at both ends by the electrodes of the unit; a piece should never be fluxed on a bar or in a coil. Each piece shall be fluxed, so that the resulting magnetic field is perpendicular to the slots, and the slots shall be placed uppermost. Each piece shall be demagnetized before each test fluxing and shall have a clean bright surface over the slot area. The indications should be affected as little as possible by washing or run-off of the bath. Only a single shot or flux of current for ½ to 1 second duration shall be used to magnetize a bar, and the continuous method of applying indicating solution shall be used.

TABLE 2-1.

ITEM	CLEARANCE		DESCRIPTION
1	7.270		Maximum ID of barrel blade bore.
2	.408		Minimum wall thickness of barrel blade bore in critical area. (Critical area extends inward 3/8 inch from thrust shoulder.)
3	.400		Minimum values may be reduced .030 inch in local area covering less than 20% of the circumference
4	8.199		Minimum distance between cone seat gage diameters.
5	T .003 L .015	L .020	Clearance between OD of spider ring and ID of barrel at rear bore.
6	See Description		Involute splines should be checked with a No-Go plug gage HSP-706 or its equivalent. The gage may enter full length of splines and show no perceptible looseness.
7	L .0013 L .0045	L .008	Clearance between ID of blade bushing and OD of spider arm bearing surfaces (both large and small diameters).
8	4.1825		Maximum pitch diameter of retaining nut threads.
9	L .0045 L .0185	L .025	Clearance between ID of cam slots and OD of cam rollers on least worn of four slots.
10	T .0001 T .0019	L .0005	Fit between ID of piston cam roller shaft holes and OD of cam roller shaft.
11	L .004 L .031	L .035	Clearance between inboard cam roller and piston flat.
12	L .006 L .020	L .040	Clearance between ID of rotating cam and OD of piston boss.
13	9.150		Maximum ID of dome shell.
14	.178		Minimum dome wall thickness.
15	T .0005 L .0015	L .003	Clearance between ID of fixed cam and OD of outboard cam bearing.
16	T .0005 L .0015	L .003	Clearance between OD of rotating cam and ID of outboard cam bearing.
17	T .003 L .002	L .003	Clearance between barrel support and spider support seat.
18	T .0005 T .0020	*	Fit between barrel locating dowel hole and cam locating dowel.
19	L .0005 L .0030	L .005	Clearance between ID of fixed cam locating dowel hole and OD of cam locating dowel.
20	T .0005 L .0015	L .003	Clearance between ID of fixed cam and OD of inboard cam bearing.
21	T .0005 L .0015	L .003	Clearance between OD of rotating cam and ID of inboard cam bearing.
22	L .0006 L .0034	L .007	Clearance between ID of cam roller shaft sleeve and OD of cam roller shaft.
23	3.138		Maximum ID of dome piston sleeve.
24	3.9725		Maximum pitch diameter of stop lever sleeve bushing.
25	3.9501		Minimum pitch diameter of stop lever sleeve.
26	T .0018 L .0052	L .006	Clearance between gear segment serrations and blade bushing serrations measured on chordal thickness.

*Replace when any looseness is evident.

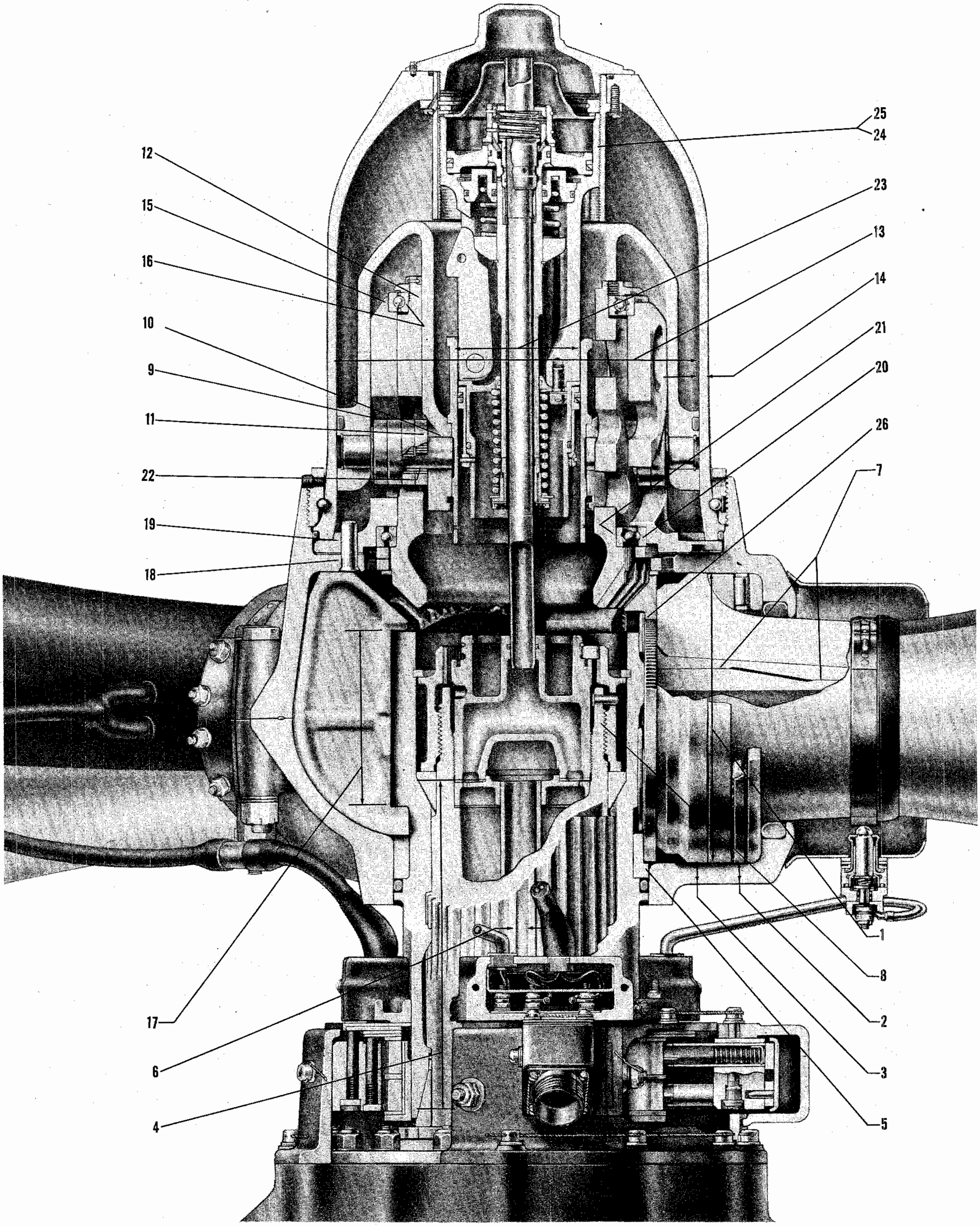


Figure 2—60. Propeller Clearance Chart

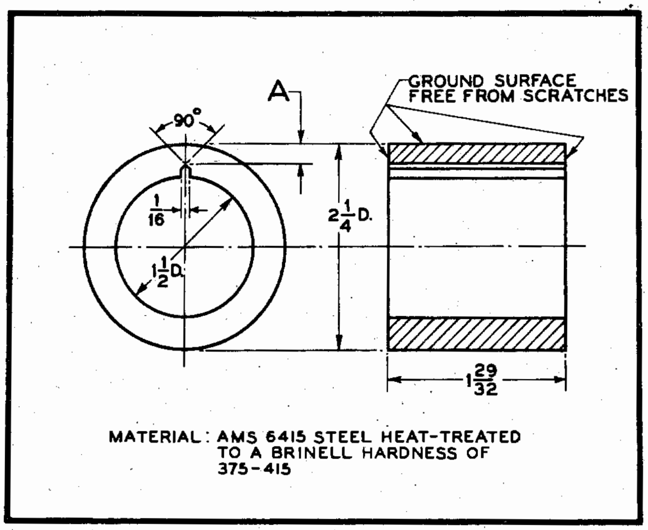


Figure 2–61. Calibration Test Piece

TABLE 2–2

Detail Number	A (Inch)
1	.199-.201
2	.239-.241
3	.259-.261
4	.274-.276
5	.289-.291
6	.304-.306

2–27. The current used for the magnetization equipment must be dc with amerpage that can be adjusted up to 4000 amperes. The concentration of indicating powder in the bath shall be between 1 and 1.5 ml per 100 ml of bath for tank or immersion units, or between 1.5 and 2 ml per 100 ml of bath for spray units as determined by a standard settling test.

2–28. To minimize the possibility of damage to propeller parts during the magnetic inspection process, it is recommended that braided copper contacts be used in place of lead contacts. It has been found that lead contacts tend to melt and become deformed under the test current and contact pressure with the result that arcing and burning occurs. When this burning takes place, a highly localized stress raiser is created which may cause a fracture under operating loads. The use of copper braid greatly reduces the possibility of burning due to the higher melting point of the copper and its cushioning and resilient nature. Strips of synthetic rubber placed in back of the copper braids provide additional cushioning.

2–29. A demagnetizer, such as Magnaflux No. SB2814, which has an inside height of 14 inches and a width of 28 inches, is also needed.

2–30. CALIBRATION LEVEL NO. 1. The equipment shall be adjusted and the technique employed so that piece No. 1 will just faintly show an accumulation of indicating powder, and piece No. 2 will not show any accumulation of indicating powder. If the equipment is operating in a normal manner, these results should be obtained at approximately 500 amperes with continuous magnetization. This is called the No. 1 calibration in the magnetization table.

2–31. CALIBRATION LEVEL NO. 3. The equipment will be adjusted and the technique employed so that piece No. 3 will just faintly show an accumulation of indicating powder, piece No. 4 will not show any accumulation of indicating powder, and piece No. 2 will show a definite accumulation of powder. If the equipment is operating in a normal manner, these results should be obtained at approximately 1500 amperes with continuous magnetization.

2–32. CALIBRATION LEVEL NO. 4. The equipment will be adjusted and the technique employed so that piece No. 4 will just faintly show an accumulation of indicating powder, piece No. 5 will not show any accumulation of indicating powder, and piece No. 3 will show a definite accumulation of powder. If the unit is operating in a normal manner, these results should be obtained at approximately 2000 amperes with continuous magnetization.

2–33. CALIBRATION LEVEL NO. 6. The equipment will be adjusted and the technique employed so that piece No. 6 will just faintly show an accumulation of indicating powder and Piece No. 5 will show a definite accumulation of indicating powder. If the equipment is operating in a normal manner, these results should be obtained at approximately 4000 amperes with continuous magnetization.

2–34. PROCEDURE.

2–35. Before magnetization, all parts shall be cleaned of dirt, grease, corrosion preventive compound, and discolorations by wiping with a suitable solvent. In order to provide good contact in the machine it may be necessary to remove surface oxidation with fine emery and crocus cloth from the contact areas. It may be desirable to remove the protective coating from some parts. This can be accomplished by the use of an approved stripping compound. After inspection has been completed, the parts shall be carefully replated according to the instructions in the paragraphs under REPAIR.

2–36. ACCEPTANCE AT MAGNETIZATION.

2–37. Parts shall be visually inspected after each magnetization with such care as to reveal all powder indications present. The acceptability of powder indications shall be judged according to the standards of the following paragraphs.

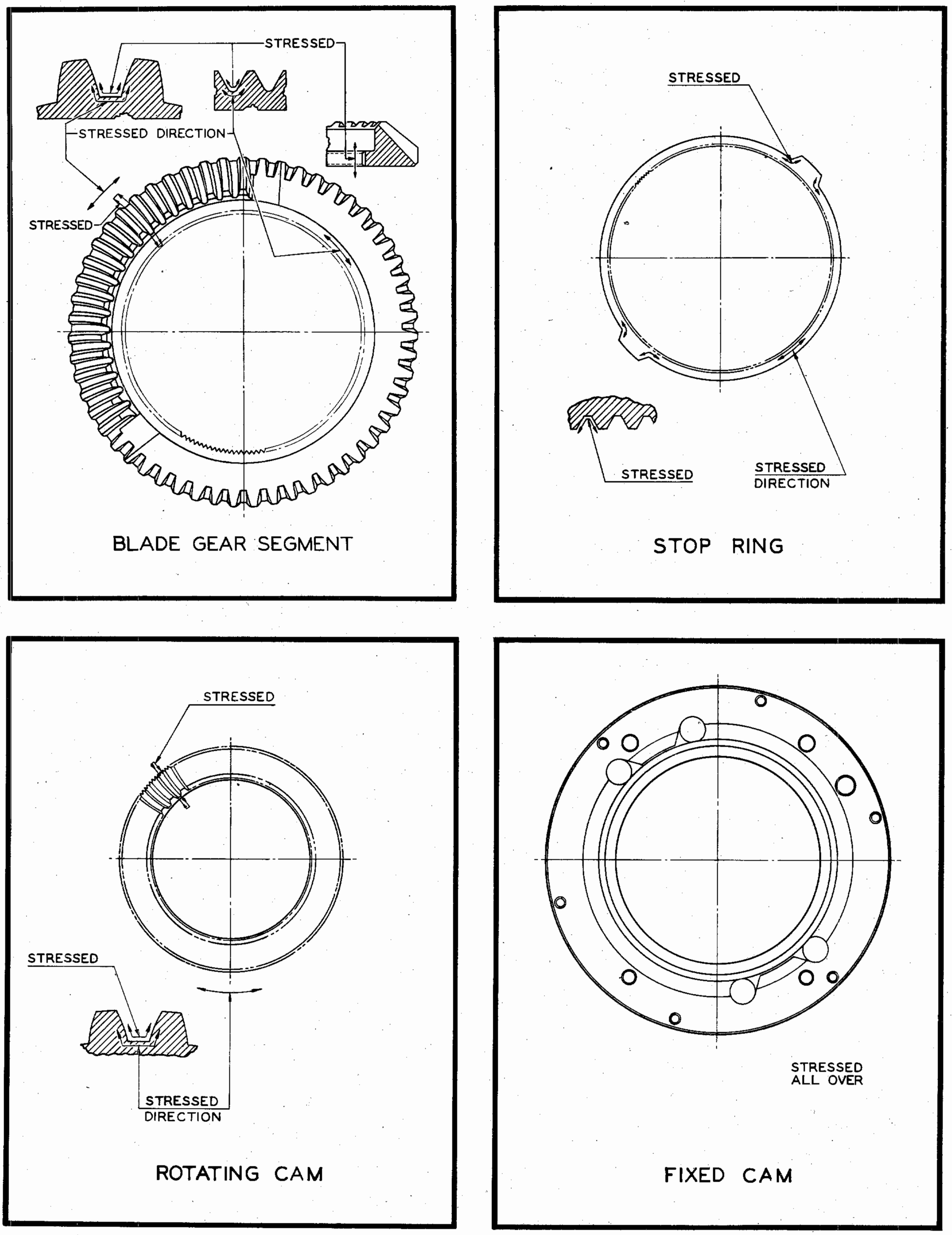


Figure 2—62. Magnetic Inspection Diagram

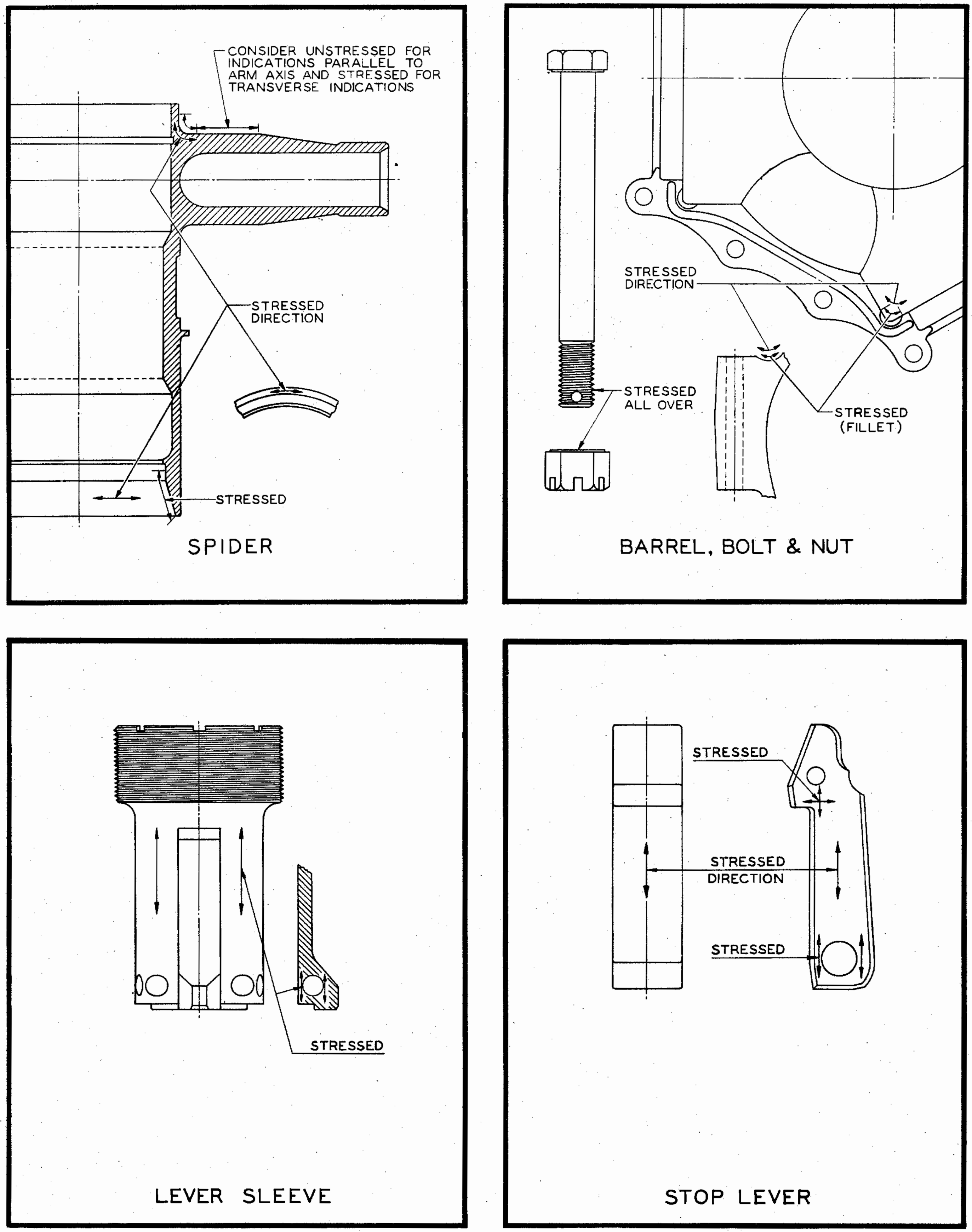


Figure 2—63. Magnetic Inspection Diagram

TABLE 2-3.

PART NAME	TYPE OF MAGNETIZATION	CALIBRATION LEVEL **OR AMPERAGE	TEST PROCEDURE
Barrel	Direct	No. 4	**CAUTION** Magnetize the two halves of the barrel separately. Due to the possibility of enlarging or damaging the dowel holes in the dome-barrel shelf when removing the fixed cam locating dowels, it is recommended that the outboard barrel half be magnetically tested with the dowels in position. When the barrel half is replated, the dowels should be protected against the plating solution by masking tape or suitable paint. Plating of the dowels and consequent removal of the plating is not recommended since that might result in a reduction of dowel diameter. Magnetize directly once by contacting the blade bore arm on one electrode and the remaining two arms in a fixture on the other electrode. Magnetize directly a second time by contacting in a similar manner on the bolt lug areas.
Spider	Direct	No. 4	Magnetize directly once by contacting the end of a spider arm on one electrode and the remaining two arms in a fixture on the other electrode.
	Bar Type Induced	No. 4	Magnetize inductively by contacting the ends of a brass rod through the center bore.
Fixed Cam	Bar Type Induced	No. 4	Magnetize inductively by contacting the ends of a brass rod through the center bore or by centering cam around vertical bar. Magnetize inductively by contacting the ends of a brass rod through the reverse end of one pair of cam slots at right angles to the stop lugs.
Rotating Cam Assembly	Bar Type Induced	No. 4	Magnetize inductively by contacting the ends of a brass rod through the center bore or by centering cam around vertical bar. Magnetize inductively by contacting the ends of a brass rod through the reverse end of the pair of cam slots at right angles to the stop lugs. **Note** Where the particular installation can be identified, only those teeth subject to continuous load during flight operation need be considered "stressed".
Gear Segment	Direct	No. 4	Magnetize directly by contacting the opposite sides of each segment on the circumference. Do not contact on the toothed area.
	Bar Type Induced	No. 4	Magnetize inductively by contacting the ends of a brass rod through the center bore. Do not magnetize more than seven segments at one time.

TABLE 2–3 (cont.)

PART NAME	TYPE OF MAGNETIZATION	CALIBRATION LEVEL **OR AMPERAGE	TEST PROCEDURE
Barrel Bolt	Direct	No. 1	Magnetize by contacting each end of a single bolt.
	Solenoid Type Induced	500 Amps.	Magnetize inductively by placing in a solenoid type coil. More than one part may be done at once, if sufficient coverage can be obtained.
Barrel Bolt Nut	Bar Type Induced	No. 1	Magnetize inductively by contacting the ends of a brass rod through the center of a number of nuts. The nuts must be spaced apart.
Stop Ring	Bar Type Induced	No. 4	Magnetize inductively by contacting the ends of a brass rod pasing through the centers of a number of rings using approximately 2000 amperes with continuous magnetization while applying indicating fluid.
Stop Lever	Direct	No. 1	Magnetize directly by contacting the ends of the lever between the electrode plates while using approximately 500 amperes and applying indicating fluid.
	Solenoid Type Induced	500 Amps.	Magnetize inductively using approximately 500 amperes and placing lever through coil while applying indicating fluid.
Lever Sleeve	Direct	No. 3	Magnetize directly by contacting the ends of the sleeve between the electrode plate while using 1500 amperes and applying indicating fluid.
	Solenoid Type Induced	1500 Amps.	Magnetize inductively using approximately 1500 amperes and placing sleeve through coil while applying indicating fluid.
Cam Roller Shaft	Bar Type Induced	No. 1	Magnetize inductively by contacting the ends of a brass rod passing through the centers of a number of shafts using approximately 500 amperes while applying indicating fluid. Only necessary to test in one direction.
Cam Rollers (steel)	Bar Type Induced	No. 3	Magnetize inductively by contacting the ends of a brass rod passing through the centers of a number of rollers, using approximately 1500 amperes. Only necessary to test in one direction.

2–38. As a basis of acceptance, for purposes of interpreting indications (using calibrated equipment), portions of propeller parts requiring magnetic inspection are classified as "stressed" and "unstressed". "Stressed" portions shall be those locations on a part which are subject to comparatively high vibratory stresses, while "unstressed" portions are those in which the vibratory stresses are comparatively low. The terms "stressed" and "unstressed" are employed merely for convenience, and it shall be understood that "unstressed" parts and areas may nevertheless be subject to substantial stresses of non-vibratory character. The following indications are cause for rejection of a part: ONE, for areas subjected to low vibratory stresses (unstressed), irregular, or cross grain heavy magnetic powder patterns having a length greater than .25 inch; and straight, heavy continuous indications having a length greater than 1.00 inch following grain lines. TWO, for areas subjected to high vibratory stresses (stressed), indications having a length greater than .25 inch parallel (±45°) to stress lines or located less than .06 inch apart in a transverse direction relative to the stress line, or any indication perpendicular (±45°) to stress lines greater than .06 inch in length that are not less than .06 inch apart except as noted in ONE above. On the rear cone seat surfaces of spiders, light magnaflux indications not exceeding 0.250 inch in length and not closer than 0.060 inch apart and substantially parallel to grain flow lines (axial) are acceptable.

2–39. Parts shall be demagnetized after the magnetic inspection is completed by passing the part slowly through the demagnetizing unit while the current is on.

2–40. THRUST WASHER MAGNETIC INSPECTION. The induced magnetic inspection may be used on blade thrust washers. A braided copper cable is placed between the washers and the blade as shown in Figure 2–64. It is not necessary to insulate the cable from the washers on the blade. Use a test current of 4,000 amperes, and magnetize the washers in five or more equally spaced positions to insure complete coverage.

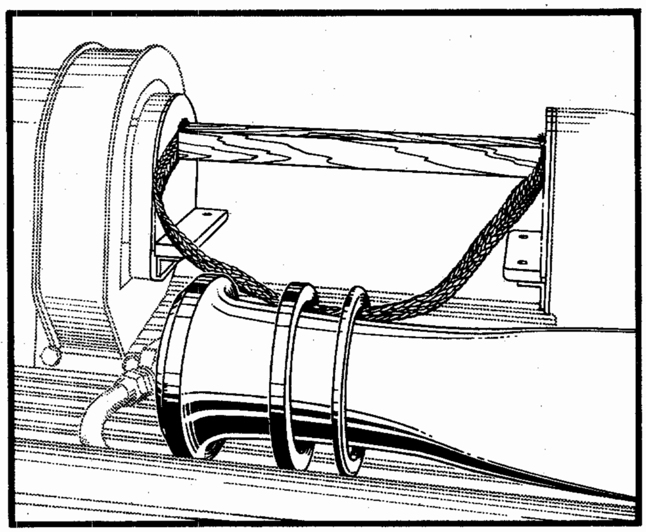


Figure 2–64. Magnetizing Thrust Washers — Induced Method

2–41. REPAIR.

Note

Each propeller part which inspection has found damaged or worn must be either replaced by a satisfactory part or repaired according to the instructions in this paragraph. If repair is impossible, the part shall be scrapped. The propeller as a unit shall be considered satisfactory only if it fulfills the test requirements of Section III and the inspection requirements of this section. Throughout the paragraphs on repair, references are made by "Item" number to the clearance chart and its accompanying figure.

2–42. GENERAL REPAIRS.

2–43. The following repairs are, in general, applicable to all parts. However, before attempting to repair any part, check to learn whether the particular part does or does not require a special repair procedure. It is assumed that these generally will be made unless otherwise specified.

2–44. STEEL PARTS. Using a fine stone, fine emery cloth, and crocus cloth, carefully eliminate all evidence of galling, nicks, burrs, and similar damage. Use extreme care to remove the damage completely, and yet do not remove more material than necessary. Leave no sharp edges or nicks.

2–45. ALUMINUM PARTS. Using fine emery cloth and crocus cloth, carefully eliminate all evidences of scratches, nicks, and burrs. Do not remove more material than needed to correct the damage. This does not apply to repair of aluminum alloy blades, since such repair is covered in paragraphs 2–71 through 2–91.

2–46. BRONZE PARTS. With fine emery cloth and crocus cloth remove all burrs. It is generally unnecessary to eliminate a nick completely, as bronze parts are not highly stressed.

Note

The information contained in paragraphs 2–44, 2–45 and 2–46 should be considered only as a method of damage removal. Before rework is started, refer to the clearance chart in this handbook.

2–47. SYNTHETIC RUBBER PARTS. It is good practice to replace all gaskets and seals at overhaul. In many cases, distorted synthetic rubber parts will regain their original shapes if they are boiled in water for 15 to 30 minutes. Discard all cut, torn, or permanently deformed parts.

2–48. PHENOLIC PARTS. Replace any phenolic part which is cracked or excessively nicked. Smooth out minor nicks with emery cloth.

2–49. PLATED PARTS. Any plated parts which are damaged so as to expose the base metal shall be stripped of plating and then replated.

2–50. BARREL ASSEMBLY.

2–51. SPIDER

2–52. Carefully remove any galling or bronze pick-up from the blade bushing on the spider arm bearing surfaces with a fine stone and crocus cloth. Smooth out any irregularities on the shim plate bearing surface.

2–53. If the spline gage reveals that excessive wear has occurred, the spider shall be scrapped.

2–54. If the clearance specified in Item 7 of the clearance chart is exceeded, the blade bushing shall be replaced. If the clearance remains excessive even with a new bushing, the spider shall be scrapped.

2–55. REPAIR OF CONE SEATS.

2–56. Most galling and scoring of the cone seats may be readily corrected by the use of a fine abrasive such as crocus cloth. When it is considered necessary to grind these seats, the limiting factor is the distance between cone seat gage diameters since this dimension determines the amount of thread engagement between the propeller retaining nut and the engine shaft. Gage HSP-1731 is used to make this measurement. The position of the gage rod relative to the front cone plate determines the amount of material that can be removed. When the gage rod protrudes above the front cone plate outer surface, the spider shall be scrapped. Any suitable equipment capable of performing the work may be used.

2–57. Carefully position the spider in a suitable grinding machine and clamp it onto the proper holding fixture. Using a dial indicator graduated in ten thousandths of an inch, indicate the spider on the cone seat. Lightly tapping the holding fixture, center the spider to within .001 full indicator reading. Due to the fact that the rework limit has to be held to the tolerance mentioned above, it is recommended that a polishing wheel only be used, except in cases of extreme damage. Use a grinding wheel when .003 inch or more material is to be removed. If any grinding is performed, it will be necessary to finish the operation by polishing the cone seat to its original mirror-like finish. The polishing operation may be accomplished with a grinding wheel made of rubber impregnated with carborundum. The wheels must be formed to the same degree of taper as the cone seat; namely, 30 degrees for the front cone, and 15 degrees for the rear cone. When the spider and grinding wheel have been set, proceed to grind the seat being careful not to damage the spider splines.

2–58. The gage specified for determining the minimum distance between the cone seat gage diameters is also used in checking the bearing contact of cone seats by the use of prussion blue. Contact of the cone seats must cover at least 80 percent of the area of the gage. Such contact must be evenly distributed around the circumference of the gage.

2–59. SPIDER ARM BENDING. The angle between adjacent spider arms and the squareness of the arms with respect to the central bore of the spider may be adversely affected by any accident which would cause bending of the propeller blades. Accurate checking of both the angles and the squareness requires special equipment which is ordinarily not available for Field use. For this reason, it is suggested that spiders suspected of having bent arms be returned to the factory for disposition.

2–60. BARREL.

2–61. BARREL WALL REPAIR. If the inner or outer surface of the barrel wall is slightly worn or galled, it can usually be smoothed out with emery or crocus cloth. Evidence of wear in this vicinity can also be removed by grinding. Service experience has indicated that wear on the blade thrust shoulder of the barrel is negligible, and dressing down with an abrasive cloth is generally all that is necessary. The repair limits with regard to minimum barrel wall thickness within and outside the critical area, and maximum ID of the barrel-blade bore are listed in the clearance chart. As shown, the critical area of wall thickness is that area extending inward 3/8-inch from the blade thrust shoulder. The wall thickness outside the 3/8-inch critical limit may be reduced in local areas .030 inch below the values in the table, providing the repair does not cover more than 20 per cent of the circumference of any one blade bore.

2–62. BARREL SHOT-PEENING. The addition of shot-peening to barrel arm bore inside diameters has become a standard manufacturing procedure for all 43E60 propeller configurations in order to provide improved fatigue strength and chafing resistance. Barrels shot-peened in the prescribed area are identified by part numbers 80391, barrel assembly number 80392, and propeller model number 43E60-9. Earlier propeller models 43E60-3 and 43E60-5 will not be interchangeable with model 43E60-9 propellers on aircraft specifying shot-peened 80392 barrels.

2–63. In addition to the above, the following examination and rework procedure is recommended:

a. Completely polish out the chafing in the arm bores in accordance with current practices on unpeened barrels.

b. Examine the reworked areas for remaining shot-peening impressions, particularly in the regions where the chafing existed. If one or more shot-peening impressions per one-quarter inch of length remain in each of the two narrow bands where chafing exists, caused by the inboard edge of the flat washer and the O.D. of the bearing retainer, or if one or more shot-peening impressions per one-quarter square inch of area in the remainder of the shot-peened region (excluding the regions of the chafing bands), remain after polishing, the barrel may be continued in service until the next overhaul.

c. If the minimum requirements for shot-peening impressions in either the areas where chafing existed or in the remainder of the shot-peened areas set forth in (b.) are not met; the region or regions where the deficiencies existed must be locally re-shot-peened or the entire peened area in the arm bore may be re-shotpeened; whichever is the more convenient.

2–64. OVERSIZE FIXED CAM LOCATING DOWEL. If a fixed cam locating dowel is loose in the barrel shelf, it shall be replaced with an oversize dowel. The end of the dowel which fits into the barrel shelf is made .015 inch oversize, but the other portion is unchanged. Ream the barrel dowel holes and press in the oversize dowel. The fit is specified in the clearance chart.

2–65. GEAR SEGMENT.

2–66. If inspection reveals a cracked or damaged gear segment tooth, the part shall be scrapped since repair of case-hardened teeth is not recommended.

2–67. If the clearance specified is exceeded, replace either the serrated blade bushing or the gear segment.

2–68. SHIM PLATE AND SHIM. Carefully stone out any irregularities on the shim plate bearing surfaces. If desired, the shim plate may be sandblasted.

2–69. FRONT AND REAR CONES. Using a fine file or stone, remove any sharp corners on the cones. If the beveled bearing surface of the front cone is nicked, it shall be scrapped. Remove all evidences of galling with fine emery cloth.

2–70. RETAINING NUT. If the lead thread of the propeller retaining nut is damaged to such an extent as to prevent the part from being properly installed on the engine shaft, the nut may be repaired by removing a maximum of one full thread. If it is necessary to remove more than one full thread, the retaining nut shall be scrapped. The allowable service limits of the retaining nut threads are given in Item 8 of the clearance chart. These figures represent a Class II fit, and are based on the assumption that the pitch diameter of the propeller shaft threads do not go below the limits.

2–71. REPAIR OF BLADE.

2–72. These blades have a cold-worked area which consists of a cold rolled surface extending from the fillet to a point just outboard of the barrel and a shot-blasted area extending from a point slightly overlapping the cold rolled area to a point approximately midway on the blade. When removing damage in the shot-blasted area, it is necessary to peen the reworked area unless three shot impressions per square inch still remain after the final polishing. This peening process is described below.

2–73. ROLLED AREA. The amount of metal which may be removed in the rolled area is extremely limited, and the removal of any metal except the most superficial damage will make it necessary to again cold work this area to re-establish the beneficial compressive stresses. Only the manufacturer has facilities for re-rolling, therefore, blades on which repairs have been made in excess of the limits stated below shall be returned to the factory for re-rolling. Cleaning of the fillet area may be accomplished with a soft-rubber eraser, or the entire rolled area may be cleaned by rotating the blade in a machine at a minimum of 100 rpm and polishing with crocus cloth. All pitting, galling, nicks, scratches, dents, bruises, etc., shall be allowed to remain if the damage does not exceed .004 inch in depth. Any blade having greater damage than this shall be returned to the factory for re-rolling, except that normal grooving of the shank by the blade seal may be allowed to go to a depth of .008 inch. Another exception, is when the damage occurs in such a location that the entire rework described below for shot-peened areas can be performed with no peening inboard of the sealing diameter (located 3.31 inch from the butt face). The pattern for peening such repairs shall be the same as specified for shot-blasted areas. In the shot-blasted and other airfoil areas, cuts, scratches, scars, nicks, dents, bruises, surface cracks, etc., shall be completely removed with a fine file, emery, crocus cloth, or by machining, forming a "saucered-out" depression smoothly faired into the blade surface. For machining, a hand grinder is suggested using a small (1½ inch dia. by ½ inch thick) felt wheel with #80 grit adhered to the surface. This area may be closely examined with a 3 power magnifying glass or by local etching, to make certain that the bottom of the damage has been completely removed. To avoid removing an excessive amount of metal, this visual check should be made at frequent intervals during the process of removing the damage. If it is found necessary during rework to remove more metal than is allowed in the repair limits given in the blade dimensional form (Table 2–4), the blade shall be retired from service.

2–74. Blades requiring removal of metal which would form a finished depression more than .125 inch in depth at its deepest point, .375 inch in width, and one inch in length, will be rebalanced. Blades from which less material than this has been removed generally do not require rebalancing. A suggested tool for measuring this depth is a dial indicator depth gage (HSP-1827) having a knife edge base 2-½ inches in length and a spindle with a phonograph needle point having a 1/16 inch radius at the point as shown in Figure 2–65. Determine the deepest point of the damage by visual inspection and careful trial and error method of checking in the bottom of the damage with the depth gage as shown in Figure 2–65 and note the indicator reading.

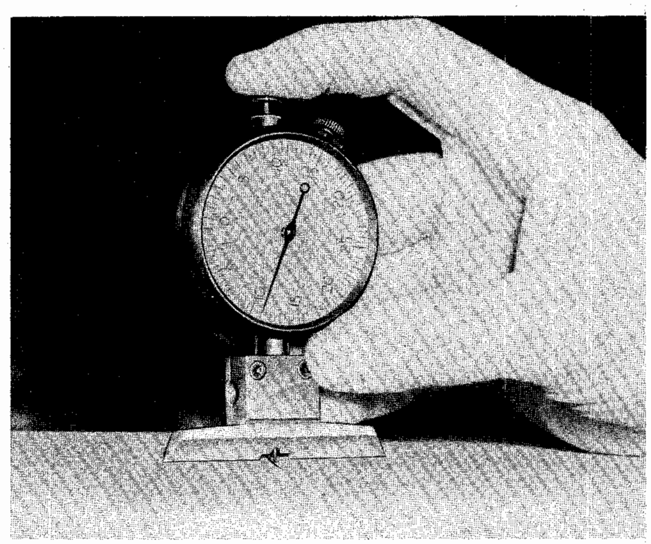


Figure 2–65. Measuring Depth

Note

Before using a depth gage, check for misalignment of the point with respect to the knife edge by rocking the gage on a hard flat surface. Misalignment will be in evidence by movement of the indicator pointer. When measuring the depth of the damage, the gage straight edge should be parallel with the blade centerline. When damage in a previously reworked area is being measured, the straight edge should be across this area and parallel with the blade centerline, taking zero reference adjacent to this previously reworked area.

2–75. The only acceptable method of removing the damage is that by which metal containing and adjacent to the damage is removed from the blade with die-makers' rifflers and emery cloth. All traces of the damage should be reworked from the blade and the resulting depression should be smoothly faired into the blade surface. Methods which attempt to relocate metal by cold-working to cover or conceal the defect rather than remove the damage are not acceptable. The number of repairs in a given area on a blade is not limited providing their locations with respect to one another do not form a continuous line of repairs that would materially weaken the blade structure.

CAUTION

Bending or twisting in any portion of surface treated blades will require straightening, reshotblasting, and possible rerolling of these blades by the manufacturer.

2–76. The equipment necessary for blade damage rework includes one each die makers' rifflers #8, 10, and 17 "O" cut (Grobet File Co. of America, 419 Canal Street, New York City, New York); one sheet each dry emery cloth Nos. 120 and 240, 3 power magnifying glass; local etching equipment described below; an automatic peening hammer as shown in Figure 2–72; and a sheet of rubber for a peening mask.

2–77. REWORK. The following procedure is recommended for the rework of blade damage:

a. Using a pencil or similar marking device which will not penetrate the blade surface, mark light perpendicular lines on the blade surface so that they intersect at the deepest point of the damaged area and extend sufficiently to permit location of the deepest point of the damage following rework.

b. Work out the abrasion using the file with the cut most convenient. File in a direction parallel to the scratches. Blend in the reworked area with the original blade surface by filing to form a saucer-shaped depression as shown in figures 2–68 through 2–71, being careful to remove all traces of the damage. This depression must not exceed the dimensions in paragraph 2–74 above. Remove all traces of the file marks with No. 120 emery cloth followed by No. 240 emery cloth, leaving a polished surface. The application of the emery cloth

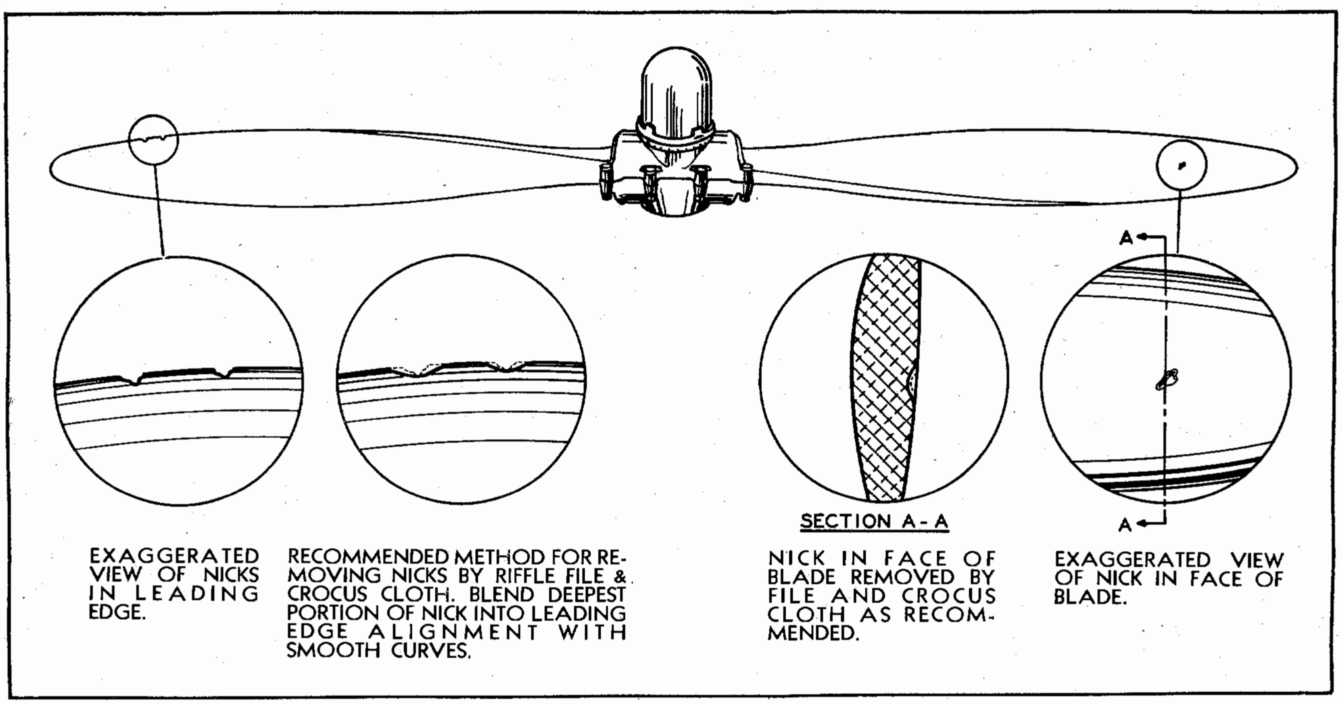


Figure 2–66. Sketch of Nicks and Methods of Removal

TABLE 2-4.

DRAWING NUMBERS AND CUT-OFF 6895A-8

RADIUS: 80 inches
DIAMETER: 13 feet, 4 inches

STATION	"A" WIDTH (inches)	"A" EDGE ALIGNMENT (inches)	"B" WIDTH (inches)	"B" EDGE ALIGNMENT (inches)	"C" WIDTH (inches)	"C" EDGE ALIGNMENT (inches)	THICKNESS MINIMUM (inches)	FACE ALIGNMENT MAXIMUM (inches)	FACE ALIGNMENT MINIMUM (inches)	ANGLE MAXIMUM (degrees)	ANGLE MINIMUM (degrees)
12	5.29	2.72–2.47					3.989	2.16	1.91	73.5	69.5
18	7.19	3.33–3.08					3.050	1.63	1.38	72.0	68.0
24	9.36– 9.16	4.12–3.87	9.15– 8.96	3.98–3.73			2.272	1.16	.91	70.5	66.5
30	11.09–10.86	5.03–4.78	10.85–10.63	4.87–4.62			1.739	.83	.58	68.0	66.0
36	12.62–12.39	5.96–5.71	12.38–12.16	5.79–5.54			1.396	.54	.36	65.6	63.6
42*	13.91–13.64	6.75–6.50	13.63–13.37	6.56–6.31			1.196	.36	.18	60.5	60.5
48	14.87–14.55	7.27–7.02	14.54–14.23	7.05–6.80			1.047	.23	.05	57.5	55.5
54	15.46–15.21	7.56–7.31	15.20–14.95	7.38–7.13	14.94–14.69	7.21–6.96	.924	.10	–.08	53.6	51.6
60	15.66–15.35	7.65–7.40	15.34–15.04	7.45–7.20	15.03–14.73	7.24–6.99	.821	–.02	–.20	50.1	48.1
66	14.62						.728	–.12	–.30	47.3	45.3
72	14.44						.645	–.23	–.41	45.0	43.0
78	14.34						.570	–.29	–.47	43.8	41.8

Tip Corner Radii – 1.00"

can be facilitated with the use of a riffler as a pushing tool as shown in Figure 2–70.

c. With a depth micrometer set at the zero reference, measure the amount of blade stock removal. If the final depth exceeds permissible stock removal depth as described in table 2–4 above, the blades shall be removed from service.

2–78. Blades that have the leading edges pitted from normal wear may be reworked by removing sufficient material to eliminate the irregularities. The metal will be removed by starting at approximately the thickest section and working forward over the leading edge camber so that the contour of the reworked portion will remain substantially the same as shown in Figure 2–67. In all cases, avoid abrupt changes in section or blunt edges.

2–79. INSPECTION OF REWORKED AREA. If local etching is performed on reworked areas to inspect for possible cracks resulting from the abrasion, the following procedure is recommended.

a. Swab the reworked area with a solution composed of one pound of commercial technical grade caustic soda to one gallon of water mixed and maintained at approximately 150-170 degrees F.

CAUTION

Do not allow the caustic soda (or nitric acid) solution to contact heater strips or rubber fairings or to enter the cavity between the blade and the hub.

b. After the area has been etched for approximately three minutes, clean by swabbing with a nitric acid solution composed of one part concentrated technical grade nitric acid to five parts water. After the black deposit has been removed, swab the area with clean warm water.

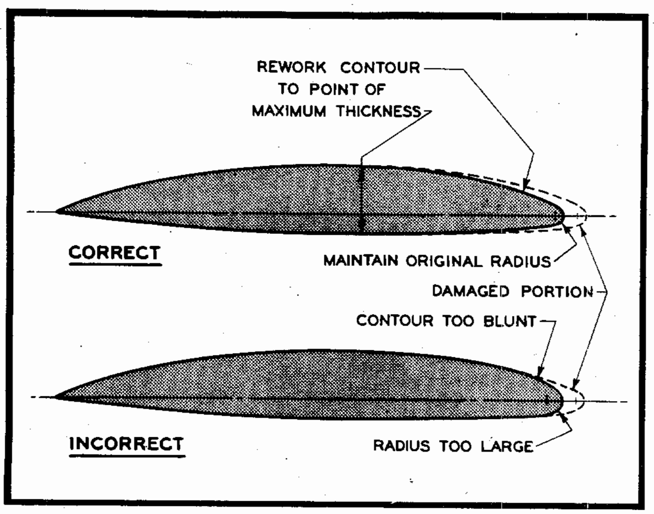


Figure 2–67. Rework of Leading Edge — Cross Section View

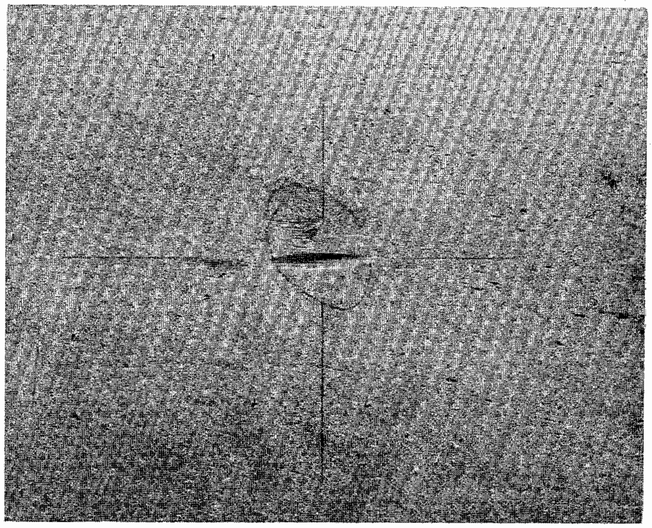


Figure 2–68. Abrasion before Rework

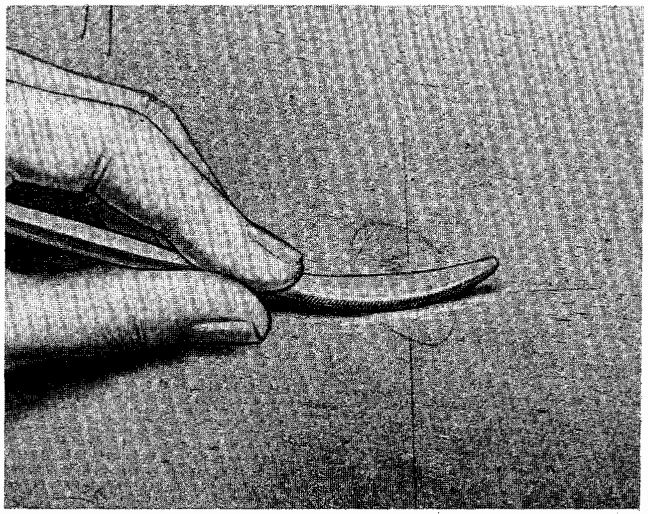


Figure 2–69. Filing Tool Application

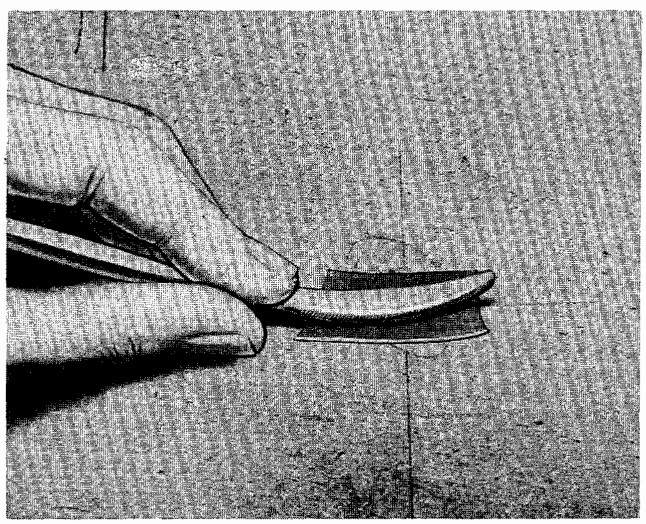


Figure 2–70. Emery Cloth Application

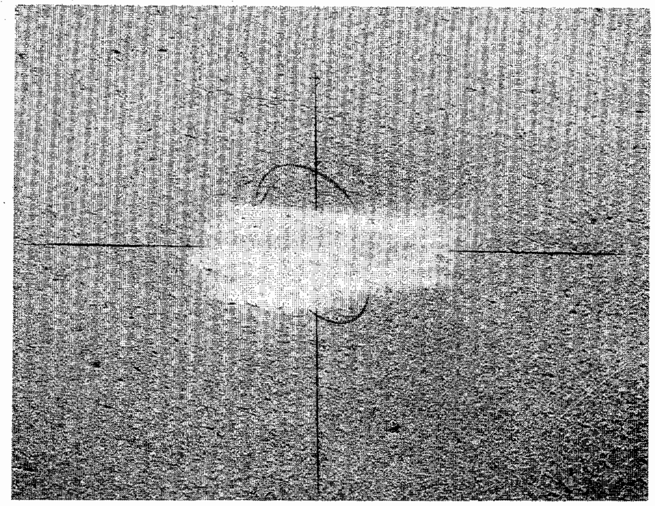


Figure 2–71. Abrasion Area After Rework

c. Any cracks in the reworked area will appear as dark lines. Evidence of a crack is cause for removing the blade from service.

d. If no cracks are evident, polish the treated area to remove all traces of etch.

2–80. COLD WORKING SURFACE TREATED AREAS. Following rework and etch inspection in the shotblasted or rolled areas, it is necessary to cold work the repaired area to re-establish the beneficial compressive stresses. As an aid in establishing a uniform peen intensity and pattern, an automatic peening hammer (HSP-2382) has been developed. As a temporary measure only, it is permissible to hammer peen manually using the hammer shown in Figures 2–80 and 2–81, and following the instructions below.

CAUTION

Cold working is to be accomplished in surface treated areas only.

2–81. OPERATION OF AUTOMATIC PEENING HAMMER. The motor used has a low starting torque and if the cam is stopped in a position such that the hammer has started its upward travel, the motor will not start again because of the spring load on the hammer. To prevent the possibility of burning out the motor, the switch latch and switch latch housing units are built into the lower section of the handle. By raising the small protruding lever (detail 19, Figure 2–72), the entire spring load is released and the motor switch button is depressed thus starting the motor. The lever is then brought down in place and the tool is ready for peening. It is, therefore, warned that at all times the motor should be started and stopped with this lever. Stopping the motor by pulling out the plug, then plugging in again may result in a burned out motor.

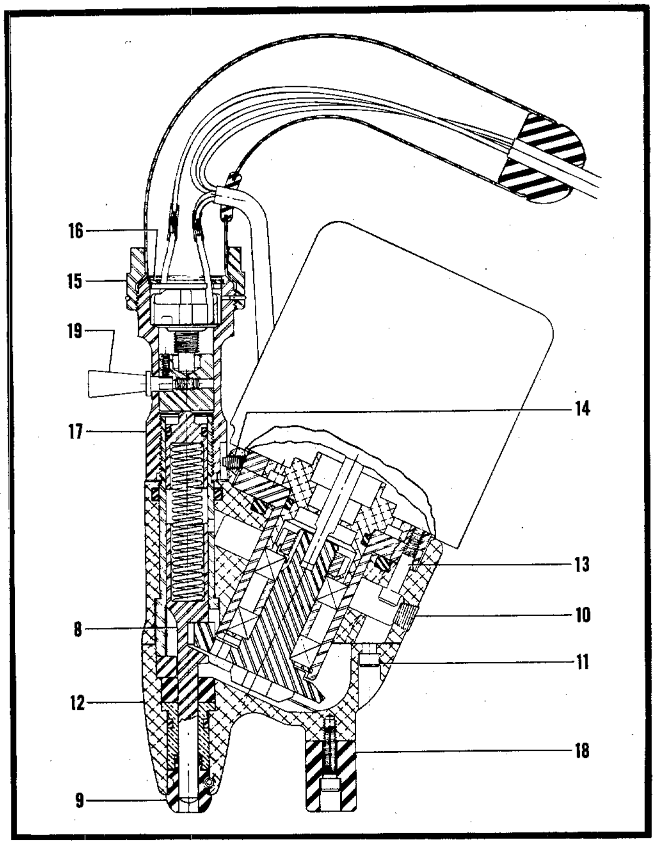


Figure 2—72. Cross-Section of Automatic Peening Hammer

2—82. CARE OF AUTOMATIC PEENING HAMMER. The peening hammer is to be used for the specific purpose of repairing surface treated HS-26 alloy blades. Peening any material harder than HS-26 is very likely to ruin the hammer tip. It is recommended that the hammer tip be closely examined for damage before each peening operation. If the hammer tip is accidentally nicked or damaged, the radius may be reground to remove the damage, provided the following operations are carried out:

a. Measure the overall length of the hammer (detail 8, Figure 2—72) before and after grinding to determine the change in length due to grinding.

b. After grinding, the hammer tip radius must be within the specified 3/16 inch radius.

c. Remove material from the surface of micarta sleeve support (detail 9) which contacts the blade during peening so that this part is shortened by the same amount as the hammer.

d. After completing the above, it is necessary to check the diameter of the impressions by peening on a .150 to .250 x .750 x 3.00 inches HSP-26 alloy strip mounted on an Almen holding block. If too much material has been removed from the hammer, the diameter of the impressions will be below the recommended .04± .002 inch due to the hammer mass reduction and the hammer will have to be replaced. Also, a new full length sleeve support (detail 9) will have to be used with a new hammer.

2—83. To remove the hammer for grinding or for replacement, the peening tool must be partially disassembled as follows (see Figure 2—72).

a. Remove plug (detail 10) and drain the oil from the tool.

b. Take off the cover (detail 12) by removing the four screws (detail 11).

c. Remove the four screws (detail 13) which will allow the motor to be separated from the housing.

d. Remove the set screw (detail 14).

e. Unthread nut (detail 15) and lift up the handle assembly.

f. Remove snap ring (detail 16) which will allow complete removal of the handle assembly and switch.

g. Unthread the switch housing (detail 17) which will allow removal of the hammer (detail 8).

2—84. Slight oil leakage may be experienced around the hammer tip because of the pumping action of the hammer. It is recommended that the oil level be checked after every four hours of actual peening. Oil should be up to the level of the oil plug in the housing after filling and holding the tool in a normal vertical position. Meropa #1 Texaco oil has been found to be very satisfactory.

2—85. The peening tool was designed for intermittent peening intervals of short duration and is not intended for long periods of continuous peening. It has been found that continuous operation for periods longer than ¾ hour will cause excessive heating, and continued use may burn out the motor.

2—86. Before peening the reworked area, check diameter of impressions by peening on a .150 to .250 x .750 x 3.00 inches HS-26 alloy strip mounted on an Almen holding block. DIAMETER of impressions must be between .038 and .042 inch. A brinell scope is suitable for these measurements.

2—87. PREPARATION. For both the machine and manual method, prepare and install a rubber mask on the blade as shown to aid in avoiding stray impressions. The hole in the mask should be sufficiently large to allow peening of the reworked area plus a band ¼ inch wide surrounding the area. The minimum surface which may be peened shall be equal to the area of a 1-inch diameter circle or in an irregularly shaped repair, the minimum radius shall be ½ inch. Stray impressions must not appear on the blade. However, if one occurs, the area surrounding the stray impression must be worked into the original peened area or the minimum peening area established around it.

2—88. PROCEDURE. When using the automatic peening hammer, hold it in a manner which is most convenient and peen the repaired area using a fairly rapid feed, (not less than 1.2 inches per second) in a circular direction

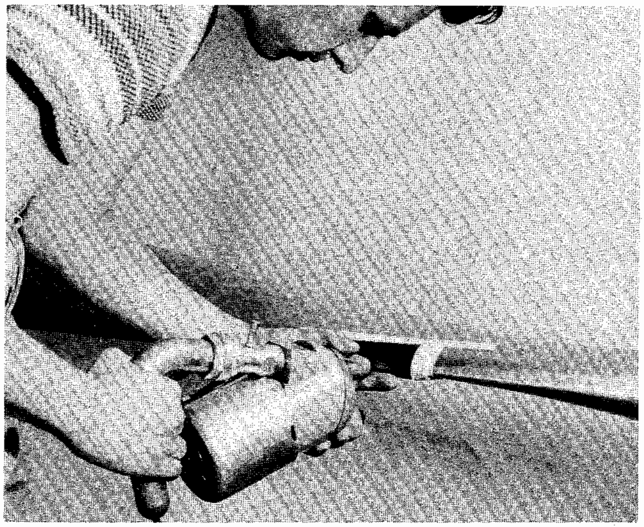


Figure 2—73. Method of Peening Blade Leading Edge

whenever possible. The hammer should be very nearly perpendicular to the surface being peened at all times. To assure proper positioning of the hammer relative to the blade surface, the sleeve support (detail 9) should contact the blade surface being peened, and the support leg (detail 18) should contact either the blade surface or the rubber mask, depending on the size of the area being peened. When peening directly on the leading and trailing edges, the automatic peening hammer should still be held in a manner so that it is approximately perpendicular to the surface being peened. However, in this case it may be inconvenient to use the support leg. Figure 2—74 shows a convenient way of peening the face and camber sides and Figure 2—73 shows the most convenient way of peening leading and trailing edges. Distinct peening impressions should be made as shown in Figure 2—75 and 2—76. Peening should be continued until the area is completely covered with overlapping impressions as

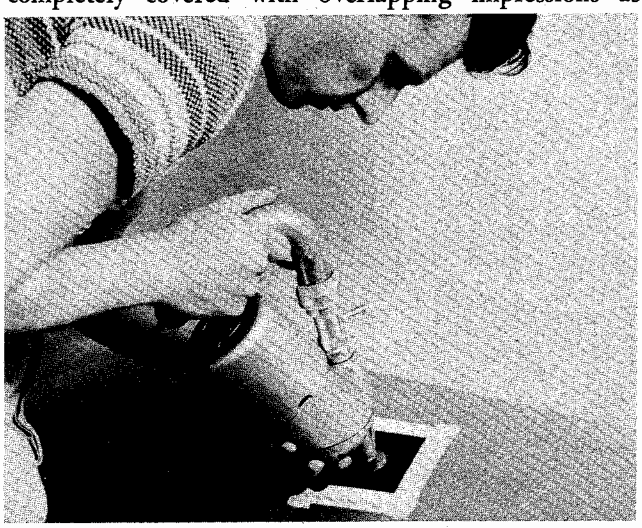


Figure 2—74. Method of Peening Blade Face and Camber Sides

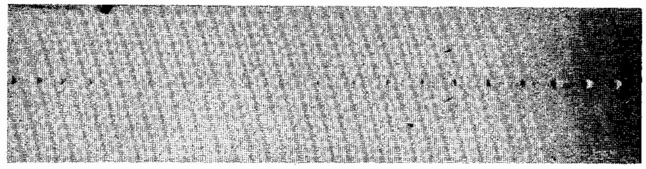


Figure 2—75. Typical .040 inch Diameter Impression — Rate of Feed 4.0 inch per second

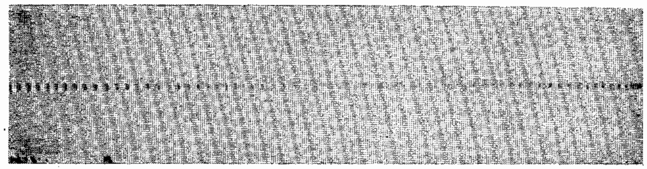


Figure 2—76. Impressions Resulting from Minimum Rate of Feed 1.2 inch per second

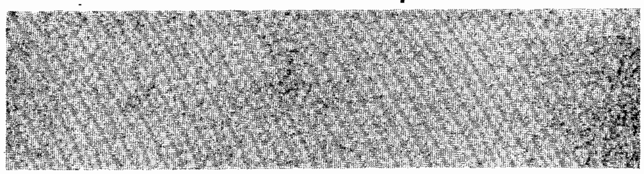


Figure 2—77. Appearance of Properly Peened Surface

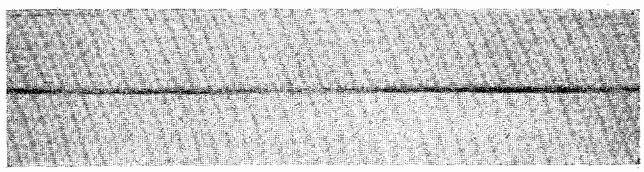


Figure 2—78. Worm Effect Resulting from Too Slow a Rate of Feed approximately .4 inch per second

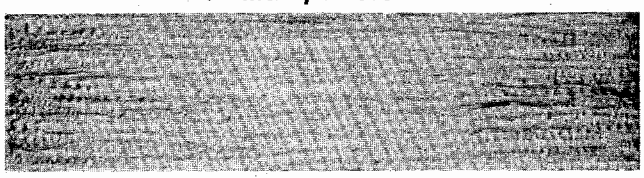


Figure 2—79. Appearance of Improperly Peened Surface with Worm Effect

shown in Figures 2—76 and 2—77. A peening time of approximately 1 minute is required to completely cover the minimum area. Too slow a rate of feed results in a worm effect peened area (Figures 2—78 and 2—79), and requires a much greater time to cover the area; also it is very likely that small unpeened areas will be left.

2—89. Remove the mask from the blade. It is recommended that the area be left "as peened"; however, the high spots may be removed with #120 and then #240 emery cloth, the bottom of the pits being left as evidence of the peening treatment with a minimum of three impressions per square inch. These repaired and peened areas are subject to the same general limitations as shot-blasted and rolled areas.

2—90. When using the manual hammer peening method, hold the recommended hammer loosely (Figure 2—81) and allow it to rebound from the blade at an intensity which will produce .075 inch diameter impressions similar to those shown in circle 1, Figure 2–82. Impressions ranging from .050 to .090 inch diameter are acceptable, but the majority of impressions should be .075 inch. Continue peening until the repaired area is completely covered with overlapping impressions resulting in a pattern like that in circle 2, Figure 2–82. A peening time of approximately two minutes has been found necessary to adequately treat the minimum area. If stray impressions occur, the area surrounding the impressions must be reworked into the newly peened area or the minimum peened area established around it.

2–91. REPAIR OF ELECTRIC BLADE HEATERS.

2–92. The following procedure is recommended for the repair of electric de-icer heaters. Examine the damaged area to determine its depth. In the case of surface treated blades, if the damage extends through the heater and into the blade in the surface treated area, the heater should be removed and the blade repaired in accordance with instructions under Blade Repair. Broken internal wires will necessitate replacing the heater.

2–93. To maintain sufficient de-icing efficiency on repaired heaters, the following repair limits are recommended. No one-foot length of heater shall have more than 15% of its area covered with patches, and no single patch shall be greater than four square inches. The patch shall overlap the damaged area by at least 1/16 inch on all sides; therefore, the greatest dimension of the damaged area must not exceed 2 1/8 inches.

a. For cuts or tears in the heater that do not penetrate through the insulation layer onto the blade, select a circular patch which is at least 1/8 inch larger in diameter than the greatest dimension of the damage. Then clean the surfaces to be cemented thoroughly with toluol. Apply a uniform coat of cement 1008 to the area being covered and to the patch and allow to dry for 30 minutes.

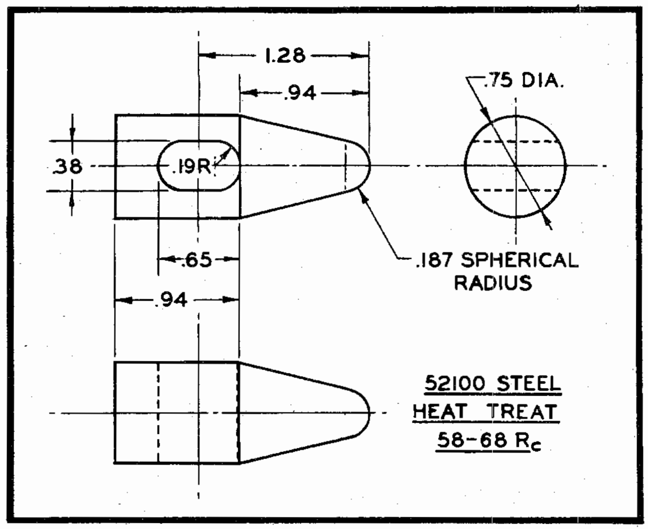


Figure 2–80. Design of Blade Peening Hammer

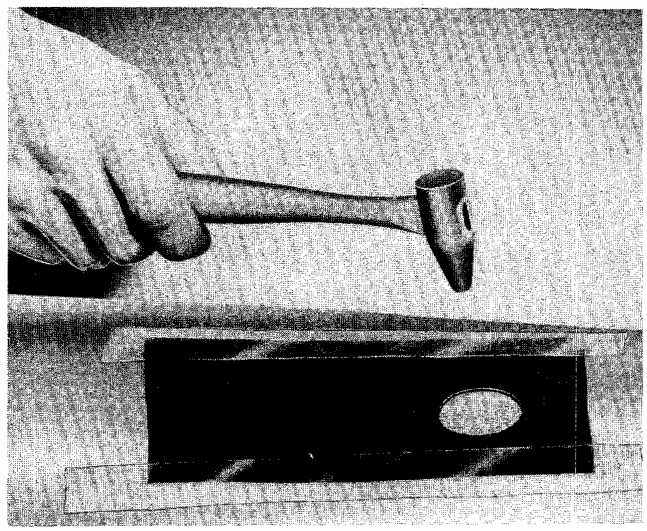


Figure 2–81. Hammer Peening Repaired Area

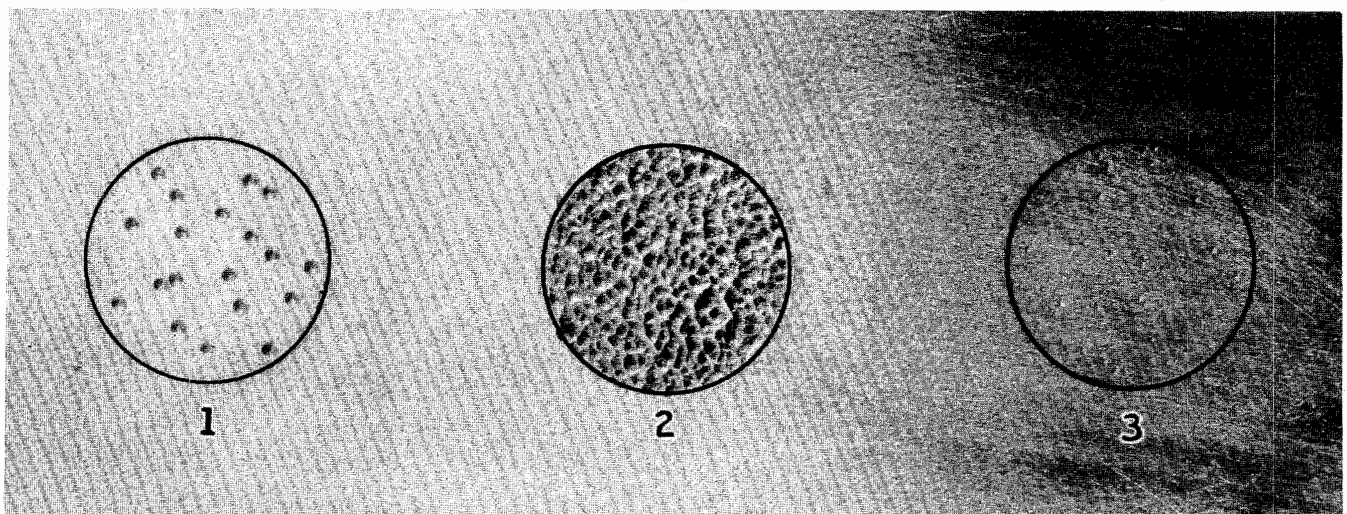


Figure 2–82. Steps in Peening Repaired Area

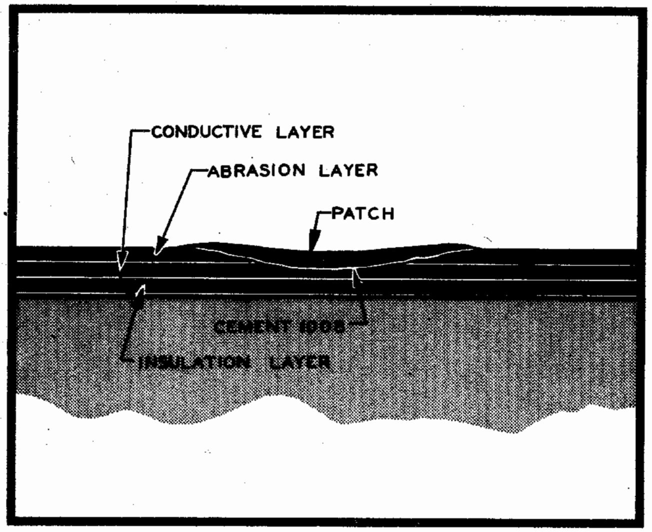


Figure 2—83. Cross Section of Patch

Apply a second coat of cement to these surfaces. Allow to dry until tacky (15 to 20 minutes), and install the patch. Apply cross-wrap tape around the blade over the patch. Over-lap each preceding turn ½ inch while exerting as much tension as possible and allow to dry for 24 hours at 70°F before the blade is put into service.

b. For damage that penetrates through the heater and into the blade outboard of the shot blasted area, check the heater resistance to determine if the conductive layer is grounded to the blade in the damaged area. If the damage falls within six inches of the original tip of the heater, the heater may be cut off just inboard of the damaged area in accordance with instructions in paragraph c. If damage is not in tip area or tip is not to be removed, cut away the damaged portion of the heater as required to permit repair of the blade and to break the ground, if present. Care should be taken to prevent additional damage to the blade when cutting the heater. Then repair the blade as necessary in accordance with existing instructions. To repair the heater, select a circular patch which is at least ⅛ inch larger in diameter than the greatest dimension of the damaged area. Then clean the surfaces to be cemented with toluol, being careful that the heater is not loosened from the blade. Apply a thin even coat of primer 1047 to the exposed area of the blade and sllow to dry for at least one hour. Next, apply a uniform coat of cement 1008 to the primer, the sides of the hole and the under surface of the patch and dry for 30 minutes. Apply a second coat of cement 1008 to these surfaces. Allow to dry until tacky (15 to 20 minutes) and install the patch. Apply crosswrap tape around the blade over the patch. Overlap each preceding turn ½ inch while exerting as much tension as possible and allow to dry for 24 hours at 70°F before the blade is put into service.

c. It is permissible to cut as much as six inches, at the tip end, from the original length of the heater, if it becomes damaged beyond practical repair. To accomplish this, loosen the heater to ½ inch inboard of the portion to be removed, using methyl ethyl ketone, toluol, or similar solvent to soften the cements. This should be done carefully by working the solvent under one corner and gradually loosening the heater from the blade. A square cut-off should be made when trimming the heater to remove the damaged portion. Cut two strips (A and B) from rubber stock 73500. Strip A should be ¾ inch wide and strip B should be long enough to overlap the end of the heater ½ inch and extend over the blade area covered by the heater's original length. If each heater on a propeller is being shortened, their cut-off lengths should be made equal. In this case, rubber strip B need not extend to the heater's original length, but should be one inch wide to cover the end of the heater adequately and permit cementing to the blade. Clean all the cement and primer from the blade and under side of the heater with solvent and allow to dry thoroughly. The outer end of the heater (upper side), both sides of rubber strip A and the under side of strip B should also be thoroughly cleaned with solvent and thoroughly dried. Mask a blade area approximately ¼ inch greater than the area to be cemented. Apply a thin even coat of primer 1047 to the area on the blade enclosed by the mask and allow to dry for at least one hour. Next, apply a uniform coat of cement 1008 to both sides of rubber strip A, one side of rubber strip B, both sides of the heater ½ inch from the end, and the masked area on the blade. Allow to dry for at least one hour before applying a second coat of cement 1008 to these surfaces. Allow second coat to dry until tacky (15 to 20 minutes). Then install rubber strip A on the blade and lay the heater over it. Next install rubber strip B over the end of the heater, rubber strip A and the blade as shown in Figure 2—84. Apply crosswrap tape around the blade over the repair. Overlap each preceding turn by ½ inch

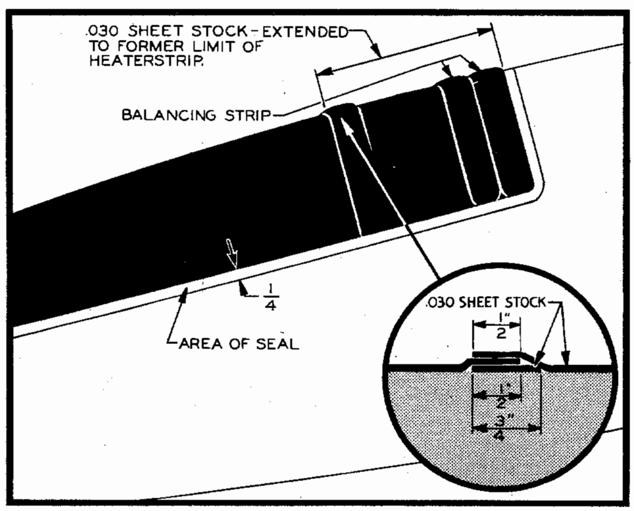


Figure 2—84. Installation of New Tip and Balancing Strip

while exerting as much tension as possible and allow to dry for 24 hours at 70°F before the blade is unwrapped. Then seal the edges of rubber strip B with cement 1008 extending approximately ½ inch on blade and rubber.

d. To compensate for changes in propeller balance due to heater patching or cut-off balancing strips 72037-1 and 72037-2 are provided. These strips may be cemented to the blade adjacent to the outboard end of the heater or may be cemented over the rubber strip B after making a heater cut-off as shown in Figure 2—84. When applied to approximately the 75% blade radius, balancing strip 72037-1 affects propeller balance about the same as the addition of two balancing washers to the blade balancing plug. Balancing strip 72037-2 is about twice the weight of strip 72037-1. Use the same cements and method to apply balancing strips to the blade (see Figure 2—84) as recommended for applying rubber strip B in paragraph number c. These strips should not be used in place of blade washers for balancing propellers during assembly, but only for balancing after repair of the de-icer heater.

Note

If it is necessary to repair all heaters and they are cut-off at an equal length, it will not be necessary to add balancing strips.

2—94. MATERIALS.

2—95. Circular patches 73499 are available in the following diameters; 1, 1-½, and 2-¼ inches, and are identified by dash numbers 1, 2, and 3 respectively added to the part number. Rubber stock 73500 is available by the foot. The circular patches, rubber stock, and balancing strips 72037-1 and 72037-2 may be purchased from Hamilton Standard, East Hartford, Connecticut.

2—96. EC-776 manufactured by the Minnesota Mining & Manufacturing Corporation is an insulating cement which may be thinned with methyl ethyl ketone to painting consistency.

2—97. Bostik 1007 manufactured by the BB Chemical Company is a primer cement which may be thinned with Bostik 315 or methyl ethyl ketone to a painting consistency.

2—98. Bostik 1008 manufactured by the BB Chemical Company is an adhesive cement mixed in the following manner: To one part by weight of accelerator (Part B), mix eight parts by weight of cement (Part A). Thoroughly work in the two parts and thin as necessary with toluene to a good brushable consistency. Discard any of the mixture not used within four hours after mixing.

2—99. EC 539 cement and EC 566 accelerator manufactured by the Minnesota Mining & Manufacturing Company is an oil-and alcohol-proof compound that is prepared by mixing ten parts by weight of EC 539 with one part by weight of EC 566.

2—100. The drying time of the cements may be reduced to 4 hours by maintaining 140±10°F (measured on the blade) to the patch area. The humidity and consistency of the cements also affect the drying time.

CAUTION

A maximum temperature of 150°F must not be exceeded as it may result in harmful effects on the blade.

2—101. INSTALLATION OF HEATER ABRASION STRIPS. The use of rubber abrasion strips adhered to the outboard leading edge of external blade heaters is an effective method of controlling normal abrasive wear, thereby prolonging the service life of the heater. The following information is provided for the installation of these protective strips:

a. The heater abrasion strip (part number 83643) is a

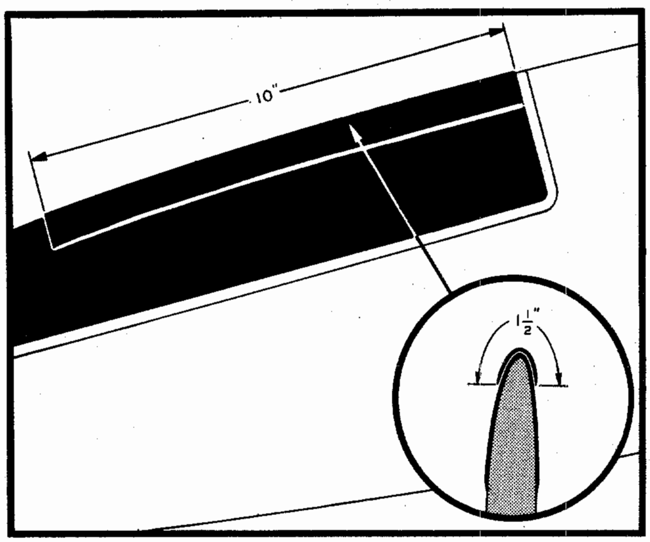


Figure 2—85. Heater Protective Strip

strip of rubber approximately 20 inches long and 1-½ inches in width and shall be cemented over the leading edge of the heater in such a manner as to be located centrally with the blade leading edge and extending inboard from the heater tip.

b. The surface of the heater shall be prepared by cleaning with toluol to remove any foreign material detrimental to adhesion. No abrasives shall be applied to the heater surface. A thin coat of 1008 cement shall be applied approximately ½ inch wider than the area to be covered by the abrasive strip and allowed to air dry from 1-3 hours before applying second coat.

c. The mating surface of the abrasion strip shall be heavily roughened with course #40-80 grit sandpaper or emery cloth to remove any gloss or foreign matter. This surface shall then be wiped off with a clean cloth soaked with toluol. A thin even coat of 1008 cement shall be applied to the prepared surface and allowed to air dry from 1-3 hours. When dry, apply second coat and allow to air dry 1-3 hours.

d. When the cement on both surfaces is dry, locate the abrasive strip as mentioned above and roll carefully to obtain good adhesion and exclude all air bubbles.

2—102. Blades with strips cemented on in accordance with the above procedure should not be flown for at least five hours to allow the cements to cure sufficiently for satisfactory strip adhesion.

2—103. DOME ASSEMBLY.

2—104. FIXED CAM. Clearance between the cam slots and the cam rollers in excess of clearance chart limits may be corrected by replacing worn rollers. If excessive clearances at the inboard and outboard cam bearings are due to fixed cam wear, the cam should be replaced. If the clearance specified between the locating dowel and the hole in the base of the fixed cam is exceeded due to a worn dowel, the dowel shall be replaced. Any damage of a superficial nature may be repaired with a fine stone. The stop lugs are an integral part of the fixed cam and cannot be replaced. The repair is restricted to hand rework of removing the raised metal or rough corners with a fine stone.

2—105. DOME ASSEMBLY BALANCE.

2—106. The major components of a Hydromatic dome assembly are balanced separately at manufacture. Accumulated experience has shown that any slight out-of-balance resulting when these parts are brought together in an assembly is well within the propeller balance correction capacities. Therefore, the requirement for balancing Hydromatic dome assemblies has been discontinued. With respect to the change, stationary cams in current production do not include balancing holes or counterbores, thereby eliminating the requirement for welch plugs in the dome assembly.

2—107. PISTON.

2—108. The piston shall be replaced if wear on the piston causes clearances greater than those specified in the chart, or, if the sleeve is loose. Minor damage may be carefully repaired with a fine stone or fine-cut file.

2—109. The outboard face of the piston sleeve shall be reworked if it becomes excessively mutilated due to the action of the piston stop levers. The rework consists of facing off the flat on the outboard end of the sleeve by a sufficient amount to remove evidence of mutilation, adding a chamfer and radius, and replating. The suggested procedure is to mount the piston and sleeve in a lathe and face off the sleeve with a cutting tool. The reworked surface must be square with the centerline of the sleeve within .003 F. I. R. The minimum dimension of the length of the sleeve after reworking is 5.10 inches.

Sleeve	Propeller Model	A	C	B Min. After Reworking
78076	43E60	2.45	30°	5.10

2—110. Another practice which could be followed in some cases is to position the stop levers so that they contact areas on the sleeve which are not worn.

2—111. The copper plating shall be accomplished according to the following:

a. Clean approximately .25 inch in the ID, on the outboard surface, and on the OD of the outboard end of the sleeve with steel wool and lacquer thinner. Wipe off with a clean, dry cloth and dry with an air hose. Do not attempt to use ordinary cleaning processes due to the possibility of corrosion.

b. All exposed metal except the area to be plated should be covered with a light film of clean engine oil. Mask with a rubber mask the outboard end of the piston, extending far enough inboard so that none of the piston will be in the plating solution. The strip folds inside the piston to prevent excessive plating.

c. Copper plate approximately .001 inch thick using the following formula and conditions:

Distilled water — 1 gallon
Copper cyanide — 4 ounces
Sodium cyanide — 4.5 ounces
Sodium carbonate — 2.5 ounces
Current density — 10 amperes per square foot.
Temperature — 110 degrees F maximum.
Cathode efficiency — 40 to 70 per cent.
Anode (made of rolled copper) area equals two times cathode area.
Time — 1 hour.
Voltage — 3 to 5 volts.

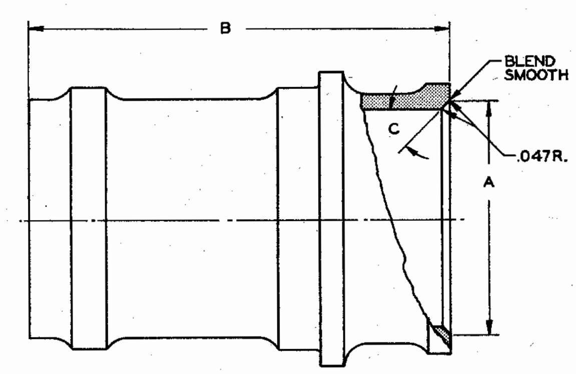


Figure 2—86. Rework of Piston Sleeve

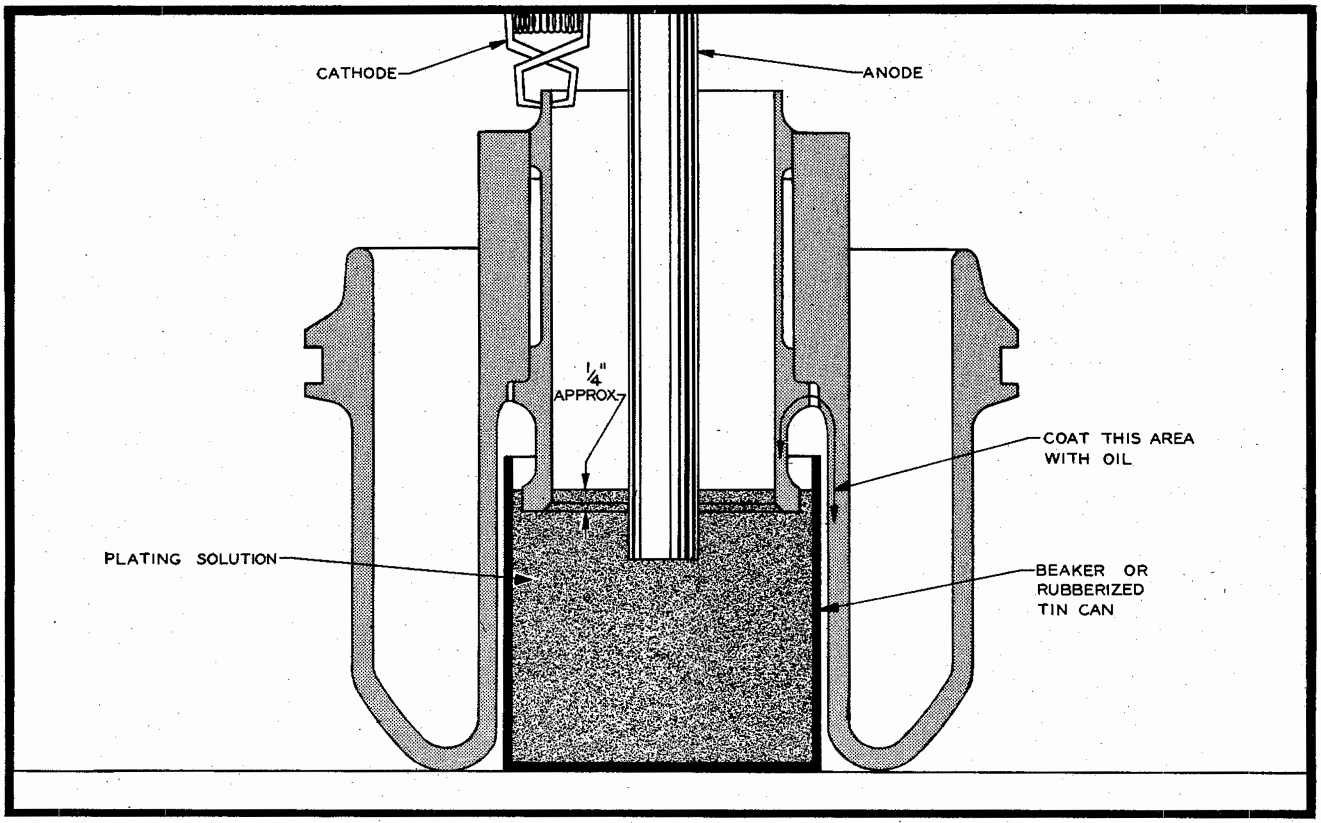


Figure 2—87. Copper Plating Piston Sleeve

d. After plating, wash with water and dry thoroughly.

2—112. LOW PITCH STOP LEVER ASSEMBLY.

2—113. If the corners on the stop levers are found to be slightly chipped, the rough edges may be smoothed with a fine stone. If the corners are badly damaged, the levers must be replaced. When replacing one lever out of the set of three, it should be checked to see that the dimension from the centerline of the attaching shaft hole to the inboard surface of the shoulder does not vary more than .003 inch from that of the other two, and the maximum dimension between these points shall not exceed 2.203 inches. To obtain this combination, it is possible to rework the lever by grinding as it is held in the proper fixture. The new lever shall be marked with the same serial number as its mates.

2—114. The servo piston valve and its seat may be polished with fine emery cloth if they are found to be slightly galled. Be sure not to disturb the square corners of the seats or the sealing qualities of the servo piston valve will be affected. Nicks and abrasions on sealing surfaces may be polished out with fine emery cloth. Be sure the wire in the end cap bleed hole is free.

2—115. Rework the early model 75360 servo valve by increasing the internal seal groove diameter to dimensions shown. For this operation, it is suggested that a sleeve as shown be made to protect the valve surface when clamped in the chuck. The cutting tool may be made to dimensions shown.

2—116. It is recommended where necessary with early model servo shafts, that the 69984-112 spiral lock ring be superseded by a heavier wedge retaining ring 82078. This change may be accomplished in the following manner: Increase the width and depth of the servo piston shaft wedge retaining ring groove to dimensions shown. The rework may be accomplished by turning the shaft

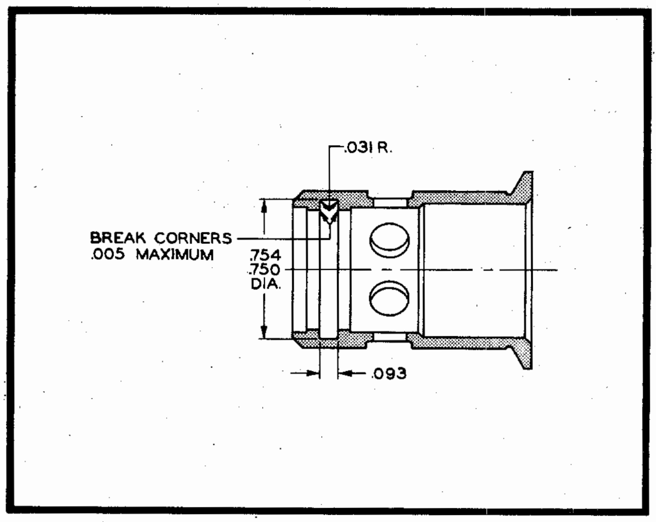


Figure 2—88. Rework of Servo Valve

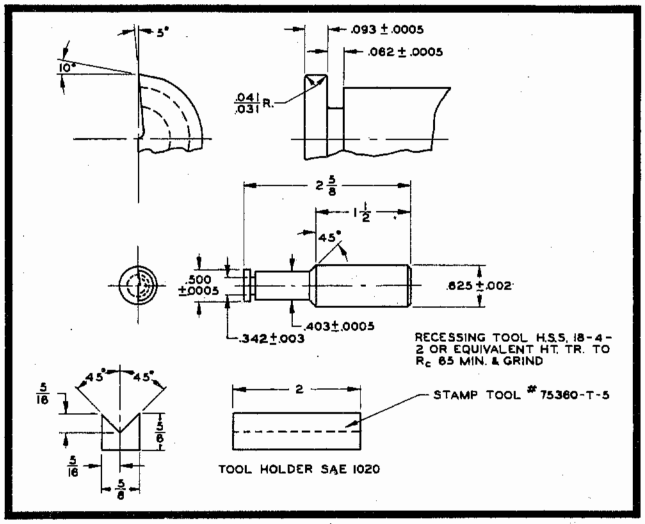


Figure 2–89. Cutting Tool

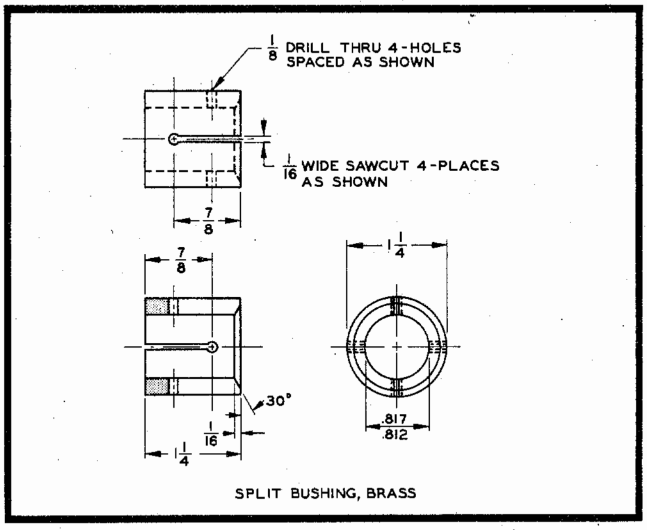


Figure 2–91. Valve Sleeve

assembly in a lathe and machining the groove with a tool as shown. Because of the hardness of the shaft in the area to be reworked, the material quality of the tool should be H.S.S. Type T-15 or equivalent, and care must be exercised during the machining operation to prevent burnishing. Magnaflux the reworked area and change the shaft assembly number to 82076.

2–117. LUBRICATION.

2–118. The propeller assembly operates in oil which is circulated through the system by the gear pump in the control; therefore, special lubrication is not required. However, in order to facilitate assembly, it is recommended that grease meeting AN specification AN-G-15 be used on the spider arm bearing surfaces, the blade thrust bearings, the spider shim plates, and the barrel half seals. Light engine oil may be used on the other parts as desired to permit easier assembly.

2–119. REASSEMBLY.

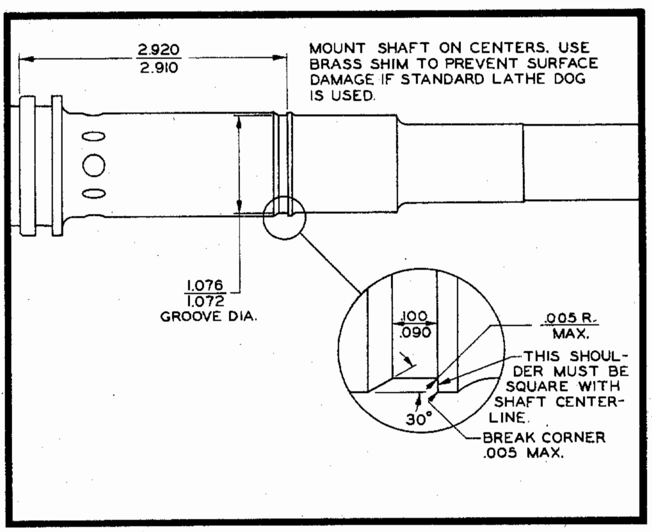


Figure 2–90. Rework of Servo Shaft

2–120. GENERAL PRECAUTIONS.

2–121. The correct assembly tools are listed in paragraph 2–1. Before assembling the propeller, all parts are to be carefully inspected, cleaned, and all surfaces except those coated with grease shall be coated with light engine oil. All damaged parts should be repaired or replaced.

2–122. The various components of the propeller assembly are numbered to indicate their location in the assembly. It is imperative that these parts be installed in their correct numbered position in order to obtain proper fit and balance of the complete propeller. Parts not numbered shall be properly marked before assembling them into the propeller. Carefully remove any high spots caused by the stencil stamping operation.

2–123. After the propeller has been completely assembled, it shall be carefully and thoroughly tested in accordance with the test procedure in section III.

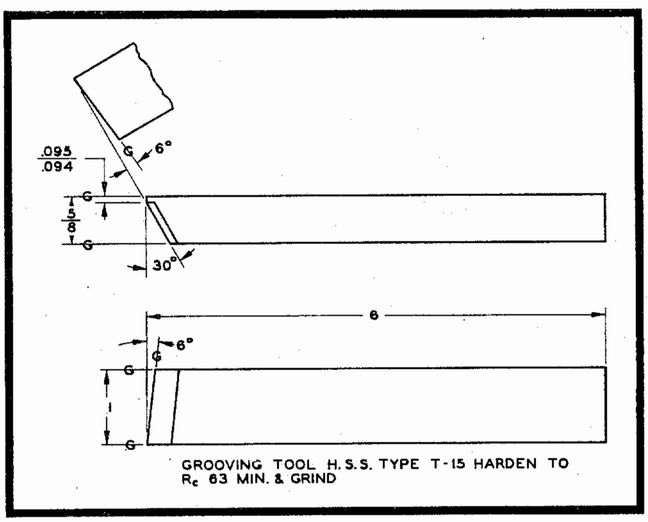


Figure 2–92. Cutting Tool

2—124. ASSEMBLY OF BLADE.

Note

To protect the blade surface during propeller assembly, wrap paper around the shank beneath the thrust washers.

2—125. INSTALLATION OF DE-ICING HEATER PAD.

2—126. Equipment and Material: The following list of equipment and material is recommended to obtain the best results.

a. Mild abrasive cleanser such as Bab-O, Dutch Cleanser, or equivalent, to be used only on blades that are not anodized.

b. Emery cloth, 40-80 grit.

c. Paint brush, one inch wide.

d. Rubber roller, two-inch wide face.

e. EC-776 manufactured by the Minnesota Mining & Manufacturing Corporation is an insulating cement which may be thinned with methyl ethyl ketone to painting consistency.

f. Bostik 1007 manufactured by the BB Chemical Company is a primer cement which may be thinned with Bostik 315 or methyl ethyl ketone to a painting consistency.

g. Bostik 1008 manufactured by the BB Chemical Company is an adhesive cement mixed in the following manner: To one part by weight of accelerator (Part B), mix eight parts by weight of cement (Part A). Thoroughly work in the two parts and thin as necessary with toluene to a good brushable consistency. Discard any of the mixture not used within four hours after mixing.

h. EC 539 cement and EC 566 accelerator manufactured by the Minnesota Mining & Manufacturing Company is an oil- and alcohol-proof compound that is prepared by mixing ten parts by weight of EC 539 with one part by weight of EC 566.

2—127. PREPARATION OF THE BLADE.

a. Clean the blade area with an overlap of one inch all around the area to be covered by the de-icing parts using a volatile solvent such as methyl ethyl ketone.

b. With anodized blades, the cleaning is limited to wiping the area described above with a clean cloth dampened with a safety cleaner comprising two parts white gasoline or toluol to one part carbon tetrachloride. A water rinse of the cleaned area should produce no "water breaks".

Note

It is important that surfaces cleaned are not touched with the hands or any oily or otherwise dirty cloth.

c. Mask off the cleaned area in such a manner as to allow a 0.5 inch overlap of the cements on the blade surface which will not be covered by the adhered parts.

2—128. PREPARATION OF PARTS.

a. Trim the inboard end of the heater square with the heater sides to remove uneven feathered edge.

b. Remove the protective covering from both sides of the pad.

c. Lightly roughen the sides of the parts to be adhered with No. 40-80 grit emery cloth or sandpaper. Roughening should remove all traces of gloss, molded fabric impressions, talc, wax, etc. Wipe the roughened area with a clean cloth dampened with tuluol.

d. Using a colored chalk, mark a centerline the length of the pad on the exterior surface for installation convenience.

2—129. CEMENT APPLICATION.

a. Apply a thin even coat of EC 776 within the masked area of the blade and allow to dry one hour minimum time.

b. Apply a coat of BB 1007 over the EC 776 and allow to air dry one hour minimum time.

c. Directly after application of BB 1007 to the blade, apply a thin coat of 1008 to the adhesion surface of the part to be installed. Allow to air dry one hour.

d. Apply a thin even coat of 1008 over the BB 1007 on the blade and a second coat of 1008 on the part to be installed. Allow the cements to dry one to three hours.

2—130. INSTALLATION PROCEDURES.

a. Pencil mark a centerline on the blade shank in line with the "A" degree marking as tabulated. Extend the line to the cemented area.

b. Using a vernier caliper or a similar measuring device, measure the "B" and "C" distances as tabulated

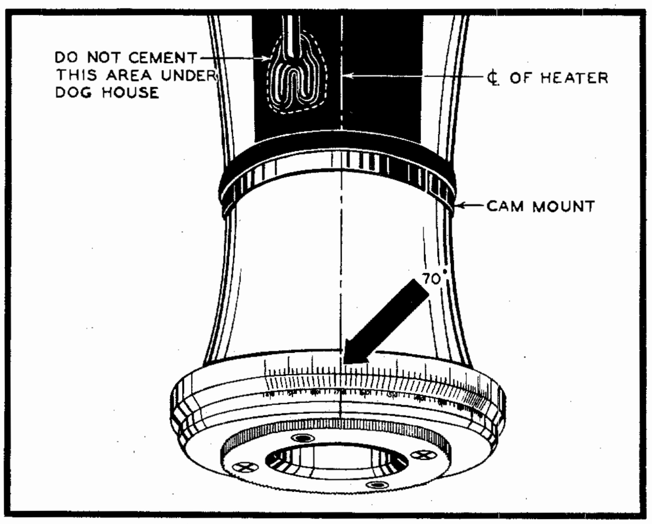


Figure 2—93. Angular Location

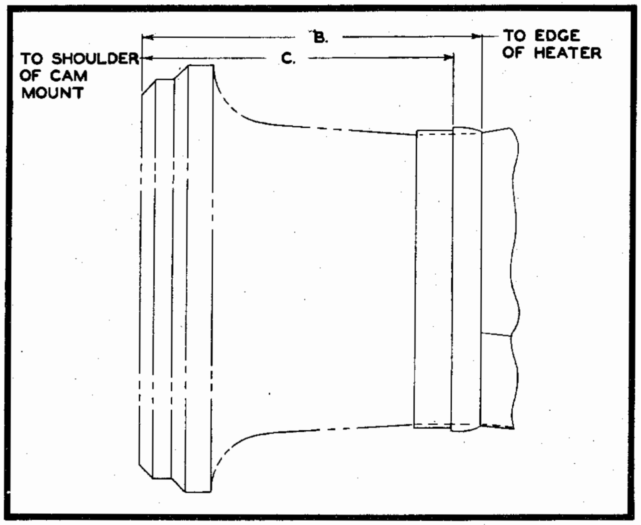


Figure 2–94. Axial Location

to locate axially the parts to be installed. Very lightly scribe location points on the blade. The lines should not be so heavy as to penetrate the outer layer of cement.

c. Install the cam mount of electric de-icing assemblies.

d. Install the heater on the blade using the markings as a guide for their location. Factory methods adhere the pad to the blade along its centerline and then gradually roll outward from the centerline on the face side and the camber side. Any method of application is permissible providing the parts are well rolled and the finished product is a smooth fit, free of overlaps, bulges, and air bubbles. When installing heater pads, do not apply pressure on the junction area of the pad and connector.

e. Remove the masking tape and seal the edges of the parts with EC 539. The seal should extend approximately .25-.50 inch over each rubber part and .25 inch beyond the band of the exposed cement on the blade.

2–131. The cements used realize their maximum strength after five days at 68 ± 5°F, or approximately one day at 140 ± 5°F. Blades with parts cemented on in accordance with the above procedure are not to be flown until such a curing period has elapsed.

2–132. Check the resistance of the electric de-icing pads after installation. The resistance of 78932 heater and connector assembly should be .34-.44 ohms.

DE-ICING EQUIPMENT LOCATION

BLADE	HEATER	A (degrees)	B (inches)	C (inches)
6895	78932	70	5.93	5.43

2–133. ASSEMBLY OF HUB.

Note

Removal of plating is sometimes performed to facilitate magnetic inspection. This obliterates the propeller identifying numbers etched on the outer surface of the barrel. These numbers must be replaced by an approved acid etching process. The propeller model number, parts list number, and serial number shall be etched in letters .15-.19 inch high between two barrel arms of the outboard half so that they may be read from the outboard side of the propeller. The serial number shall also be etched in the corresponding position on the inboard half. In addition, new barrels must be steel stencil stamped with the blade bore number adjacent to the blade opening on the parting surfaces of both barrel halves.

2–134. PRELIMINARY ASSEMBLY.

2–135. ASSEMBLY OF SPIDER AND ATTACHING PARTS.

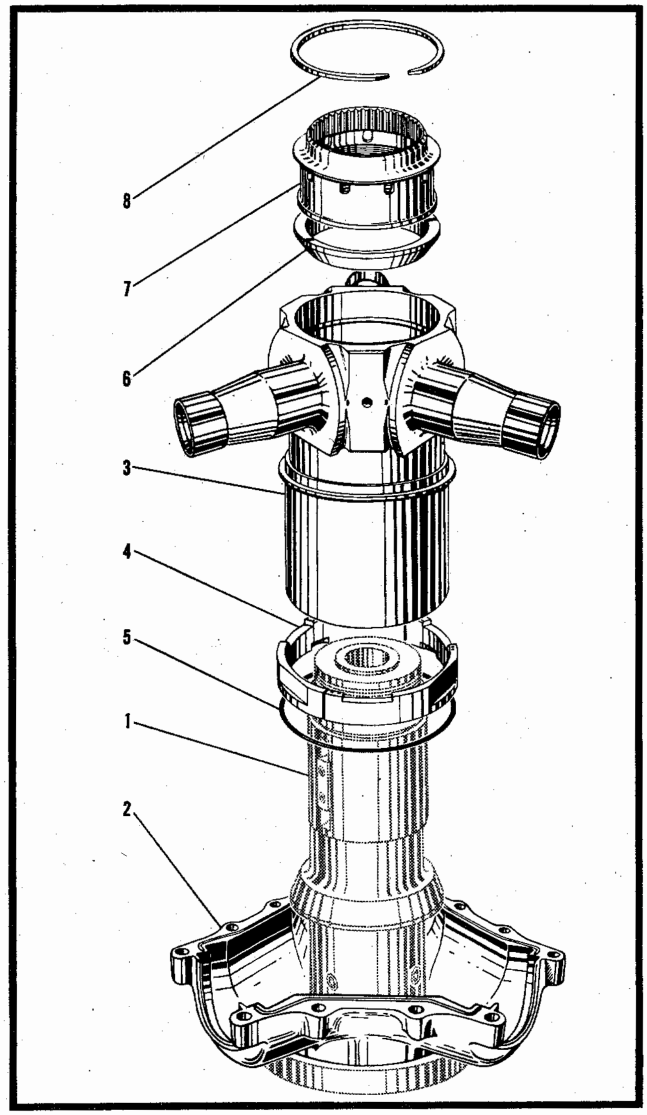


Figure 2–95. Assembly of Spider and Attaching Parts

a. Install the assembly and balancing sleeve on the assembly post, and apply a thin film of engine oil to the sleeve.

b. Set the inboard barrel half over the sleeve, and let it rest at the base of the assembly post on the assembly table.

c. Turn the spider upside down on the assembly table, and install the "O" ring spider-barrel seal over the inboard end of the spider.

d. Place the spider on the assembly and balance sleeve. If the spider has not been numbered, it shall be done at this time. The spider arms are steel stencil stamped on the tapered surface of each arm with No. 1 adjacent to the wide spline in the central bore. The other numbers shall progress in an anticlockwise direction when viewed from the outboard end.

e. Carefully check the front cone pair numbers, and then set the halves in place on the spider cone seat. Screw the retaining nut onto the assembly and balancing sleeve, and tighten with the propeller retaining nut wrench.

2–136. PRE-ASSEMBLY OF BARREL WITHOUT BLADES.

a. The barrel shall be pre-assembled without the blades to assure a tight fit of the barrel supports. The barrel support shim thickness selected shall be the minimum required to obtain a light drive fit of the barrel rear half over the barrel supports when the hub is assembled without blades.

b. Place one .010 inch barrel support shim on each barrel support. The barrel support shims are manufactured in thicknesses from .010 to .035 inch in increments of .001 inch. The dash number following the part number indicates the thickness of the shim in thousandths of an inch. Set the supports and shims in place on the spider, being careful to note that the No. 1 support is installed on the No. 1 support seat, the No. 2 support on the No. 2 seat, etc. Number any support or shims not yet marked.

Note

The barrel support seats on the spider are numbered beginning with No. 1 at the clockwise side of the spider arm No. 1 looking at the outboard end of the spider, and continuing in an anticlockwise direction; that is, in a three-way spider, No. 1 barrel support seat lies between arms Nos. 3 and 1, No. 2 seat is between arms Nos. 1 and 2. These numbers are stamped on the flat surface at the outboard end of the spider adjacent to the barrel support seats. The support blocks are steel stencil stamped with a position number on the beveled outboard surface. Each barrel support shim is lightly steel stamped with its correct position number.

2–137. SQUARENESS CHECK. The dome-barrel shelf shall be at right angles to the cone axis within .002 inch full indicator reading. Install the concentricity post in the assembly post and attach the dial indicator concentricity gage. Set the gage so that the ball tip touches the dome-barrel shelf inside of the fixed cam locating dowels and clears each dowel by about 1/8 inch. On a complete turn of the propeller around the gage, the full indicator reading should not exceed .002 inch.

2–138. CONCENTRICITY CHECK.

a. The configuration of 43E60 propellers employ the use of two sizes of dowel locating pins to limit the dome installation on the barrel to only one position. The two longer 75232 pins have a diameter of .4370-.4375 inch compared with a diameter of .4057-.4062 inch for the

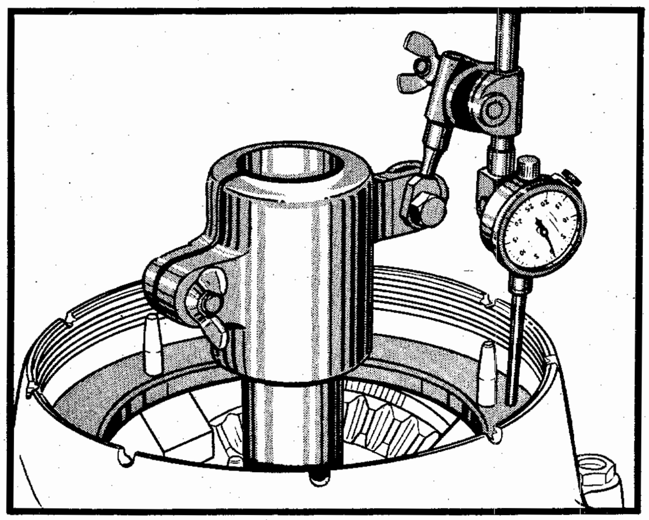


Figure 2–96. Checking Squareness with Dial Indicator

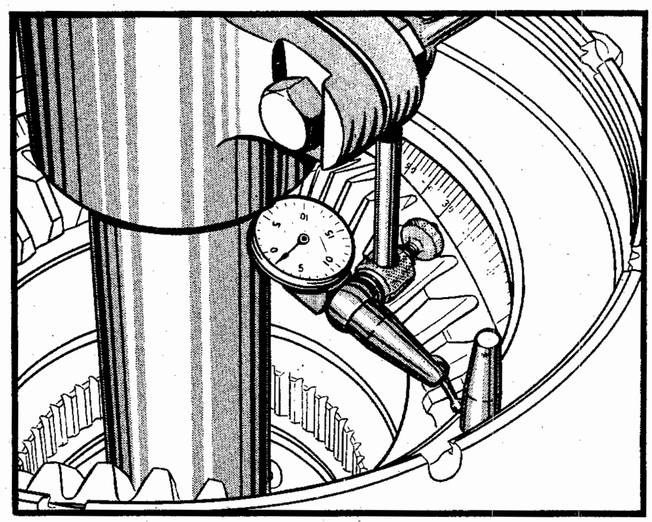


Figure 2–97. Checking Concentricity with Dial Indicator

one 75231 pin. As the centerline of the three pins are equi-distant from the hub centerline, a nominal difference of .0156 inch in the radial location of the innermost surfaces of the two size pins must be considered when measuring propeller concentricity. It is suggested that the following method be employed when measuring 43E60 propeller concentricity.

b. Set the dial indicator zero reading on the small 75231 pin.

c. Indicate to each of the larger pins. Reading the dial indicator clockwise from its zero reference, subtract .0156 inch to obtain the correct reading.

d. The maximum difference between readings (including the zero reference) should not be more than .004 inch.

e. Any change in the thickness of barrel support shims necessary to adjust for barrel concentricity shall be accomplished by replacement of a shim by one of a greater thickness. The total of barrel support shims after concentricity has been obtained shall be equal or greater than the total that was selected for obtaining the light drive fit of the rear barrel half. If the greater thickness shim to be added to a barrel support to obtain concentricity exceeds .005 inch the added thickness of the shim shall be compensated for by reducing the thickness of shims of the other barrel supports by a total equal to the added thickness. Only one shim of the required thickness is used under each barrel support. Be sure the correct position number is stamped on each shim.

CAUTION

An allowance is permitted in the manufacture of propeller front cones on the eccentricity of the cone bore to the cone taper. Because of this tolerance, it is possible to change the indicated spider-barrel eccentricity by changing the position of the front cone in the propeller hub assembly. If, at reassembly of the propeller, the spider-barrel eccentricity falls outside the specified limit of .004 inch total indicator reading, install the front cone in several different positions in an effort to duplicate initial assembly conditions before changing the support shims.

2–139. INSTALLATION OF BLADES ONTO SPIDER.

a. Shims are installed on the blade butt to regulate the clearance between the blade thrust bearing assembly and the barrel, and thereby establish the correct frictional torque on each blade. Apply grease meeting Specification No. AN-G-15 to the spider shim plate and the shim, and install these parts over the shim plate drive pins on the blade bushing, the shim next to the bushing. Make certain that the position numbers on the shim and shim plate match with the position number of the blade. The shim position number is stencil stamped; the shim plate number is electrically etched on its outer edge to prevent any high spots on the bearing surface. If new shims are used, the preliminary installation should be an .008-inch shim on each blade.

b. Apply a light film of grease equivalent to Specification No. AN-G-15 to the spider arm bearing surfaces, and then install the blades with the previously assembled parts on the spider. The No. 1 blade is installed on the No. 1 spider arm, the No. 2 blade on the No. 2 arm, etc. If a new blade is installed, it must be marked with the proper number on the OD of the butt flange.

Note

Before pressing the blades against the spider shim plate bearing faces, be sure that the spider shims and shim plates are correctly

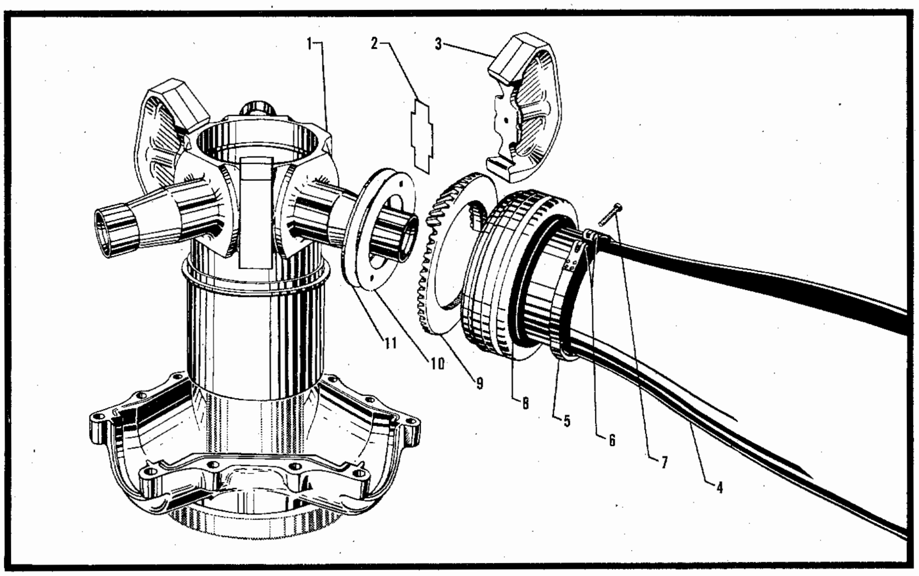


Figure 2–98. Installation of Blade onto Spider

Note

In the following illustrations having index numbers without nomenclature lists, the index numbers are in parts assembly sequence.

fitted over the bushing drive pins, and that the position number of the shim plate corresponds with the position number of the blade.

2–140. ASSEMBLY OF BARREL HALVES OVER SPIDER AND BLADE PARTS.

a. Fit the thrust bearing retainers between the flat surfaces of the beveled thrust washer and the flat thrust washer. These retainers should also be lightly coated with grease equivalent to Specification No. AN-G-15.

b. While holding the thrust bearing assemblies in place on each blade, and with the blade packings moved outboard of the barrel on the blade, raise the inboard barrel half into position. Assemble the barrel over the spider and blades so that the arm identifying numbers on the spider and barrel halves coincide. The inboard barrel half shall be a light drive fit over the barrel supports, and after it has been ascertained that the barrel is properly aligned, carefully drive it into place using rawhide mallets.

c. Install the three fixed cam locating dowels in their respective holes in the dome-barrel shelf of the outboard barrel half. The base of each dowel should lie flush with the inboard face of the shelf. If oversize dowels are required, be sure the proper size is used.

d. Match up the position numbers of the outboard barrel half with the inboard barrel half, and then drive the outboard barrel half down with rawhide mallets

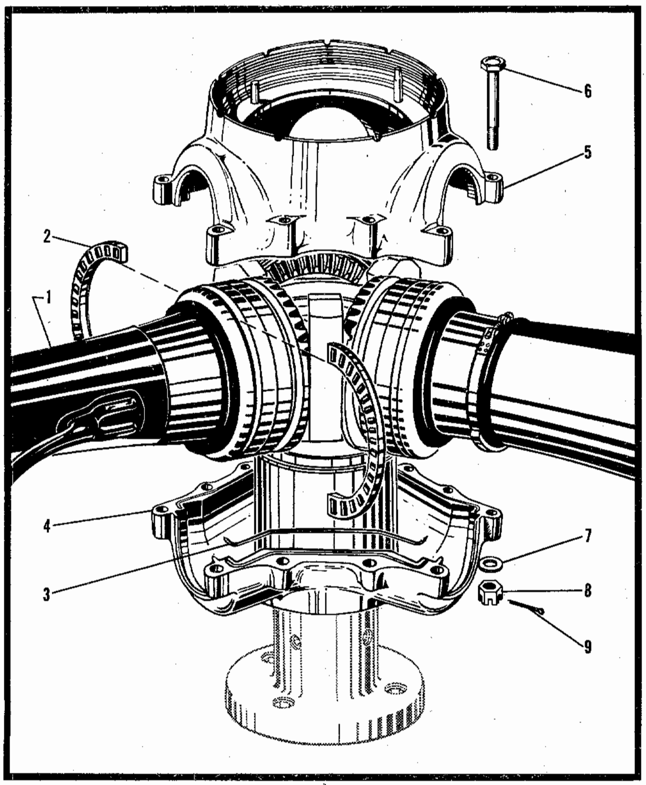


Figure 2–99. Assembly of Barrel Halves over Spider and Blade Parts

until it seats on the barrel supports. When assembling either the inboard or outboard barrel halves, drive them into place evenly. Do not hammer continuously on one side.

e. The barrel bolt bosses shall be numbered (by means of a steel stencil stamp placed on the spot-faced surface of the outboard barrel half) so that the numbers progress in an anticlockwise direction with numbers 1, 2, etc. between barrel arms 1 and 2, and so that the first and last numbers are at opposite sides of the first barrel arm. The barrel bolts are numbered correspondingly.

f. Install the numbered bolts in their respectively numbered barrel bolt holes. With this non-spinner installation, shorter barrel bolts are used in hole numbers 2, 3, 6, 7, 10 and 11. Two washers are used on the thread end of bolts 3, 7, and 11, and one washer on the thread end of bolts 2, 6, and 10. Put a nut on each bolt but do not safety at this time. Install the longer bolts in the barrel bolt holes at either side of each blade bore and attach with nuts. No washers are used on these bolts.

Note

If the bolts bind at installation, do not drive them into position; however, light tapping is permissible. Binding may be due to misalignment of the bolt holes in the barrel halves, a condition which can usually be corrected by lightly tapping the barrel halves.

2–141. BLADE TORQUE CHECK.

a. Using the blade turning device, with spring balance scale, type 33, serial No. 1, capacity 125 pounds, manufactured by the R. H. Forschner Co., New York, N. Y. or an equivalent, attach the turning device to the blade between the 18- and 30-inch stations with the bar end of the fixture on the leading edge side. Place the fixed end of the scale in the ring at the end of the bar. With fixture in the horizontal position and the spring scale hanging freely, the pointer on the scale shall read zero.

b. Turn the blade to the high pitch position. Grasp the movable end of the scale with one hand, and, using the other hand on the end of the turning device, start turning the blade toward low pitch. Slowly transfer the pull to the scale hand until the blade is being turned entirely by pulling on the scale. Keep the scale as closely as possible at right angles to the bar. As the blade passes over the range from 45 to 30 degrees, observe the scale reading. The true torque reading shall be 100 ± 10 pound-feet. Due to the length of the torque arm, the reading on the scale should be one-half of the true torque reading or from 45 to 55 pound-feet. If any other system is used for measuring torque, the necessary corrections must be made.

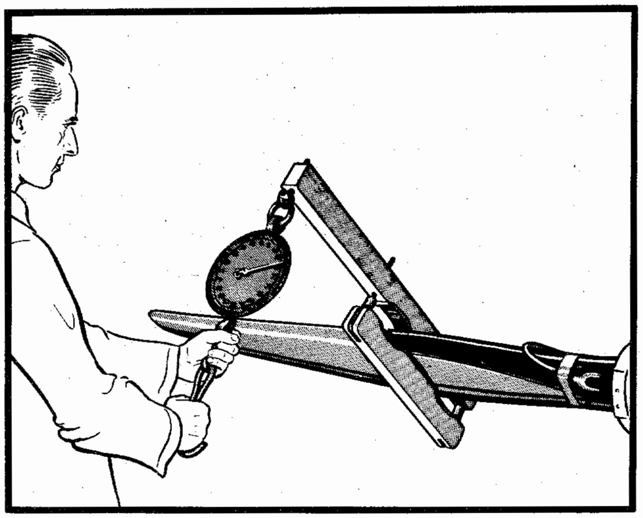


Figure 2—100. Checking Blade Torque

c. In case the recorded blade torque does not fall within the specified limits of 100 ±10 pound-feet, disassemble the inboard and outboard halves and change the spider shim thickness. Spider shims are manufactured in sizes from .008 to .030 inch in increments of .001 inch, and from .030 to .040 inch in increments of .002 inch. The thickness in thousandths is marked in ink as a dash number following the part number.

Note

Increasing or decreasing the shim thickness on one blade will slightly affect the torque of the other blades. This should be taken into account when readjusting blade torque.

d. Only one shim, of the required thickness, is used on each blade. Stamp the shim with the proper blade number, using a steel stencil. Be careful not to indent the metal excessively.

e. After changing the blade shims, reassemble the propeller and again recheck blade torque with the blade seals still outside the hub assembly.

2—142. PRELIMINARY HUB BALANCE. After the specified squareness, concentricity, and torque tests, the hub assembly shall be balanced. There are two approved methods of balancing: the "vertical" method, and the "horizontal" method. In the vertical method, the plane of the blades is vertical, and the hub is mounted on a mandrel between two parallel horizontal ways. For horizontal balance, the plane of the blade is horizontal. The apparatus shall have a sensitivity of .0005 inch x the weight of the propeller.

2—143. VERTICAL BALANCE.

a. Set each blade for 30 degrees at the 42 inch reference station. This may be done either with a protractor or by aligning the 30-degree blade butt graduation with the barrel index mark. This blade design requires the use of a template to measure the angle at the reference station. Bring the blade packings against the barrel and hold them in place with a rubber band or string. This is done so that the position of the blade packings will not affect the hub balance. The assembly should be dry for this balancing operation.

Note

Due to the difference between the location of the basic reference line shown on the blade drawing and the actual centerline of the hubs, a correction of .531 inch must be applied to the assembly bench markings, out from the post centerline when locating the position of any blade station on an assembled propeller.

b. With a hoist, lift the propeller off the assembly post and insert the balancing arbor in the assembly and balance sleeve. Carefully lower the assembly onto the balancing stand ways. Make certain that the balancing arbor first contacts the way protectors rather than the ways. Move the propeller along the ways and then turn the protectors up. Unscrew the adapter retaining nut and take off the adapter with the trolley and hoist. Prior to balancing, remove any hoisting equipment attached to the propeller. Screw the nut back in position. All balancing shall be done in a room free from air currents with the propeller centered on its cone seats, mounted on a hardened and ground mandrel and supported on a balancing stand which is in accurate alignment.

c. Check each blade in the horizontal position. The assembly shall show no persistent tendency to rotate. To check balance stand accuracy, repeat this operation with each blade on the opposite side of the stand.

d. If the assembly shows a persistent tendency to rotate, add blade balancing washers on the light blades.

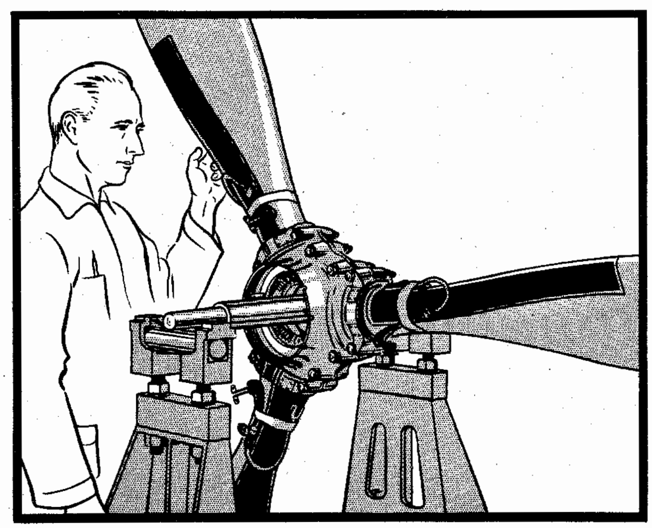


Figure 2—101. Checking Hub Balance

These washers should be placed on the blade shank section at approximately the position they will occupy inside the blade bore on the blade balancing plug stud. Any number of steel washers which can be fitted on the blade balancing plug stud, with one full thread projecting, can be used when necessary in service propellers.

e. After the closest possible balance has been obtained by the use of blade balancing washers, hoist the propeller off the balancing stand and reinstall it on the assembly post. If balancing washers are to be added, disassemble the propeller and add the washers to the blades.

2–144. BLADE TRACK. This is generally a convenient time to check blade track, although it may be checked at any time when the hub is mounted so that it can be rotated past a fixed point. Rotate the blades so that the face stations approximately 3 inches from the tip are horizontal. Set up a pointer to register at this position on one blade and then turn the hub so that each blade passes this point. The blades shall track within 1/8 inch.

2–145. After correct torque, concentricity, squareness, and preliminary balance have been obtained, remove the barrel bolts and raise the outboard barrel half. Lower the inboard half enough to allow the blade packings to be put in place behind the blade packing retaining lips of the barrel. Place the barrel half seals in the inboard barrel half oil seal grooves, making certain that the small extensions at the end of each seal lie in the smaller diameter grooves in the barrel. To hold the seals in place during barrel tightening procedure and to improve the sealing effectiveness, small quantity of AN-G-15 grease may be used. Drive the outboard and inboard barrel halves together evenly, using rawhide mallets.

2–146. ATTACHMENT OF DE-ICING AND CONTROL PARTS.

2–147. The sequence of the following procedures may be altered to suit the prevailing conditions.

2–148. SLIP RING ASSEMBLY. Align the slip ring locating screw with the depression in the spider rear extension and gently tap the unit into place with a nonmetallic hammer. Set the screw into the depression with a torque of 5-8 lb-inches.

2–149. SIGNAL AND CONTROL CAM ASSEMBLY. Locate the signal cam assembly on the cam mount of the blade No. 1 so that the larger of the two cam lobes is approximately midway between the leading and trailing edges on the face side of the blade and the smaller lobe is toward the trailing edge. Tighten but do not safety wire the clamp screw. Install the control cam having two approximately equal size lobes on the cam mount of blade No. 2. Locate the assembly so the center of the lobe furthermost from the clamp screw is approximately 65° from the leading edge on the face side of the

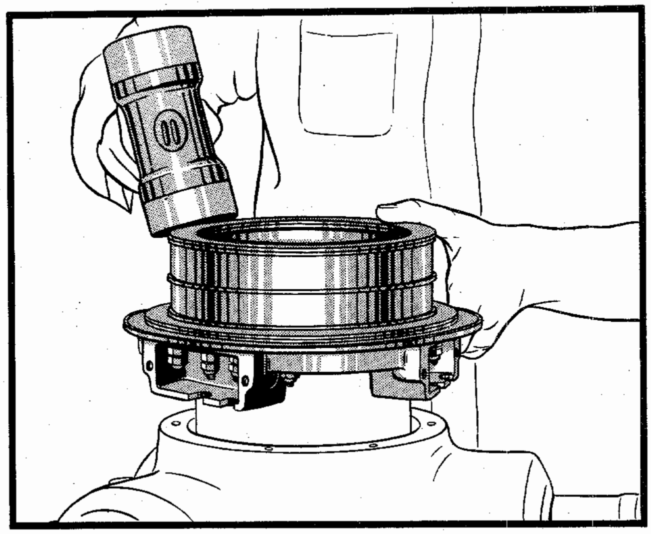


Figure 2–102. Instaling Slip Ring Assembly

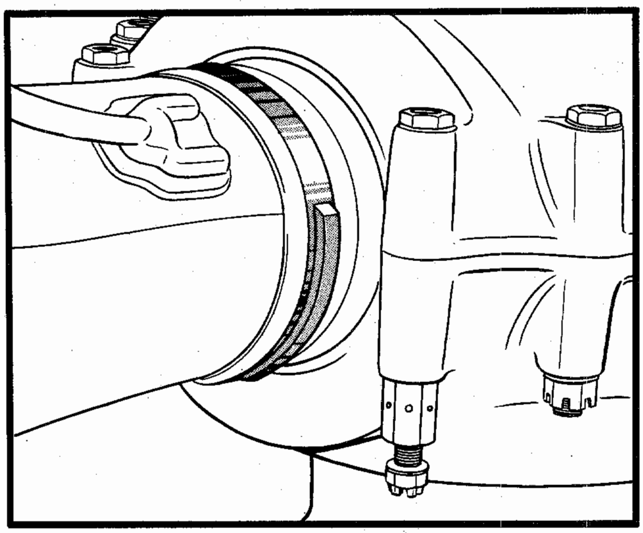


Figure 2–103. Control Cam Assembly on Mount — Blade No. 1

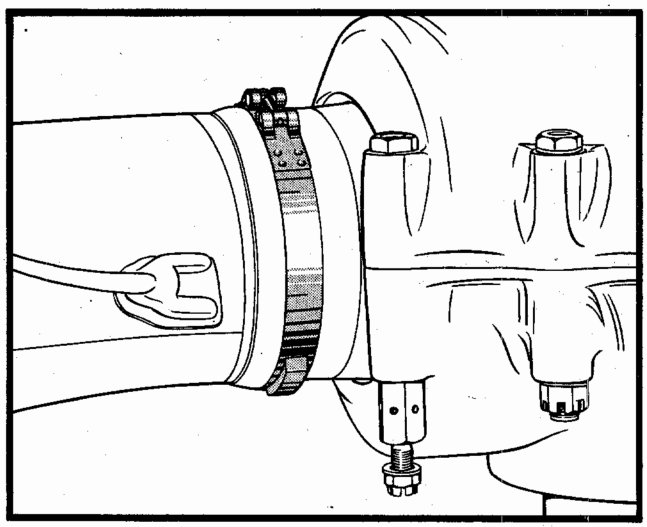


Figure 2–104. Signal Cam Assembly on Mount — Blade No. 2

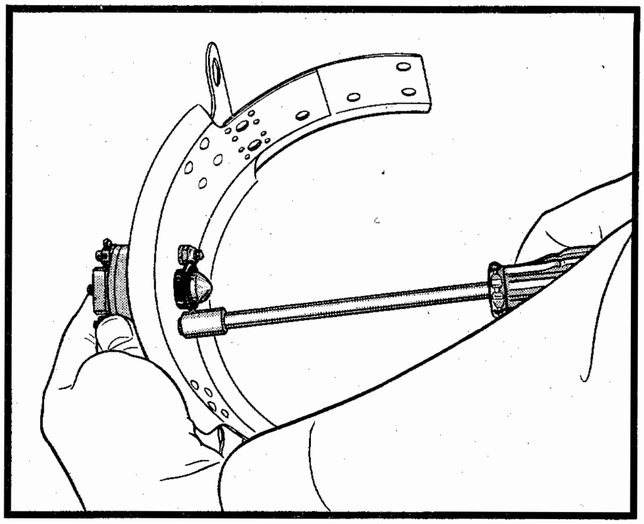


Figure 2—105. Installing Switch on Guard

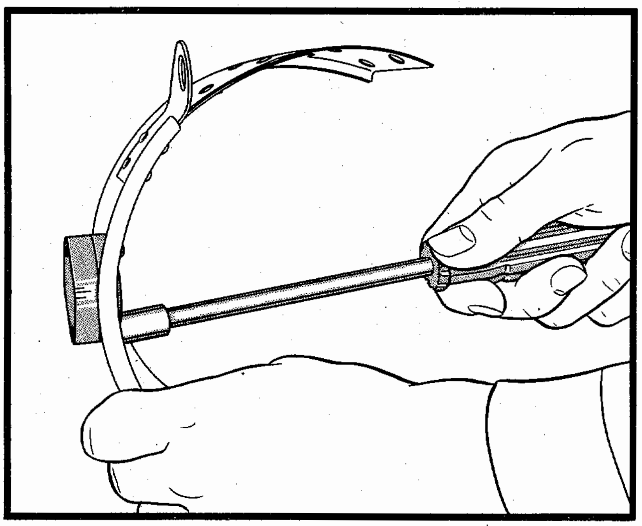


Figure 2—106. Installing Counterweight on Guard

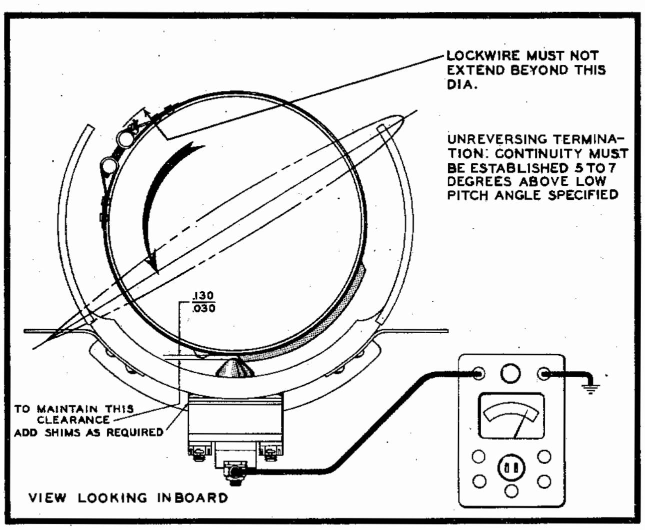


Figure 2—107. Locating Control Cam Assembly —Blade No. 1

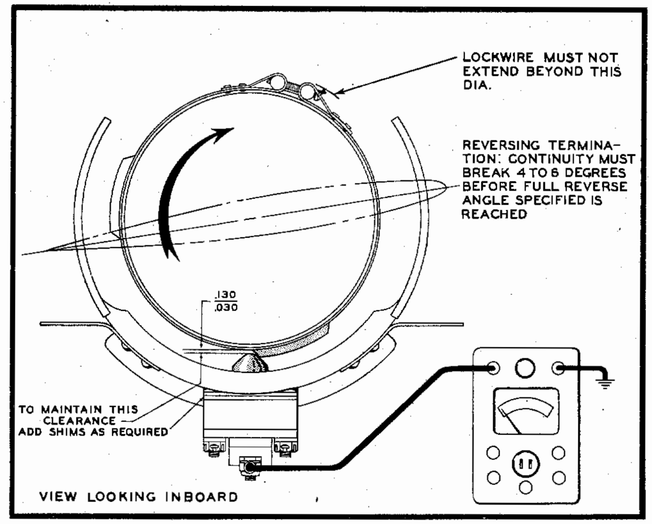


Figure 2—108. Locating Control Cam Assembly —Blade No. 2

blade and the second lobe is near the trailing edge. Tighten but do not safety wire the clamp screw.

2—150. CONTROL SWITCH BODY ASSEMBLY. Install a control switch body assembly onto each of the guard assemblies used on blade Nos. 1 and 2. Shims are used between the switch body and the guard as necessary to maintain a clearance between the switch plunger and the blade cam strap of .030-.130 inch after parts installation as shown. Attach each switch with two washers and self-locking nuts.

2—151. COUNTERWEIGHTS. Assemble a switch body, outer counterweight, and inner counterweight in a sequence as shown on to the guard assembly of No. 3 blade. Safety wire the two attaching screws.

2—152. GUARD ASSEMBLIES. Each guard assembly is installed around the shank of its respective blade. The two halves should be loosely assembled with twelve

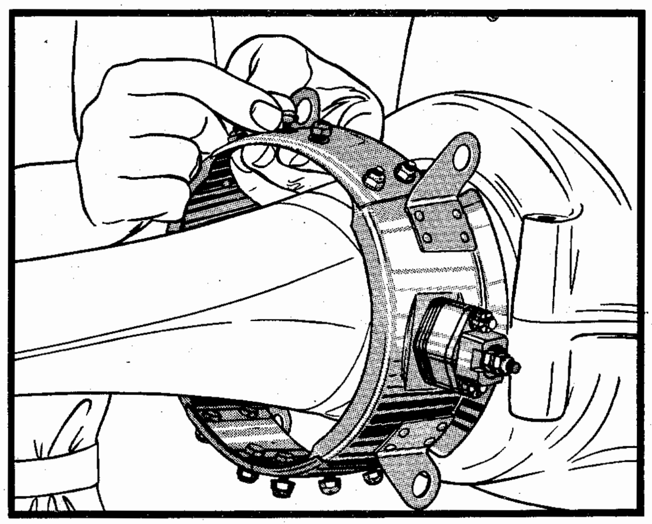


Figure 2—109. Installing Guard Halves Around Blade Shank

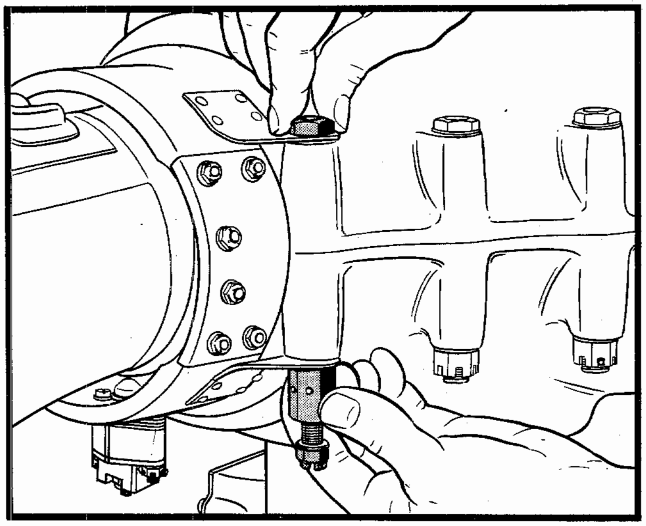


Figure 2—110. Installing Guard Assembly on Barrel

screws, twelve washers and twelve self-locking nuts. Remove the barrel bolts adjacent to the blade bores and mount the guards on the barrel bolt lugs with the switch and counterweight location toward the inboard side. Install the barrel bolts as required. Attach bolts Nos. 4, 8, and 12 with standard barrel bolt nuts, and bolts Nos. 1, 5, and 9 with barrel bolt extension which support the de-icing connector assemblies.

2—153. EXTERNAL CONTROL CONNECTOR ASSEMBLY. Install the flat contact end of the connector assembly onto each switch housing terminal stud and install the self-locking nut and washer. Install connector clamp on the adjacent switch mounting stud and secure with nut and cotter pin. Do not attach the free terminal ends of the two connector assemblies to their respective terminal posts in the slip ring junction boxes until final adjustments of the blade slip rings have been completed.

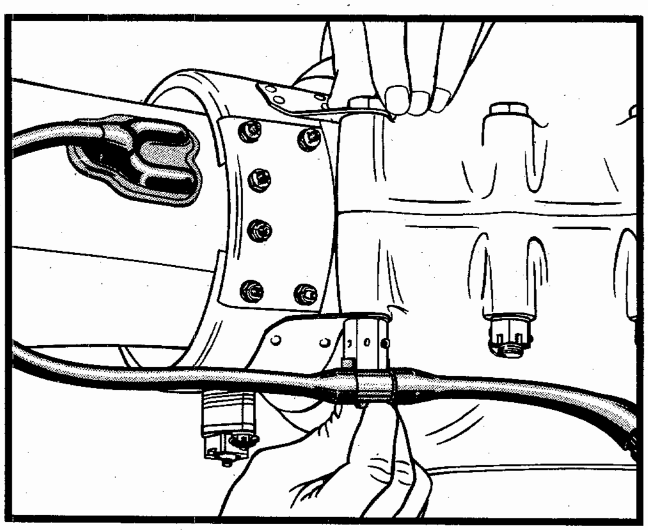


Figure 2—111. Attaching Heater Connector Support Clamp

2—154. BLADE SLIP RING AND SWITCH BODY ADJUSTMENT. Turn No. 1 blade to a position which will allow the switch plunger to be free of the blade slip ring cam lobes. Measure the distance between the switch plunger and the cam strap and add a .060 inch shim between the switch body and the guard if necessary to establish a clearance between the plunger and cam strap of .030 to .130 inch. Attach one lead of an ohmmeter to the free end of the connector assembly and ground the second lead to any convenient place on the hub. At initial continuity, not exceeding two ohms resistance, measure the blade angle at the 42-inch reference station with a protractor. If the angle is not 5 to 7 degrees above the low blade angle specified, remove the guard and switch assembly from the hub by sliding the parts as a unit onto the blade shank. Make the necessary adjustments to the blade slip ring, reassemble the parts, and recheck. In a similar manner, connect the ohmmeter to locate the cam assembly on blade No. 2. Gradually move the blade from zero angle position toward full reverse. At the initial break in continuity, measure the blade angle at the reference station with a protractor. If the angle is not 4 to 6 degrees above the reverse angle specified for the aircraft, remove the guards in a similar manner described above and make the necessary cam adjustments. When final adjustments have been made, safety wire the blade slip ring clamp screws in a manner as shown, complete the tightening of the guard self-locking nuts, and safety the barrel bolt nuts and barrel bolt extensions with cotter pins. Install each heater connector loop support on its respective barrel bolt extension and attach with a washer and castellated nut. Safety the nuts with cotter pins. Attach the heater leads to the de-icing terminal screws in the slip ring junction boxes. There is no power and ground distinction between the two leads of each heater and connector assembly. Connect the terminal end of each external control connector assembly to its respective terminal screw in the slip ring junction boxes. Spray or brush Red Glyptal on all surfaces within each junction box. Allow the Glyptal to dry and install the terminal housing separator over the terminal screws. Install the junction box covers. Safety wire the two screws attaching each cover. The slip ring assembly set screw is also safetied to the cover screws on the adjacent junction box.

2—155. ADJUSTMENT OF CAM AND BLADE GEAR MESH. (GEAR PRELOAD).

2—156. In order to obtain proper mesh between the rotating cam gear teeth and the teeth of the blade gear segment, generally referred to as GEAR PRELOAD, it is necessary to regulate the clearance between the rotating cam gear and the blade gear segments. The correct distance between these parts is maintained by a selection of preload shims placed between the base of the fixed cam and the dome-barrel shelf. The height of the rotating cam gear with respect to the base of the fixed cam is regulated by manufacturing tolerances allowed on the component parts of the dome assembly. Similarly, the position of the blade gear segments with respect to the dome-barrel shelf is governed by the tolerances allowed on the various parts which comprise the hub assembly. The position of the dome assembly in the hub assembly (and therefore the distance between the pitch lines of the cam gear teeth and the segment teeth) is regulated by shims between the base of the fixed cam and the dome-barrel shelf. Gear preload should be established with a +.003 to +.007 inch clearance between the rotating cam and segmental gear teeth; i.e., add a .005 inch thickness shim after establishing zero preload.

2—157. DEPTH MICROMETER METHOD.

a. Measure the distance from the top or outboard end of the barrel to the barrel shelf with a depth micrometer and note this reading. Some type of "straight-edge" on which to rest the base of the micrometer should be placed across the top of the barrel.

b. Set the blades at 30 degrees by means of a protractor and a template at the reference station (add .531 inch to the assembly table markings when checking blade angles on this propeller), or by means of the markings on the blade butt and the ID of the barrel shelf.

c. Measure the thickness of the fixed cam flange and note this reading. Set and lock the stop rings at 30 degrees on the cam assembly, and place this assembly in position, meshing the rotating cam with the blade gear segments.

d. Place the dome shell with the retaining nut in the proper position on the cam assembly and tighten the nut to mesh the rotating cam and the blade gear segment teeth. Remove the dome shell and retaining nut, leaving the cam assembly in position.

e. Measure the distance from the "straight-edge" on the top of the barrel to the top of the flange on the fixed cam. To this reading add the thickness of the fixed cam flange previously determined. If this sum is smaller than the reading obtained in "a", subtract this sum from the "a" reading. The difference plus .003-.007 is the thickness of shims required to provide the specified mesh of the gears. If these specifications cannot be met, a different combination of hub and dome should be used. With correct establishment of preload, a slight backlash in each blade will be noted.

f. The total thickness of preload shims required for each propeller assembly should be acid etched on the outboard surface of the barrel shelf with the note, SHIM THICKNESS, and covered with one coat of clear lacquer. The shim thickness marked shall be the actual value determined by measurement adjusted to the nearest figure divisible by five.

2—158. SERVICE GAGE METHOD.

a. Using the preload gage, place it on a surface plate and insert the contact point of a standard Federal dial indicator Model 75 or equivalent with a one-inch contact point through the hole in one of the blocks attached to the gage.

b. With the contact point of the indicator against the surface plate, set the dial to zero. Install the inboard cam bearing on the rotating cam making certain that it seats properly against the base of the cam gear teeth.

c. Remove the indicator and install the preload gage over the rotating cam to be used in the propeller. The ID of the gage is smaller than the OD of the outer bearing race and therefore the gage will rest on this race.

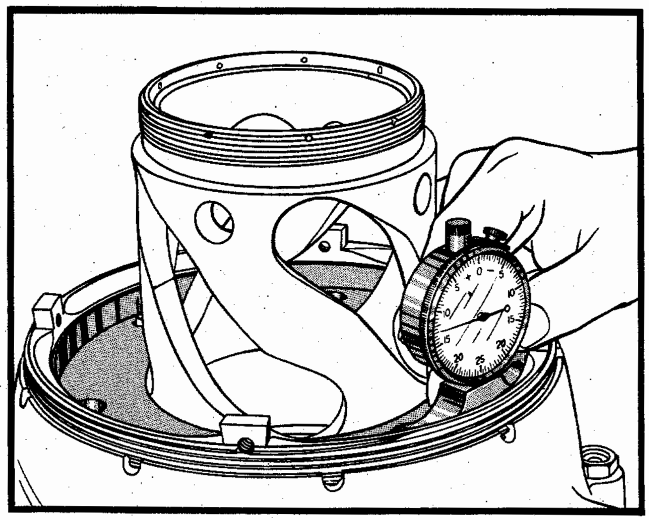


Figure 2—112. Checking Gear Preload

d. Install this assembly in the hub assembly with the blades at 30 degrees at the reference station.

e. Using a standard dome retaining nut, drive the cam gear teeth down until proper meshing of the cam gear with the blade gear segments is assured. This will require a torque on the dome retaining nut of approximately 150 pound-feet.

f. Remove the dome retaining nut without disturbing the cam and gage.

g. Install the dial indicator on the preload gage with the contact point of the indicator extending through the gage and resting on the dome-barrel shelf. The indicator will then read directly the amount of gear mesh plus the shim thickness required.

h. Check the other two positions on the gage and average the three indicator readings. Average indicator reading plus .003-.007 inch gives the shim thickness required in thousandths.

2—159. ASSEMBLY OF THE DOME ASSEMBLY.

2—160. ASSEMBLY OF THE CAMS.

a. Tap the inboard cam bearing evenly into place in the fixed cam just inside the serrated stop ring flange, and install the outboard cam bearing on the opposite end of the fixed cam. Make certain that the word "OUT" etched on each of these cam bearing faces is toward the nearest ends of the cams. To avoid springing the bearing, always tap on the race touching the cam.

b. Place the rotating cam, gear down, in the cam bearing nut torque fixture, and then lower the fixed cam over it. Move the fixed cam into position by tapping lightly with a brass drift rod on the outboard cam bearing.

c. Install the cam bearing nut on the outboard end of the rotating cam. Place the torque plate of the torque fixture over the nut and onto the threaded post. Tighten the cam bearing nut using a torque wrench on the hex nut of the torque plate of the fixture to 300-340 pound-feet.

d. Lock the cam bearing nut with a cotter pin which is inserted from the outside and bent over along the inner periphery of the cam.

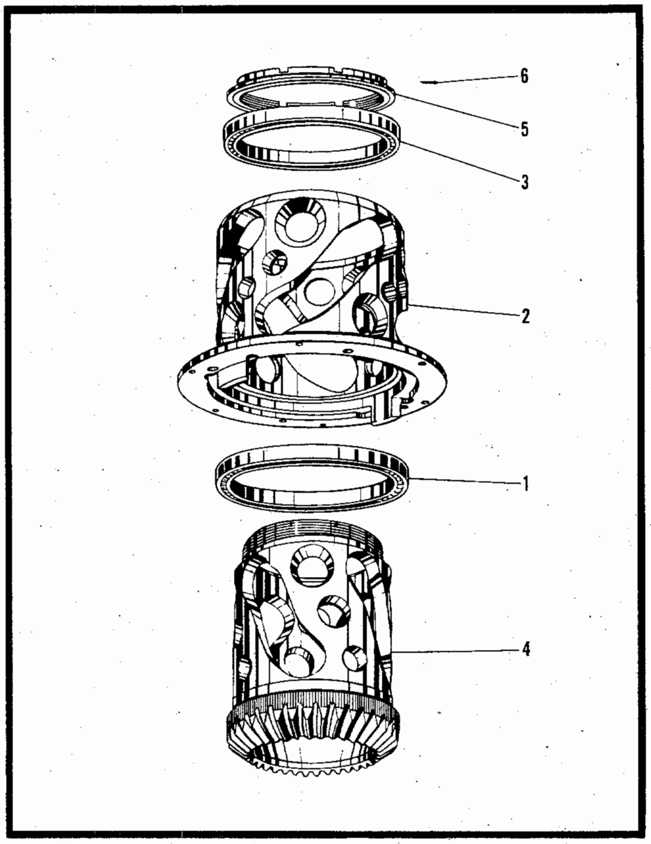


Figure 2—113. Assembly of Cams

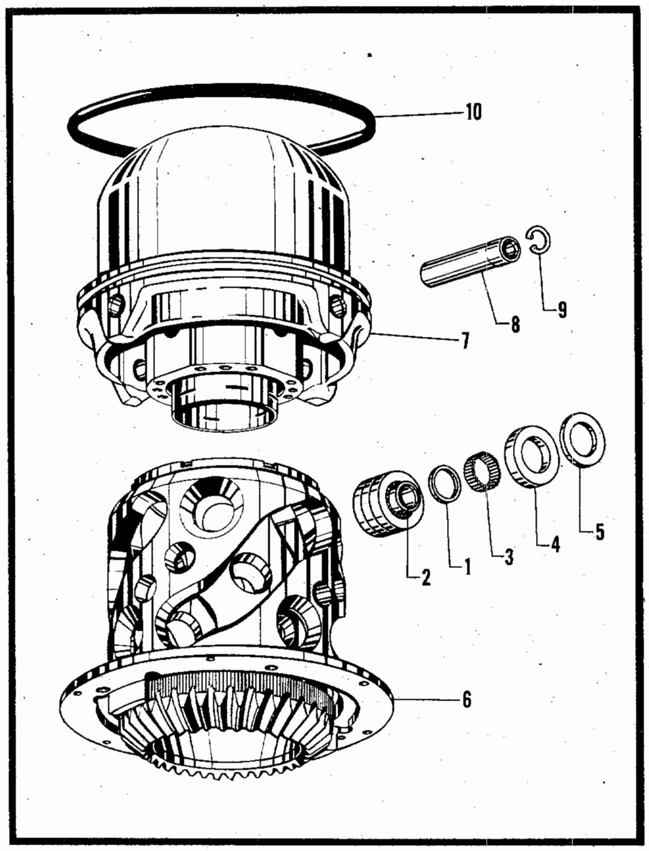


Figure 2—114. Installation of Piston onto Cams

2—161. INSTALLATION OF PISTON ONTO CAMS.

a. Rotate the fixed cam on the rotating cam until the ends of the cam roller slots which are identified by the letter "O" are aligned.

b. Place the cam rollers on each of the cam roller sleeves by inserting the needles and spacer washers in proper sequence. Insert one cam roller and bushing assembly in the bottom of each cam track of the cams in such a way that the bushing washer faces outward. Make certain that the rollers fit snugly against each other and against the bushing washer, and insert each group in such a way that clearance is provided for the cam roller shaft bosses on the piston.

c. Slip the piston assembly over the cams so that the "O" stamped on the one cam roller shaft boss is in alignment with the "O"s" of the cam tracks. Never force the piston over the cams and rollers. If it does not go in place smoothly, check to see that the correct parts are being used and that they are properly installed.

d. Apply a thin film of grease to Specification No. AN-G-15 (or its equivalent) to the cam roller shafts. These shafts are a press fit in the piston. They can be installed by inserting the screw from the cam roller shaft puller inside the threaded portion of the shaft to be used as a drift when the shaft is driven into place.

Note

During installation of the cam roller shafts, it is important that the shaft be driven into the piston boss only far enough so that the outer threaded end of the shaft just clears the snap ring groove. If the shaft is driven beyond this point, it will contact and damage the piston sleeve inside the inner piston skirt.

e. Compress the cam roller shaft lock rings with Truarc pliers and insert one in each cam roller shaft piston boss.

CAUTION

Keep fingers out of cam tracks.

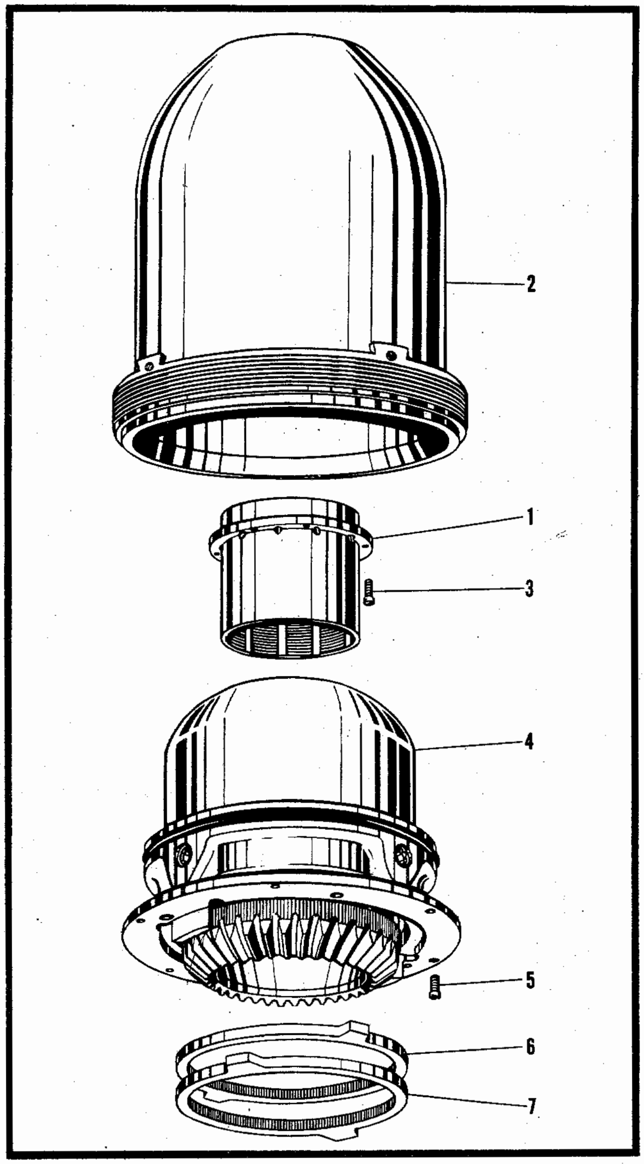


Figure 2—115. Assembly of Dome Shell onto Piston and Cams

f. Coat the piston seal with a thin film of grease and install it in the machined groove on the OD of the piston.

2—162. Each part of the dome assembly is balanced separately during manufacture. If it is necessary to replace any part, it is not necessary to balance the dome assembly as a unit because any slight deviation can be corrected when balancing the complete propeller.

2—163. ASSEMBLY OF DOME SHELL ONTO PISTON AND CAMS.

a. Install the lever sleeve bushing inside the dome shell. Insert the six screws and tighten with a screw driver, safety adjacent screws in pairs with wire.

b. Slide the dome shell over the piston and cam assembly so that the dome shell retaining screw holes line up with the corresponding holes in the base of the fixed cam.

CAUTION

The dome shell should be a light fit over the piston seal. Be careful that the dome shell is not cocked during installation, and do not hammer it into place.

c. Insert the dome shell retaining screws through the base of the fixed cam and tighten them into the dome shell. Make certain that the dome shell fits snugly against the ledge on the base of the fixed cam.

d. The serial number of the hub on which the dome is to be used shall be acid etched on the base of the fixed cam. This permits the dome and hub to be kept together by means of the same identifying numbers.

e. Install the stop rings in accordance with the instructions discussed under STOP RING SYSTEM.

2—164. FINAL PROPELLER BALANCE.

a. Turn each blade to the full high pitch or feather-

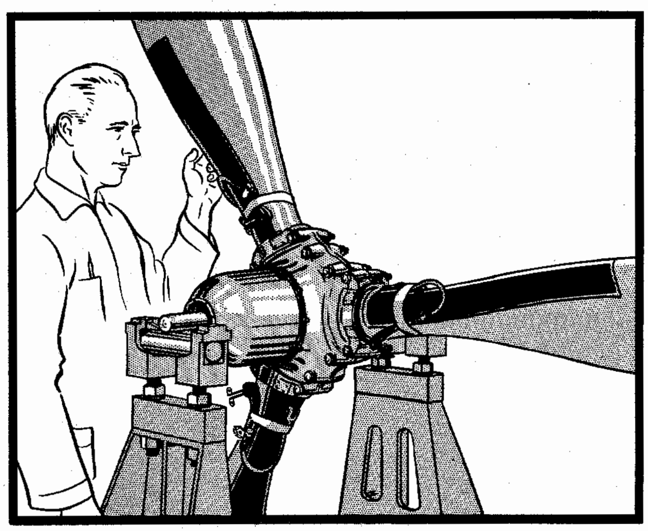


Figure 2—116. Checking Propeller Balance

ing angle (for example 95 degrees). This can be done by lining up the 95 degree graduation on the blade butt with the mark on the inner periphery of the dome-barrel shelf, or with the aid of a protractor at the blade reference station. Install the required preload shims as determined earlier.

b. Install the dome assembly on the hub assembly. Tighten the dome retaining nut. A few light blows on the wrench with a mallet will provide proper seating of the dome. With the aid of the blade turning device, set the blades at 30 degrees at the reference station.

c. Vertical balance with the plane of the blades vertical is performed as follows in a room free of air currents: Lift the propeller off the assembly post. Insert the balancing arbor in the propeller through the inboard end until one end protrudes through the dome, and then lower the assembly onto the ways of the balancing stand. The final balance of the complete propeller shall be obtained with the propeller dry by using lead wool inserted in the hollow barrel bolts. Balance is considered satisfactory if, with each blade successively placed in the horizontal position, the propeller has no persisten tendency to rotate in one direction, or if any persistent tendency to rotate is stopped or reversed by the application of a moment equal to .001 inch times the total weight of the propeller approximately 55 inch pounds. After the required amount of lead wool has been determined, hammer it into the proper hollow barrel bolts with a drift rod of a diameter small enough to enter the bolt bore. Remove the propeller from the balancing ways, and take out the balancing arbor. Set the propeller on the assembly bench and close all the barrel bolts with welch plugs.

d. For the "horizontal" method, if used, the plane of the propeller blades is horizontal. The apparatus used shall have a sensitivity of .0005 inch x the weight of the propeller. The balance is performed in a similar manner and to the same tolerance as the vertical method except that the plane of the blades is horizontal. Balance is obtained with lead wool as before.

2–165. ASSEMBLY OF LOW PITCH STOP LEVER ASSEMBLY.

2–166. ASSEMBLY OF STOP LEVERS AND REVERSE DUMPING MECHANISM ONTO LEVER SLEEVE.

a. Insert the stop levers into the slots in the lever sleeve so that the shoulder of each lever is adjacent to the OD of the sleeve. The levers must be used in matched sets which are identified by the same serial number on each lever in the set. Secure the levers by inserting the lever shafts into position. Each shaft is locked in place by two pins inserted from the inboard end of the lever sleeve. These in turn are held in place by attaching the end cap with its "O" ring seal in place to the inboard

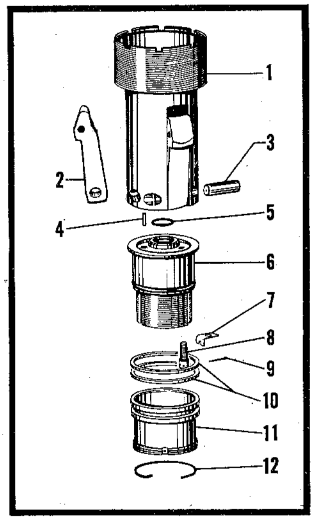


Figure 2–117. Assembly of Stop Levers and Reverse Dumping Mechanism onto Lever Sleeve

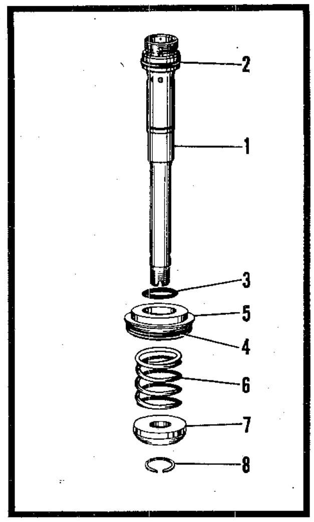


Figure 2–118. Assembly of Servo Piston Shaft

end of the sleeve by means of screws which are safetied and sealed with locking clips and cotter pins. New locking clips shall be used at each assembly. To make sure that the levers contact the piston sleeve simultaneously, they are assembled in matched sets so that the dimension from the center of the shaft hole to the contacting surface of the shoulder shall vary no more than .003 inch.

b. Using a piston ring expander, install the two sealing rings into the outboard annulus on the adjusting sleeve with the sides marked "PRESS" facing one another and the ends 180 degrees apart. Place the "O" ring seal in the inner groove of the end cap. Thread the sleeve onto the end cap in the extreme outboard position to permit oil testing the propeller assembly. Secure in place with the lock ring through the hole in the sleeve and the slot in the end cap.

2–167. ASSEMBLY OF SERVO PISTON SHAFT.

2–168. Slide the end plate with the two "O" ring seals on the servo piston shaft from the inboard end as far as it will go (open end facing inboard). Then install the wedge spring of the new type (free length 2.6 inches) and wedge on the shaft from the inboard end (beveled end facing inboard). Push these parts on the shaft enough to lock in place with the lock ring. Place the "O" ring seal in the groove in the OD of the shaft.

2–169. INSTALLATION OF SERVO PISTON SHAFT, PISTON, AND SERVO VALVE INTO LEVER SLEEVE.

a. At this point insert the servo piston shaft assembly into the lever sleeve assembly from the outboard end of the sleeve.

b. Fit the spiral lock ring against the end plate in a groove at the outboard end of the lever sleeve.

c. Using a piston ring expander place the two bronze sealing rings in the groove on the OD of the servo piston. Assemble rings with splits 180° apart and with sides marked "PRESS" facing one another.

d. Thread the servo piston onto the servo piston shaft by hand, with the nut end outboard. Using the servo piston wrench, tighten the piston until it bottoms and safety it with a lock ring. It may be backed off to align the lock ring.

e. Install the servo piston valve and its associated parts into the servo piston shaft as follows: Insert the servo piston valve with "O" ring beveled end first, followed by the valve spring and the adjusting nut. Screw the nut in by hand and tighten it with the proper wrench until it is approximately flush with the end of the servo piston. Safety with a lock ring after the proper setting has been made.

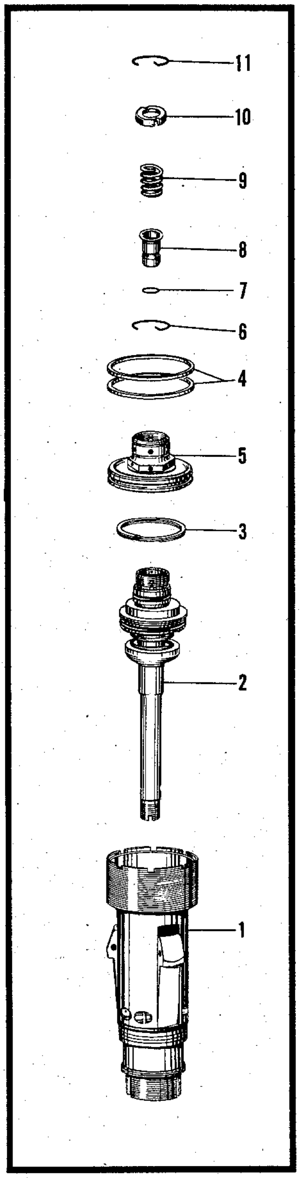


Figure 2—119. Installation of Servo Piston Shaft, Piston, and Servo Valve into Lever Sleeve

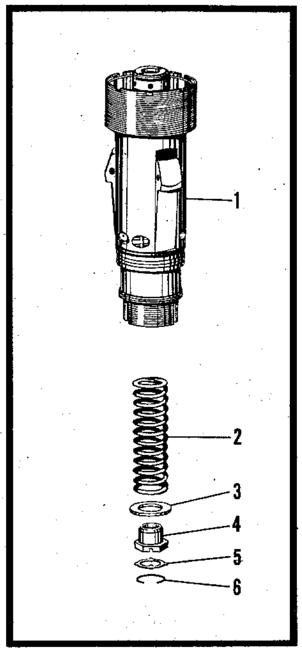


Figure 2—120. Assembly of Stop Return Spring

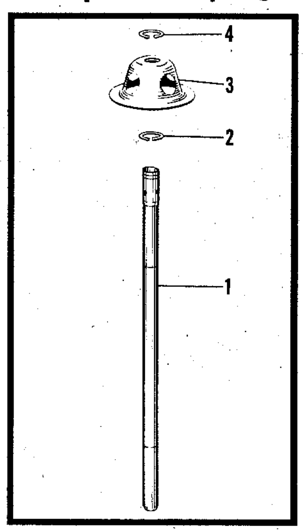


Figure 2—121. Assembly of Oil Transfer Tube

2—170. TEST OF SERVO PISTON SHAFT MOVEMENT.

2—171. Test the stop lever assembly thus far assembled in the following manner to determine the force required to move the servo piston shaft with the servo piston in the stop lever sleeve. With the aid of two blocks on the bench, place the outboard end of the stop lever assembly on the blocks. Push the servo piston shaft down and then release. If the servo piston shaft returns, this will indicate satisfactory seal and ring friction.

2—172. ASSEMBLY OF STOP RETURN SPRING ONTO SERVO PISTON SHAFT.

2—173. Place the stop return spring on the inboard end of the servo piston shaft. Then screw on the return spring seat and washer until the hexagonal end with slots align with the slots on the end of the shaft. Safety the seat and the shaft together with the tab lock ring and secure the tab lock ring with the snap ring.

2—174. ASSEMBLY OF OIL TRANSFER TUBE.

2—175. Assemble the oil transfer tube as follows: Install a snap ring in the inboard groove at the end of the tube. Then slide the retaining cap (open end inboard) up against the snap ring. A second snap ring is placed in the groove adjacent to the retaining cap. During propeller installation this assembly is locked along with the low pitch stop lever assembly.

2—176. STOP RING SYSTEM.

2—177. Two stop rings serrated on their ID to match with serrations on the OD of the rotating cam are used to set the low pitch angle and provide the mechanical stops at full reverse and feathered positions. Two similar series of graduations are stamped on one side of each ring and although like numbers are diametrically opposite, the one number indexes a tooth whereas the opposite number indexes a tooth space. Indexing in this manner permits the establishment of settings in increments of one degree from the index angle.

2—178. The segmental gears are serrated on their ID to match with serrations on the OD of the blade bushings. Index markings of 9 to 34 degrees are stamped on certain serrations of the bushings. It will be noted that the serrations are indexed in increments of 5 degrees with an unmarked serration between indexes. Therefore each serration represents a value of 2.5 degrees.

2—179. The basic angle range of the propeller is 120 degrees, providing 41 degrees of negative blade rotation from the lower end of the constant speed slope. The basic operating range must be chosen so that it includes the range between the reverse and feathering angle settings and yet keeps the take-off angle in the constant speed range as near the lower knee of the cam as possible. This is accomplished by using the table below and selecting a basic pitch range most suitable in respect to the above conditions and including a basic reverse angle equal to or lower than the reverse setting specified (in other words, numerically higher), a basic low pitch angle equal to or lower than the low pitch angle specified, and a basic feathering angle equal to or greater than the feathering angle specified. Furthermore, as the stop rings can be set only in increments of one degree with respect to the index angle, the basic pitch range selected must necessarily be in increments of one degree with the settings specified. In other words, when the specified angle is in whole degrees, the stop rings can only be set in whole degrees and likewise when the basic pitch range numbers are selected, they must be whole numbers. If the specified angles are in half degrees, the stop rings can only be set in half degrees and the basic pitch range numbers must be in halves. If, for instance, the specified low pitch angle is in half degrees while the specified reverse and feathering angles are in whole degrees, a protractor is used to set the low pitch angle whereas the stop rings are set at the whole degree specified for reverse and feathering angles.

TABLE 2–5

REVERSE ANGLE (Degrees)	LOW PITCH (INDEX) ANGLE (Degrees)	FEATHERING ANGLE (Degrees)
—37	4	83
—34.5	6.5	85.5
—32	9	88
—29.5	11.5	90.5
—27	14	93
—24.5	16.5	95.5
—22	19	98
—19.5	21.5	100.5
—17	24	103
—14.5	26.5	105.5
—12	29	108
—9.5	31.5	110.5
—7	34	113

2–180. The following example will serve to illustrate how the basic angle range is selected and applied. The following angles are specified for this particular installation: reverse angle —8 degrees, low pitch angle +30 degrees, and feathering angle +96 degrees. Comparing these values with the basic pitch ranges listed, it will be noted that the —12, +29, +108 range will encompass the desired settings, sacrifice a minimum of constant speed range, and will be in increments of one degree with the specified settings.

2–181. Once this basic range has been chosen, the 29-degree angle is the index angle used in making all settings.

2–182. LOW PITCH SETTING.

2–183. Turn the rotating cam to the full counterclockwise position and temporarily install one stop ring on the rotating cam with the mark indicating the index angle (29 degrees) on the ring aligned with the low pitch marking on the rotating cam (30 degrees). Turn the cam in a clockwise direction until the cam stop lugs contact the stop ring lugs. Apply a thin coat of thread lubricant or engine oil to the lever sleeve threads and insert the low pitch stop lever assembly into the dome assembly through the dome cap hole. Screw the stop lever assembly into the dome until the low pitch stop levers just contact the piston sleeve and a locking slot of the lever sleeve is in alignment with a locking slot in the lever sleeve bushing.

Note

Care should be exercised to prevent the stop levers from dragging against the threads of the lever sleeve bushing.

2–184. To complete the installation, insert the transfer tube and lock ring and turn the lock ring nut until it bottoms against the ring. Alignment of the nut locking hole with the nearest lever sleeve bushing slot may be made by backing off the nut slightly. Insert the nut lock wire and remove the stop ring from the rotating cam.

2–185. REVERSE PITCH SETTING.

2–186. With the rotating cam in the approximate low pitch position, install the reverse pitch stop ring onto the rotating cam in a manner which will align the index angle (29 degrees) on the ring with the reverse angle specified (—8 degrees) on the cam.

2–187. FEATHERING ANGLE SETTING.

2–188. With the rotating cam in the approximate low pitch position, install a second pitch stop ring onto the rotating cam in a manner which will align the index angle (29 degrees) on the ring with the feathering angle specified (95 degrees) on the cam.

2–189. SEGMENTAL GEAR INSTALLATION.

2–190. The segmental gears shall be installed on the blade bushing flanges with the index angle (29 degrees) in line with the indicating line on the blade bushings.

2–191. In instances where the low pitch angle specified is not in increments of one degree with the reverse and feathering angle specified, the above procedure will remain in effect in that the basic pitch range will be in increments of one degree in respect to the reverse and feathering angles. However, with this condition, the stop ring method of locating the low pitch stop lever within the dome assembly cannot be used, but instead the dome must be mounted on the propeller and a protractor used for location purposes. The following example will serve to illustrate the above condition. Assume that the following angles are specified: reverse angle —8 degrees, low pitch angle +29 degrees, and feathering angle +95 degrees. Applying these values to the table, the basic range of—14.5, +26.5, and +105.5 would logically be considered best suited for a basic operating range in respect to having the constant speed range as near the lower knee of the cam as possible. However, the —14.5 basic reverse range and the +105.5 basic feather range are not in increments of one degree with the —8 reverse and +95 feathering angles specified, therefore the basic range of —12, +29 and +108 must be used. Applying this range, the angle settings are made as follows:

a. Install the reverse stop ring first and then the feathering stop ring on the rotating cam in the manner described previously.

b. Install the stop ring spacer inboard of the feathering stop ring on the base of the rotating cam.

c. Using a protractor at the blade reference station or referring to the index markings on the blade butt, set all blades of the propeller to the feathering angle specified (95 degrees).

d. Rotate the dome rotating cam counterclockwise until the cam stop lugs contact the stop ring lugs in the feathered position.

e. Install the dome assembly onto the propeller hub and tighten the dome retaining nut. Correctly installed, the dome assembly and all blades should be in the full feathered position.

f. With the use of a blade turning device and a protractor for angle measurement, turn the blade to low pitch (29 degrees). In this position, install the low pitch stop lever assembly in a manner described previously.

2—192. CORROSION PREVENTIVES FOR PARTS STORAGE.

2—193. The following corrosion preventives and their method of applications are recommended for the protection, during storage, of propeller parts and accessories that are not painted, anodized, or plated over the entire exposed surface. While the preventives suggested are generally preferred, other preservatives meeting AN-P-30 standards for corrosion are acceptable.

2—194. PREPARATION OF PARTS.

2—195. Thorough cleaning of the surface to be treated is the basic requirement necessary for the success of anti-corrosion treatment. Varsol or methyl alcohol are suggested as cleaning agents and the parts cleaned should be wiped substantially dry as promptly as possible after treatment. During and after the process of cleaning, gloves should be worn to forestall finger-print corrosion. On parts incorporating molded or cemented rubber accessories, care must be taken to prevent either the cleaning fluid or preventive from contacting the rubber.

2—196. CORROSION PREVENTIVE APPLICATION.

2—197. Tectyl 506, manufactured by the Valvolene Oil Company, Edgewater, N. J., is recommended for long periods of corrosion prevention. It is suitable for use on both aluminum and steel parts such as aluminum blades, domes, hub assemblies, and governor parts. Application may be accomplished by dipping, swabbing, or brushing with the solution at room temperature.

2—198. Cosmolene 903, manufactured by the E. F. Houghton Company, Philadelphia, Pennsylvania is finger-print neutralizer that may be used in place of Tectyl 506 for short periods of protection. This light-bodied solution may be applied at room temperature by either dipping, swabbing, or brushing.

2—199. Compound 70416B, manufactured by the R. M. Hollingshead Company, Camden, New Jersey, or PD-815B, manufactured by the Socony-Vacuum Oil Company, New York, N. Y. is recommended for all ball or roller bearings that are not in an assembly already treated with Tectyl 506. The solution should be at a temperature of 25 to 50 degrees above its melting point before the bearings are dipped. After dipping, the bearings should be wrapped in oil-resistant paper.

2—200. Cosmoline 1123, manufactured by the E. F. Houghton Company, Philadelphia, Pennsylvania is recommended for the internal mechanism of auxiliary pumps and propeller governors. This solution consists of a mixture of three parts by volume of aircraft engine lubricating oil, grade 1120, and one part Cosmoline 903. The internal parts of the mechanism should be corrosion proofed by introducing the solution at the intake port while operating the unit at a low rpm.

2—201. REMOVAL OF PRESERVATIVES.

2—202. Removal of the preservatives from parts to be used as replacements in an assembly will be optional inasmuch as the small amount of preservative contained should not adversely affect the engine oil. However, if completely preserved assemblies are involved, it may become desirable to remove the excessive amounts of Tectyl 506 before assembly by wiping with a soft rag soaked with kerosene or varsol and substitute finger-print neutralizer as mentioned above for temporary protection.

Test Procedure

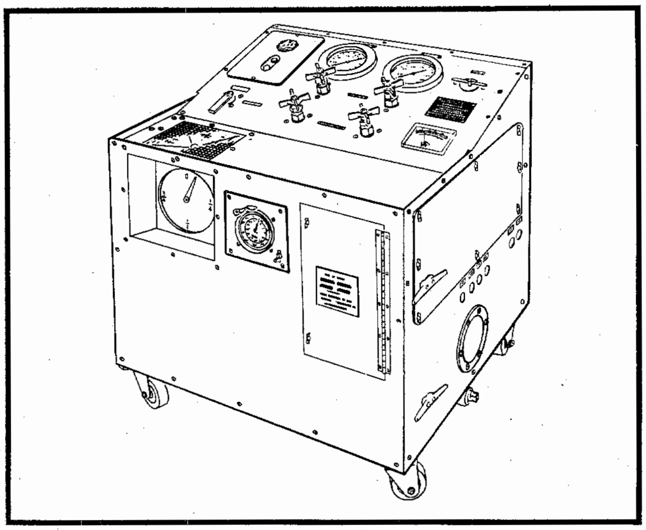


Figure 3—1. Propeller Hydraulic Portable Test Unit

3—1. OPERATING INSTRUCTIONS FOR THE PROPELLER HYDRAULIC TEST UNIT.

3—2. These instructions are issued to give the basic operation information for the Hamilton Standard Propeller Hydraulic Tester HSD-1733, which is an electrically powered unit designed to test the characteristic performance of all standard non-reversing Hydromatic and reversing type propellers manufactured by Hamilton Standard. The tester is self-contained, and is equipped to test accurately and rapidly the propellers and those component units which require functional tests.

Note

Thermostats are not correctly set when shipped by the manufacturer, inasmuch as operating conditions at the various overhaul bases are not known. It will, therefore, be necessary to check the thermostats before test procedures are started.

3—3. CONVERSION FACTORS.

3—4. The following tabulation gives the approximate temperature range for the various grades of oil which will give the specified viscosity of 150-400 S.U.S.

Mixture of equal parts of	
MIL-O-6081 Grade 1010	75-115
MIL-O-6082 Grade 1100	

Note

This mixture is preferred for testing; however, if it is unavailable, one of the other grades of oil at the proper temperature may be used.

Oil	Temperature F°.
SAE 10	80-115
20	90-130
30	105-145
40	120-165
50	135-175
60	150-195

3—5. OPERATING INSTRUCTIONS.

3—6. Blade angles must be measured at the basic reference station with the blades in the low, reversing, and high blade angle positions and shall be within 0.5 degrees of the recommended setting at each position.

3—7. TEST UNIT OPERATION FOR TESTING LOW PITCH STOP LEVER.

3—8. Test the low pitch stop lever assembly before it is installed in the dome in the following manner: Place the lever assembly in the fixture HSP-1685 and secure. Install an AN6227-33 "O" seal around the dump valve OD for this test, seal to be removed when test has been completed.

3—9. Using the Hydraulic test unit HSP-1733, a line is connected between the inboard outlet on the side of the test unit, and the test fixture. In this line after it leaves the test unit is a 1/8 inch needle valve, a drain line controlled by a globe valve, and a 0-300 psi gage with graduations of five psi installed within two inches of the HSP-1685 test fixture as shown in Figure 3—2.

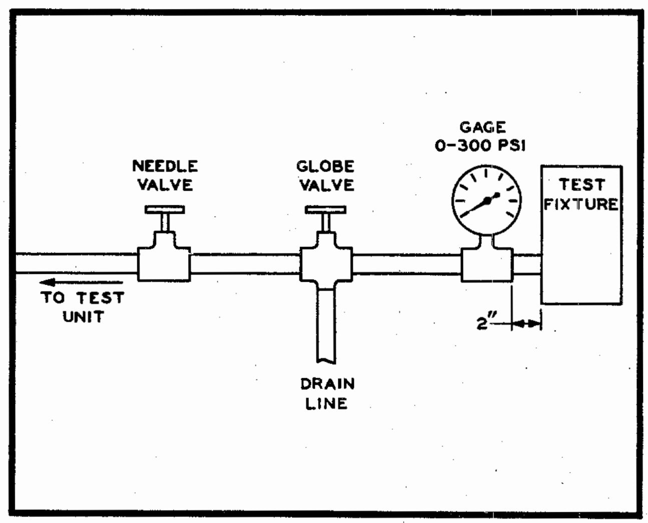


Figure 3—2. Test Set-up for Low Pitch Stop Lever

3—10. To test the assembly, start the test unit and close the outboard pressure valve, open the outboard back-pressure valve. Open the inboard pressure valve and slowly close the inboard back-pressure valve until the inboard pressure gage on the test unit reads 600 psi. The line needle valve is in the closed position. The servo valve is then exercised several times by partially opening and closing the needle valve in the line. Open the drain line valve after each lever operation, then close again.

3—11. Starting from a pressure reading of zero on the line gage, slightly crack the line needle valve. As the pressure on the line gage passes through 150-180 psi, a time reading is taken. This pressure increase should be accomplished in 8 seconds minimum to pass through the 150-180 psi range. Allow the pressure to increase until a drop-off is noted which indicates that the servo valve has opened. Note the pressure reading at the drop-off and close the needle valve, open the drain valve then close. Make any necessary adjustments and repeat the procedure at least five consecutive times to assure that the servo valve cracks each time within the specified 240-250 psi limit.

CAUTION

The cracking point of the servo valve must remain within the above specified setting.

3—12. Maintaining the pressure at the drop-off point, (valve setting) check the oil leakage from the outboard end of the assembly by catching the leakage in a measuring container. This leakage shall not exceed 45 fluid ounces per minute. Drop the pressure by opening the back-pressure valve until a pressure of 150 psi is reached. Check the oil leakage from the outboard end of the assembly. This leakage shall not exceed 2 fluid ounces per minute. This completes the low pitch stop lever check, and if satisfactory, the assembly may be installed in the dome.

3—13. TEST UNIT OPERATION FOR TESTING.

3—14. Install the propeller on the bench testing post and install the dome to the propeller leaving the dump valve screwed all the way in so that the propeller may be tested without the dumping action. Set the reverse stop ring approximately 10 degrees above the reverse setting to obtain the required pressure.

3—15. An oil pressure of 600 psi is the maximum pressure to be used for those propellers incorporating dump type valves. The first test will be to oil test the propeller by running through the low, high, reverse, and feather angles by means of applying the necessary oil pressure to the inboard or outboard side of the piston.

3—16. Attach the oil lines from the tester (inboard, outboard, and table drain) to the proper connections of the bench fixture, and connect the water inlet and outlet lines. The pressure and back-pressure valves will be in the open position and the flowmeter check valve will be in the outboard position. Press the starting button to start the tester.

a. For low blade angle and reversing blade angle, the valve positions are as follows and only enough pressure is required to move the blades.

Pressure valves — inboard OPEN — outboard — Closed

Back-pressure valves — Inboard ADJUST — Outboard —OPEN

Flowmeter valve — Outboard position.

b. For high blade angle and feathering angle, the valve positions are as follows:

Pressure valves — Inboard CLOSED — Outboard OPEN

Back-pressure valves — Inboard OPEN — Outboard ADJUST

Flowmeter valve — Inboard position

3—17. When the oil test has been completed, the valves will be positioned as in Section a. above. Adjust the inboard back-pressure valve to obtain an oil pressure of 800-900 psi read on the inboard pressure gage, and hold for one minute with the propeller blades in the full reverse position to assure that the seals are properly seated. While this pressure is being held, check for external leakage. A slight external leakage is acceptable. Drop the oil pressure to 600 psi and hold for one minute. There shall be no external leakage while maintaining this pressure. Integral oil propellers that incorporate muffs shall show no external leakage while maintaining 1100 psi oil pressure on both sides of the piston for a minimum of one minute. This check applies to the muff only.

3—18. INTERNAL LEAKAGE FOR REVERSING ENGINE OIL TYPE PROPELLERS.

3—19. With an oil pressure of 600 psi on the inboard side of the piston of all reversing type propellers, the leakage past the piston shall be noted in the applicable leakage chart shown below. The valves on the tester will be positioned as noted in Section a. above for checking inboard leakage through the flowmeter. This is accomplished in conjunction with the timer at the right of the flowmeter, which times the leakage flow in seconds by the black pointer, and minutes by the red pointer. To zero the timer, depress the lever located at the top left of the timer, and it is electrically started by moving the toggle switch at the lower right. The flowmeter is so designed as to measure the flow from ½ pint to 1 gallon with one complete pointer revolution.

3—20. This test shall be repeated with oil pressure of 600 psi applied to the outboard side of the piston and the leakage must remain the same as above. To accomplish this, the valves shall be positioned as noted in Section b. above.

Note

If it is necessary to make the internal leakage test to the outboard side of the piston after the dump valve is set, the reverse stop ring should be temporarily positioned to an angle approximately 10° numerically less than the reverse dump angle setting. An oil pressure of 600 psi is the maximum pressure to be used for this propeller which incorporates the dump type valve.

3—21. PROPELLER LOW PITCH POSITION.

3—22. After the blade angles have been checked, place the propeller blades in the low pitch position by adjusting the valves on the tester as noted in paragraph 3—16 Section a. above. Slowly apply pressure with the inboard back pressure valve until a pressure of between 225-240 psi is obtained and hold for a minimum of 5 minutes. There shall be no movement of the blades during this period.

Note

Tests shall be conducted with test sleeves HSP-1631 and HSP-1768 with an increase and decrease pitch line installed on the spider or barrel rear extension for Integral Oil Propellers.

3—23. ADJUSTMENT OF HYDRAULIC REVERSE STOP.

3—24. The hydraulic reverse stop shall be adjusted as follows: Operate the propeller blades to full reverse position against the mechanical stops. This is accomplished by adjusting the valves on the tester as noted in Section a. above and applying the necessary oil pressure to move the blades. When the full reverse position is obtained, open all valves on the tester (pressure and back-pressure) and stop the tester by depressing the stop button. Remove the dome and stop lever assemblies as a unit from the propeller. Unsafety the adjustment sleeves and back off on the lever sleeve end cap until the inboard oil seal ring land which is marked with an arrow is flush with the end of the piston sleeve. Replace the dome on the propeller, and start the tester. Adjust the tester valves as noted in Section a. above to apply 150 psi oil pressure measured on the pressure meter to the inboard side of the piston. A flow of 15-30 quarts per minute is required and is read on the flowmeter. If the flow is not within specifications, remove the dome, first using tester method stated above, and move the adjustment sleeve out-board (clockwise) on the end cap to reduce flow, and inboard (counter-clockwise) to increase flow. When the correct flow is obtained, lock the sleeve in place with the lock wire.

CAUTION

If the low pitch angle is subsequently changed, it will be necessary to reset the reverse adjusting sleeve.

3—25. SUCTION LINE.

3—26. The tester is provided with a suction line for draining the oil from dome and barrel assembly when the check has been completed. To use this line, the valves on the tester are set as follows: Inboard and outboard pressure valves closed. Inboard and outboard back-pressure valves open. To use the nozzle, open the shut-off and insert the tube into the oil. This allows the relief valve in the pump assembly to open allowing the pump pressure to drain through the suction drain pipe back to the sump.

3—27. The above test unit operation need not be conducted in the sequence as described, but may be rearranged to suit the individual overhaul procedure requirements.

Note

If a given pressure is unable to be obtained at any time during test procedures, turn the filter handle at the upper right of the control panel, one complete turn. It is also suggested that the handle be turned at the start of each propeller test to clean the filter.

3—28. PROPELLER INTERNAL LEAKAGE LIMITS.

3—29. The following table gives the allowable leakage limits under given conditions:

No. of Piston Bleed Holes	Internal Leakage at 300 psi fluid ounces per minute	Internal Leakage at 600 psi fluid ounces per minute
0	6 max.	45 max.
1	40-64	55-135
2	80-128	110-225
3	120-192	165-315
4	160-256	220-405

3—30. Test unit operation for standard Hydromatic propellers may be conducted with this tester and the applicable propeller manuals should be consulted for the proper test specifications.